The Issues of Competition in Mainframe and Associated Services in India
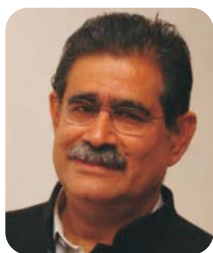
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One of ICRIER's thrust areas is Trade, Openness, Restructuring and Competitiveness under which several studies have been undertaken to try and analyze determinants of competitiveness in specific industries and suggest suitable public policy action. This study, by Professor Rajat Kathuria and his team, is the first study in India that analyses competition, technology and related issues in the Indian computer server industry, with a focus on mainframe computing. The study uses both the traditional Structure Conduct Performance (SCP) paradigm and the New Economics of Industrial Organization for conducting the analysis. It finds that while the high-end market is highly concentrated, late adoption has fortuitously resulted in users being able to avoid many of the costs associated with being locked into a proprietary technology such as the mainframe. These costs, although low at present, are by no means irrelevant since migration from the z operating system (z/OS) owned by IBM and tied to its mainframe hardware to an alternative platform is undeniably tricky.

Therefore, while there is no immediate public policy concern for this industry, it is important to recognize that expansion in the installed base of proprietary mainframes could possibly lead to welfare losses like those reported for Europe and the US due to the ability of the vendor to control prices charged from locked-in clients. This study suggests a possible role for the Competition Commission of India in this regard and the adoption of a forward-looking regulatory stance that prevents IT system vendor lock-in from establishing itself as the norm in the Indian economy. Economic benefits to India of such "pre-emptive" action could be significant both in the short and long term. I hope the study will contribute to informed policy making in this area and also be of interest to academics and researchers.

Indicus has been working on all facets of growth and progress of the Indian economy for the last decade. It has undertaken studies in economic geography, competition, regulatory and policy analysis, social sector development, ongoing changes in Information, Communication and Technology sector, etc. Increasingly Indicus is partnering with established and respected academic and policy institutions in order to bring together the best and most experienced minds in the country for investigating emerging economic and social research questions and suggesting the way forward.

We are pleased to partner with ICRIER for this particular study which brings together Indicus's expertise in the domain of interface between technology and competition and the experience of ICRIER in industry analysis. This is a unique and a first of its kind study in India that looks at competition in the market of high end computing. In this sense it is a forward looking study as going ahead, India's need for a dynamic competitive market in this sector will become critical for its development goals, especially given the large scope of applications that this technology offers.

This study would be of interest to academia, policy makers and civil society organizations in understanding the importance of competition in all its facets as well as the way forward in this market. I congratulate the team for an excellent and highly informative study.

(Laveesh Bhandari)

(Rajiv Kumar)

ABSTRACT

Very little is known about the extent and nature of competition in the mainframe and associated services market in India. This is the first study to analyze competition and related issues in the Indian server market, with an extensive focus on mainframe computing. Structural indicators of competition are estimated using secondary data across different segments of the server market. These reveal that the market is highly concentrated, especially in the high-end segment. Concentration progressively reduces in the mid- and entry-level segments, respectively. Since structural indicators of competition do not always reflect or imply abuse, firm conduct is gauged from an extensive primary survey of users and vendors. The survey of users across different size classes and verticals belonging to both the private and public sectors reveals that by being late starters, Indian users were able to avoid many of the costs associated with being locked into a proprietary technology such as the mainframe. While competition to the mainframe *has* developed in recent times, our survey also points to the difficulty of migrating away from a proprietary technology such as the z/OS owned by IBM and tied to its mainframe hardware. The low installed base of such systems in India compared to Europe and the United States implies that there are no immediate public policy concerns in this regard. At the same time the report cautions that expansion in the installed base of mainframes with the proprietary z/OS could lead to welfare losses like those reported for Europe and suggests a possible role for the Competition Commission of India (CCI) under the existing legal framework.

EXECUTIVE SUMMARY

1. Albeit rapid technological development was expected to ring the death knell for mainframe computing as smaller computers became more powerful and microprocessors more multipurpose, over the years the mainframe has become even more powerful and versatile. At the same time, rivals of IBM, the only surviving mainframe vendor, have also come up with a wide range of mainframe-like products to provide more competition in the high-end server market. This study focuses on understanding the nature and extent of competition in the server market in India by investigating both structure and conduct.

2. The definition of the server market is a thorny issue as there is no universally acceptable standard. Although there are at least five traditional ways of segmenting this market – by server hardware brand, by server selling price, by server operating system, by types of processor, by number of processor sockets in the market – keeping the objective of the study in mind, we use the first two definitions. Global IT market research firms such as Gartner and IDC also classify the server market by average selling price and, therefore, this taxonomy makes it easier to compare our findings for India with the findings for the broader Asia market and the world market as a whole. We use the following price bands to classify the market, with US$100,000 as the cut-off point for the high-end configuration based on our finding that the Indian market is relatively more 'price sensitive'.

Prices (US$), at current prices

< 25,000	Entry-level servers also known as volume server market
>25,000-100,000	Mid-range enterprise server market
>100,000	High-end enterprise server market, including mainframes

3. The structural estimates of competition are measured using the Herfindahl-Hirschman Index (HHI), which is determined by adding the squares of the market shares of all firms and C4 (market share of the top 4 firms in the segment). We do this for both revenue and shipment data for the APAC region as a whole and for individual countries. If the Herfindahl is low, there are many competitors and exercising market power should be difficult; a high Herfindahl, on the other hand, results in a concentrated market in which price rises may be easier to sustain. The numbers show that the high-end server market on average is more concentrated than the mid-range market, which in turn is more concentrated than the entry-level or volume market. The levels of concentration over time have not altered much

either. The levels of concentration reduce slightly if we use shipment data instead of revenue, although the qualitative result does not change, i.e., the high-end and medium-range markets are persistently more concentrated than the low-end or volume market. It is noteworthy that the high-end market is effectively a triopoly between IBM, HP and Sun Microsystems with the last a distant third. In other words, this segment is highly concentrated with the 4 firm concentration ratio measuring 100 for the entire sample period.

4. We are unable to calculate structural estimates of market concentration for only the 'mainframe' segment since there is no competitor to the IBM mainframe in India.   In fact, the only other manufacturer of mainframes in the world today is Fujitsu, which does not yet market these computers in India. IBM's revenue from mainframes in India is minuscule compared to its overall revenue; its revenue is higher in China and APAC. In the early 90s there were no mainframes in India or China. Mainframe installations and skills are growing in India, not only for running financial market transactions but also to support millions of lines of programming code that are being developed for the rest of the mainframes circling the globe. IBM's India-specific revenue from all its businesses crossed $1 billion in 2009. IBM had revenues of $1.13 billion from domestic business in India for fiscal 2009, up from $1.05 billion in fiscal 2008 and $0.77 billion in fiscal 2007.

5. Although we club the mainframe market with the high-end for the sake of measuring concentration, the qualitative analysis of competition and assessment of conduct is carried out recognizing that, under certain conditions, it may not be appropriate to combine the high-end market and the mainframe market. For example the 'lock-in' for legacy applications is likely to be different in the high-end market compared to the mainframe market. Accordingly we distinguish between the *ex ante* nature of competition and *ex post* competition within this segment, based on whether the application is a new workload capable of being handled by any server in the high-end segment or a legacy workload for which the options are rather limited.

6. The two key building blocks of servers, the microprocessor and the Operating System (OS) are often bundled with the hardware by vendors. Customers exercise choice over a specific type of processor and OS (the performance of the OS depends upon the number of processors in a multiprocessor environment and the performance of the application software largely depends on the choice of OS), database management software (industry experience says performance of databases

varies across sectors), application software and other technical specificities. Depending on these needs, a customer can choose a single vendor or opt for a multivendor arrangement. Although it is important to analyze each preference type, it is nearly impossible to track all the information for each firm across each vertical. We therefore limit our analysis to the choice of OS and choice of processor, which will give us an indication of the 'revealed preferences' in the server market in India.

7. The preferred processor for the entry-level market is the x86 processor; in fact, Dell's entire range of servers is sold with the x86 range. x86 is an open technology architecture that enables wider choices for the client. About 90 percent of all IBM servers sold in India in 2009 included x86 processors. Only Sun Microsystems sold more servers with a RISC processor than with an x86; however, Sun Microsystems' present market share in India at 15% is quite low. Across the three segments that we are studying, the x86 processor dominates the entry-level market across all vendors. For example, 90 percent of IBM's systems come bundled with x86 processors in the entry-level market. This number progressively decreases to about 40 percent and 0 for the mid- and high-end market segments, respectively. The same analysis on the basis of revenue rather than shipments shows that the share of the x86 in overall revenue is about 55 percent. This implies the average price of x86 processors is lower than that of other processors. According to Intel, the performance of x86 processors has improved manifold over the past 10 years, providing benefits of "value and standardization". At the entry level, the dominance of x86 processors can be attributed to the customer's preference for open technology. x86 processors offer flexibility to the customer in the choice of OS and applications. In addition, according to industry experts, one high-end server can replace a number of entry-level servers. In other words, by clubbing multiple small servers one can get performance akin to high-end computing. This indicates that a cluster of 'small servers' may provide incipient competition to high-end servers, especially for new workloads.

8. For legacy workloads this will be true only if the applications and operating system running on the high-end server are compatible with the small servers in the cluster. Although the Sun, HP and IBM versions of Unix that run on their high-end servers are not compatible with cheaper x86-x64 servers that are run on Linux or Windows Servers, very often the applications that run on Unix (such as Oracle database or SAP ERP) are compatible with the less expensive processors. However, the older (legacy) applications and mainframe-only operating systems used on IBM mainframes are not compatible with RISC-based Unix servers or with x86-x64 servers. Therefore, where these legacy mainframe applications are concerned, high-end servers cannot

provide competition for mainframes. Such competition is possible only where new applications are concerned.

9. The market share for the IA64 Itanium processor used in HP machines has increased, while that of the RISC processor in HP has declined since HP stopped selling servers based on its RISC chip in 2008. The HP server with the Itanium processor is known as the 'Superdome' and is believed to have competencies that can match IBM's mainframe/high-end servers. Both IBM and HP competed for the SBI core banking contract which was eventually won by HP Superdome over the mainframe/P-series configuration of IBM. Thus, for new workloads the Superdome's hardware performance can match that of IBM mainframes, although users of the IBM mainframe operating system and their associated legacy workloads are pretty much locked in, since the Superdome cannot support these latter types of software.

10. Our primary sample (purposive and stratified) consisted of 71 subjects from vendors, chip-makers, service providers and a representative cohort of medium and large enterprises from different verticals. In India, the activities of server vendors are not region specific and almost all servers sold locally by MNC vendors are imported from other manufacturing locations, which implies that they are covered by the import duty regime. A few low-end x86 servers, especially one-way servers, are manufactured locally in India. Some large MNC vendors leverage their desktop/notebook capabilities to produce low-end volume servers. Local Indian server vendors, of course, do the PC and server manufacturing in India. Indian production is limited to the low end; for example, HCL has its manufacturing capabilities in Chennai and Puducherry. Almost all these servers are in the low-range category of x86 (Intel/AMD) servers.

11. Our survey reveals that the choice of OS is dictated by the application software the client wants to run. Since the use of application software varies across verticals, the choice of OS is also likely to vary across verticals, especially between verticals that support large enterprises such as banking, insurance and telecommunications. Across segments the results are predictable. Overall, Windows server OS has the largest share in the entry-level segment, while UNIX dominates the mid- to high-level segments. Interestingly, Linux deployment has been increasing in the past 3 years and captured 20 percent market share in terms of shipments and 11 percent market share in terms of revenue in 2008. IBM's proprietary mainframe operating system, z/OS, commands less than 5 percent market share.

12. In the high-end market, installed Linux is very low, whereas the share of proprietary OS provided by hardware vendors is comparatively higher. Our survey reveals that users prefer a bundled purchase

of hardware and OS in the enterprise-level segment. Our conjecture is supported by the data which shows that in the case of HP a larger share of the installed OS goes to its own UNIX base OS, whereas in the case of IBM the larger share goes to its own AIX OS. Likewise for IBM mainframes, in most cases they only use IBM's mainframe operating systems such as z/OS. This finding, however, needs to be juxtaposed with the fact that in most cases vendors allow no other choice. If one buys a high-end RISC server from IBM, HP or Sun, the only server OS choice is (usually) the variant of Unix sold by that vendor (AIX, HP-UX and Solaris, respectively). One cannot choose to run Sun Solaris or HP-UX on IBM Power hardware. Moreover, one cannot run Windows OS on IBM Power or Sun SPARC hardware (though one can on the Intel Itanium-based versions of HP Superdome). The only exception to this general rule for high-end servers and mainframes is Linux, which can run on all these types of hardware machines (though in the case of IBM mainframes, Linux supports only new and not legacy workloads, , thus confirming the observation that legacy mainframe workloads are subject to monopoly lock-in on IBM mainframes.

13. The choice of processor and choice of OS varies across segments. No single processor technology or OS dominates across all segments although clearly x86 and Windows OS is the preferred mix for the entry-level server market. This implies that a priori the extent of 'lock-in' for entry-level users is likely to be less than for the other two segments.

14. None of the vendors follow a vertical specific strategy, although it could happen that a vendor may experience network effects in a specific domain. For example, Sun Microsystems had become very popular in the telecom vertical in the billing and customer care segments. In fact, Reliance Communications still uses the Sun Microsystems platform for 70 percent of its telecommunications applications. A successful adoption leads to positive feedback and others adopt the tested solution, thus creating network effects. As a result of this direct network effect, an increase in the number of users on the same network (platform) raises the consumption benefits for everyone on the network (platform). Sun's dominance in the telecommunications vertical in India was broken by IBM, which made a breakthrough in 2004 with a highly publicized US$750 million deal with Airtel, one of India's leading integrated telecommunications operators. IBM is using its Unix servers (AIX on Power) to challenge Sun worldwide in the telecom market, as well as in other high-value verticals such as financial services. In the latter vertical, IBM mainframes have a dominant position for legacy applications, while new workloads have typically gone to Unix or more recently to Linux.

15. Most vendors consider *lower TCO, interoperability/openness* and *better service* as important factors that differentiate their product from their rivals'.

Competition in the technology space pushes firms to innovate and introduce new product lines. In India vendors usually refresh their product cycle within 1-2 years. This shorter product refresh cycle indicates competition in the technology space. The pricing of a system includes the cost of hardware, software and services. Often hardware vendors bundle software with their hardware and charge accordingly. Our survey shows that all the vendors provide system software and management software with their hardware. The aim of bundling software with the hardware is to reduce the amount of coordination for a client across different vendors, as well as saving on distribution costs. On the other hand, bundling often results in price discrimination and creates lock-in for users. A key factor in this context – perhaps the most important from the vendors' point of view – is that software enjoys significantly higher profit margins than hardware. This is due to the fact that: (a) the marginal cost of each additional copy of a software product is close to zero, and (b) the opportunities for proprietary differentiation are generally greater with software than with hardware. Thus, large system vendors such as IBM, HP and Sun have a powerful incentive to bundle complex software such as server operating systems and middleware with their server hardware. Indeed, vendors, such as Dell who produce only server hardware and lack their own proprietary software offerings, are far less profitable than the high-end system vendors (they can only resell software provided by third-party firms, which offers lower profit margin opportunities).

16. The standard model for enterprise software vendors in most markets is to charge a single upfront fee known as a "perpetual license" and then to charge an additional recurring annual fee known as a "maintenance charge" (typically 15% to 22% per year of the perpetual license fee). Only one user in our sample, however, was able to successfully negotiate a 'once in a lifetime license fee' for a specific software; others claimed to be charged according to a variety of methods. For example, it could be per user, per core or per CPU or number of simultaneous users. There is no one-size approach in this regard in the industry and the actual price is the result of extended negotiation. The maintenance fee usually provides the customer with the right to receive all upgrades and new releases of the software, but there are some exceptions to this rule. For example, IBM mainframe operating systems and middleware are sold through a monthly license fee that varies with the size and usage of the mainframe hardware. Another exception is Sun's Solaris (Unix) operating system and its Java middleware, which are now sold only through annual subscriptions. Microsoft also has a somewhat different model, which is however fairly close in practice to a subscription model for most large customers. Oracle, SAP and IBM (for non-mainframe software), however, adhere to the strict 'perpetual license + recurring maintenance fee' model. And of course, all vendors offer negotiated

discounts which depend on the bargaining power and long-term profit potential of the customers. Typically these discounts are offered on the upfront license price and not on the recurring maintenance fees. This reflects the fact that once a customer has committed to a particular type of enterprise software (server operating system, middleware, database, packaged application, etc.), the costs of switching to other kinds of software are quite high. In the case of Linux, Unix and Windows Server, switching costs reduce but do not eliminate the customer's option to change vendors. However, in the case of legacy workloads on IBM mainframes, these switching costs are generally so high that they prohibit migration for all but the simplest (and generally least important) applications.

17. Technological advancement in this rapidly progressing industry has meant that the power of the chip has exploded in the last decade. It was thought that the mainframe would be rendered redundant by the faster computing power now available. Yet the market share for the IBM mainframe in the past 7 years worldwide has increased from 17% to 34%. In the past one year, the mainframe has acquired 54 brand new customers across the world, of which 5 are from India. The US, Europe and Japan traditionally are big IBM mainframe users. China has emerged as a big market for the mainframe lately. The reason for the low coverage in India, according to IBM, is that most companies do not have large databases. The mainframe is an enterprise class server which provides capability for extensive work load management and uninterrupted performance and security and, thus, suits extremely large workload requirements. The total number of mainframe users in India including the newly added five is 25. That is not a large base compared to mainframe customers worldwide and it reflects in the low revenue that IBM generates from mainframe sales in India. Interestingly, only two of the five users have opted for the z/OS; the rest are on LINUX.

18. The mainframe market in India is enormously different from the global market. According to IDC, there are 8,000-10,000 IBM mainframe customers in the world, of which only a few are new users. The vast majority of revenue generated by IBM from its mainframe business, therefore, represents upgrades to or replacements of existing mainframes. In contrast to the global market, the Indian market is dominated by new sales, since the installed base of mainframes is very small.

19. Lock-in effects are likely to dominate only when the installed base is high. For "legacy" mainframe applications – mostly very large custom COBOL programs that mainframe customers have developed over years or decades – the lock-in effect is very strong, which is why most sales globally are upgrades. For the "new workloads" which can run on mainframe Linux or reduced cost mainframe "specialty engines" – and these would typically be applications that use Java (e.g., on IBM's WebSphere application server), IBM's relational database DB2, or certain packaged software such as SAP – the mainframe lock-in factor is weaker. But these new workloads represent a fairly small proportion of the total number of applications running on mainframes globally. For the five new mainframe customers in India in 2008, the lock-in is therefore likely to be weak. Of the five, only HDFC was using a legacy system, AS-400. HDFC claims that the acquisition of the Z mainframe for their credit card operations was independent of the prevailing system being used by the bank, and was based on a technical evaluation of the alternatives available. Thus, even for HDFC the lock-in factor is weak. IBM India naturally disputed claims that the mainframe creates lock-in.

20. It is well-established and widely known that while the server market 'may be' competitive *ex ante*, it could be monopolized *ex post* resulting in high switching costs to the user. Most users were divided on the need for retaining flexibility (being able to switch to another platform to preempt lock-in) and addressing their immediate requirements. While all vendors and not just IBM try and create a 'lock-in', 'exit' from a proprietary technology like the z/OS is indisputably more resource-intensive (in terms of both time and money) than from a UNIX or Open source environment. IBM mainframes unquestionably have greater lock-in on average than Unix servers or x86 servers running Linux or Windows Server. But to be fair this is not because HP, Sun, Microsoft or Red Hat are less interested in lock-in than IBM, but because the legacy applications and legacy operating systems (e.g., z/OS) running on mainframes are on average substantially older than those running on the more modern platforms. The applications, middleware and databases running on Linux, Unix and Windows Server are more likely to share common standards and best practices (Java, relational data models, clean separation between data and programming logic, etc.). This greatly reduces switching costs compared to the mainframe, where the operating systems, programming methods and middleware were developed before many of these standards and best practices were fully evolved. We did not find evidence in support of users choosing a particular platform based on the perceived ease of migration were they to become dissatisfied with system performance in the future. Instead, choice was usually based on a vector of price and performance.

21. In India the high-end market is dominated by the big three; IBM holds 50, HP 33 and Sun 17 percent of the market share, respectively. During the MRTP days this would have been sufficient to launch investigations against IBM because of its size. Competition Authorities, influenced by Chicago, no longer believe that the relation between a high market share and market power is obvious. We,

therefore, need to further probe IBM's conduct and ask whether IBM has denied customers the benefits of technological innovation and whether it charged above-market prices for IBM solutions, including the mainframe in India. While there is some evidence for this in Europe and the US where IBM has a history of antitrust violations, the Indian mainframe market is relatively young, albeit growing rapidly. Our survey is optimistic about the extent of *ex ante* competition that exists in the Indian market. Mainframe workloads can be moved to other high-end servers like Unix servers made by Hewlett-Packard and Sun, and IBM itself. The SBI case study in the report provides evidence for this feature. Oracle's planned purchase of Sun will combine software and hardware expertise, making it a formidable competitor to IBM. Cisco, the world's biggest network equipment maker, has also recently entered the server market.

22. *Ex ante* competition in the market is no solace to a client who is locked into a particular platform and post-purchase has very little option to migrate. Our study provides little evidence of lock-in because of the unique features of the Indian market, namely, a growing market, well-informed and knowledgeable clients, a multi-vendor and multi-platform approach, and a late start in the computer age thus leapfrogging many legacy applications. India has only 25 mainframe applications and only a handful of them run on the proprietary z/OS. On the other hand, there are somewhere between 8,000 and 10,000 total IBM mainframe customers in the world, mostly in the US and Europe. IBM's reports show that about 2,000 new mainframes were sold in 2008 but the vast majority was bought by customers who were already using mainframes. Interestingly, there were only 54 new customers, implying that the majority of the new mainframes were sold to existing users of mainframes, representing 97.5% of the sales. In the US and Europe, legacy applications on the mainframe outnumber new acquisitions by a huge margin, raising concerns about IBM's dominance in this segment. If we define this segment as the relevant market under competition law, then IBM is a *priori* dominant and therefore needs to be tried and a remedy imposed under the law.

23. The z/OS is a proprietary system unlike UNIX or Linux. UNIX or Linux applications can easily be moved to virtually any hardware vendor's platform. Windows applications too can run on servers from any of the leading server manufacturers. On the other hand, a mainframe application can only run on an IBM mainframe with IBM system software. In the US, where the mainframe market is big and growing, licensing the z/OS would confer benefits all around. The benefits would be in the form of market expansion and perhaps lower prices especially in markets where the installed base of mainframe applications is high. For a market such as India, this is not an immediate worry for competition authorities.

But if we take a longer-term view, the concerns in the US may become concerns in India as well, as the base of mainframe users grows.

24. Because the Indian enterprise IT market is entering its high growth phase, India's competition authority (Competition Commission of India, CCI) has an excellent opportunity to avoid the pitfalls into which the more mature IT markets have fallen. **Unbundling hardware and software, i.e., to require that the sale of enterprise class server hardware shall not be tied to the sale of enterprise software (in particular, the crucial server operating systems) is the first policy recommendation.** Tying operating systems to a particular brand of hardware is the fundamental mechanism by which all the high-end enterprise system vendors – not just IBM – seek to lock in their customers and raise switching costs. The report finds that since there are few z/OS mainframes in India, the consequences of IBM's tying of z/OS to its own mainframe hardware (to the exclusion of would-be competitors seeking to offer IBM mainframe emulation on Intel servers) have been somewhat limited so far. However, the study also finds that the high-end server market as a whole in India is highly concentrated. In fact, the leading Unix vendors such as IBM and HP do compel users of their Unix operating systems to purchase their brand of server hardware.

25. A competitive IT sector can confer substantial direct and indirect benefits to the Indian economy. India would be better off if CCI is able to successfully uncouple the lock-in strategy of the large server vendors before they come to completely control the market. It would probably be healthier for Indian IT and for the Indian economy if enterprises developed their complex business applications on server operating systems that are not tied to a particular brand of hardware. Today this is obviously the case with Linux (open source), Windows Server and to some extent Sun's Solaris (which runs on Intel or AMD servers as well as on Sun's proprietary SPARC servers). It could theoretically be the case with HP-UX (the HP version of Unix), since HP's SuperDome servers are based on Itanium processors. It could even be the case for z/OS, because mature mainframe emulation software products have existed for a number of years, which allow z/OS to run on Intel server hardware. Such products include FLEX and TurboHercules. IBM itself has also recently introduced such a mainframe emulator, but limits its use to software developers and refuses to sell it to production customers. **Customer choice can be enhanced if server operating system vendors (all of them, not just IBM) are required to license their software on RAND terms (Reasonable and Non-Discriminatory). These terms, however, would in no way restrict the right, software. This is our second policy recommendation.** This is nothing new; in fact this would merely be a return to the decades-long practice of U.S. and European

regulators with respect to IBM as pointed out earlier in the report.

26. **Interoperability is a more complex issue but it is partially addressed in the two policy recommendations above.** Requiring IBM to reveal its source code a la Microsoft is not a pragmatic solution, so we refrain from making it. If customers are allowed to purchase the server hardware of their choice for use with the server operating system of their choice (unbundled hardware and software), there may be nothing wrong with the fact that z/OS is not compatible with more modern operating systems. Customers should be allowed to choose z/OS (or HP-UX, or Windows Server, or Linux, etc.) if they wish, on the basis of their own criteria of performance and functionality. But vendors should not be in a position to force customers to purchase only their brand of server hardware once the choice of server operating system has been made. To the extent that there is no inherent technical barrier to running z/OS on non-IBM hardware (e.g., on Intel or AMD servers using emulators such as TurboHercules), customers should be allowed to make this choice.

27. India has an opportunity to leapfrog the more mature IT using economies by adopting forward-looking regulatory stances that prevent IT system vendor lock-in from establishing itself as the norm in the Indian economy. Although we cannot quantify the economic benefits to India of such "pre-emptive" action, these are likely to be large indeed in the long term, and rather significant even in the short term.

I. INTRODUCTION

A mainframe is a high-performance computer used for large-scale and critical computing purposes which need greater availability and security than what a smaller-scale machine can offer. Historically, mainframes have been associated with centralized rather than distributed computing, although that distinction may be blurring as smaller computers become more powerful and mainframes become more multi-purpose. Since their inception in the 1960s, IBM has enjoyed a first-mover advantage in mainframes with significant structural dominance in the market. At times, the structural dominance has translated into abuse of that dominance with IBM having to fight many antitrust cases in the US and other markets.[1] Predictions of the death of the mainframe too have proved premature as IBM has reinvented itself to create sleeker and more powerful mainframes for the very large workloads it is capable of handling. In 2004, the IBM mainframe celebrated its 40th birthday, and in February 2008 IBM unveiled its latest offering, the z10, the result of over $1 billion of investment in R&D[2].

The mainframe therefore isn't going to disappear any time soon. The question is whether the mainframe environment is likely to change over the next few years. This report will study the structural conditions in the mainframe and high-end server market especially the extant barriers to entry, the source of contestability and the role for competition policy in this regard. The mainframe and high-end markets will be compared with the medium-range and entry-level markets to identify differences in the structural conditions along with conduct in these separate markets. For example, the reasons for the greater concentration in the high-end market will be analyzed and the impact of greater concentration on conduct will be studied. Supply-side classification or segmentation will be complemented by demand-side disaggregation to study whether there are any meaningful differences across verticals (i.e., banking, telecom, government, etc.) and between sizes of users. While the focus of the study is on the Indian market, a comparison with other countries, especially those in the Asia Pacific region and certain developed markets, is done to provide useful insights.

The importance of competition in any market cannot be overemphasized. In the mainframe market or more generally the hardware, operating system (OS) and application services market, competition gains additional significance for two reasons. First, hardware and associated services are widely regarded as general purpose technologies that contribute significantly to the competitiveness of user industries. An efficient and competitive hardware and associated services sector has the potential to therefore generate substantial spillover benefits. Second, and perhaps more crucially from the point of view of this study, effects that are uncommon in the industrial economy such as network effects and switching costs are the norm in the information technology industry. Thus, while the market 'may be' competitive *ex ante*, it could be monopolized *ex post*, resulting in decline in welfare over a longer time horizon. A recent study of the European mainframe market has estimated that lack of competition in the market for mainframes will cost the European economy $4B billion over a 20-year period.[3] It becomes imperative to ensure that such costs are either eliminated or at least reduced by addressing the underlying reasons for the monopoly conduct. Introducing effective competition in networked industries, while challenging, is a task competition authorities will be well advised to pursue.

The goal of this study is, however, not to estimate the potential dead weight losses associated with the existence of firms with market power or 'monopoly' in the mainframe market. While this would be useful, data constraints for the Indian market do not allow us to calculate these magnitudes with any degree of certainty.[4] For instance, prices in this industry are typically not available in the public domain for India. In fact a number of respondents we interviewed during the course of our survey, while reluctant to provide the exact price at which the deal was closed with the vendor, revealed that discounts in the range of 50 to 90 percent on the list price were not uncommon in this industry. The discount itself is a function of the short- and long-term worth of the client as determined by the vendor.

Such price discrimination is important in high technology industries like the one we are investigating for at least two reasons: first the high-fixed cost, low-marginal-cost technologies commonly observed in these industries often lead to significant market power and second, since price will often exceed marginal cost, vendors will benefit from price discrimination. Moreover, in technology industries, innovation matters as much as price. Even if products are getting cheaper and consumers are happy, competition policy needs to address the issue of future competition, i.e., to make sure that products, which

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1.   http://www.justice.gov/atr/cases/f1200/1273.htm and European Commission 14th Report on Competition Policy (1984), Paragraphs. 94-95; Bull. EC 7/8-1984, point 1.1.1 et seq

2.   Gary Barnett (2005). The future of the mainframe.

3.   Jeff Gould 'Benefits of Mainframe Competition for the European Economy' January 15, 2009.

4.   Published data on price for different mainframe and O/S is not available

currently exist only in laboratories, can break into the market. In 1995 the Justice Department relied partly on similar reasoning to stop Microsoft buying Intuit, a personal-finance software firm.[5]

Given the difficulty in determining price precisely, our approach relies on analyzing structural dimensions for identified market segments using secondary data from Gartner.[6] It is now widely accepted by competition authorities the world over, including the Competition Commission of India (CCI), that structural dominance is however not a sufficient condition for the exercise of market power. Accordingly, our secondary data assessment is accompanied by primary survey results of users across industry types and sizes to draw robust inferences of conduct across different segments. *We believe this is the first investigation of competition-related issues in the server market in India.*

5.   The Economist (Dec 18th 1997), "Why Bill Gates should worry". Available at: http://www.economist.com/businessfinance/displaystory.cfm?story_id=E1_QVGSDN

6.   Gartner is an information technology research and advisory firm. Gartner's data on vendor revenue is used to segment the market.

II. Developing a Framework for Analysis

The market segment that we investigate in this study can be broadly characterized as enterprise-wide client server systems deployed in organizations to support operational computing. Besides computer hardware, this includes the operating system (O/S), middleware and application software as depicted in Figure I. (See Annex I for definitions).

As shown in the figure, each logical layer is tightly integrated with the other to 'produce' services demanded by the client. In addition to this, the client needs support or maintenance services to ensure smooth running of the

provides a summary of the vendors and the corresponding market segment they serve in the Indian market.

The economic phenomena that are important for high-technology industries and which are highly relevant for the server market include personalization of products and prices, bundling, switching costs, lock-in, economies of scale, network effects, standards, and systems effects.[ ] Most of these phenomena are present in conventional industries, but they are particularly important for technology-intensive industries. From the vantage point

COMPONENTS OF SERVER MARKET
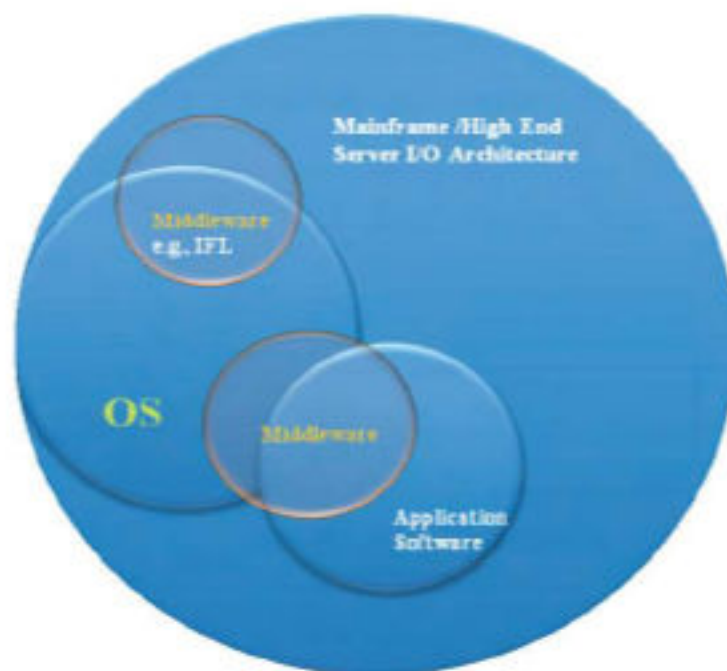
computing infrastructure. An end-to-end solution provider such as IBM is a 'vertical integrated' entity serving the entire market, while a pure 'box' manufacturer such as Dell is a niche player devoted to making only computer hardware.[ ] Also present in this space are application software developers, also known as independent software vendors (ISV), and OS developers such as Microsoft Windows and Red Hat Linux (or Novel Suse) that serve specific portions of the market. Finally, there are systems integrators such as TCS (Tata Consultancy Services) and Satyam InfoTech, who help clients evolve a workable IT solution by integrating the various 'unbundled' elements and often provide maintenance services as well. Annex II

of this study, the implications of these phenomena are relevant not only for corporate strategy but, more importantly, for public policy.

During the course of the study it became apparent that this market possesses at least three important distinguishing characteristics: (i) products are highly differentiated and customized, (ii) only a few relatively large suppliers exist in most segments and iii) the rate of innovation is very high. These features suggest that firms are price makers, not the price takers of the perfectly competitive model. Small numbers of competitors or the preference of consumers for a specific product bestows

7. Dell's recent acquisition of system integrator Perot Systems will enable it to serve the high-end server market as well, a segment in which it has had no presence until now. For more information on the merger, please see http://www.computerworld.com/s/article/9138543/FAQ_What_the_Dell_Perot_merger_means_for_the_IT_industry.

8. See Hal R. Varian (2003). Economics of Information Technology. University of California, Berkeley.

some degree of market power on firms, and competition is imperfect. Market power is the ability to profitably raise price above marginal cost. In this report we study the exercise, maintenance, and effects of market power in the server market in India.

The traditional approach to assessing market power in the industrial organization literature is the Structure-Conduct-Performance paradigm (SCP). The S-C-P approach assumes a stable, causal relationship between the structure of an industry, firm conduct, and market performance as measured by economic profits. Typically the set of observable structural variables are measures of seller concentration and barriers to entry and the line of causality is envisaged to run from structure through conduct to performance or the exercise of market power. The implication is that concentration facilitates the exercise of market power.[9]

In contrast to this industry approach to conduct and performance, one can envisage an alternative approach that makes the firm the centerpiece of analysis. Firms differ in the products they sell, their organization form and internal efficiency.[10] It is the drive to be different that locomotes dynamic competition of the Schumpeterian sort. This firm approach reverses the link between structure and conduct and performance; it is firm-specific efficiency advantages that determine how large a firm grows and therefore industry concentration. Thus, more efficient companies with superior products grow to be larger than other firms.[11]

It is difficult to apply either of these approaches in our present exercise since the focus is on a single industry [the server market], rather than the traditional inter-industry comparisons of performance and conduct of firms within those industries. *The hypotheses of the S-C-P paradigm, however, are of interest to us, namely that the exercise of market power increases as concentration increases and two, greater barriers to entry enable greater exercise of market power.* We will begin with these hypotheses and test them using secondary data for the server market from India. We are however cautious about inferring dominance and its abuse from structural aspects since it ignores the importance of competitors, extent of entry and exit barriers, countervailing buying power and, importantly, the source of high market shares. We feel that the relation between structure and market power is far from being unambiguous. America's soft-drink industry, to take one example, is noted for price competition

although only two firms, Coca-Cola and PepsiCo, control three-quarters of sales.

Inferring market power from structure was the logic however that led the Monopolies and Restrictive Trade Practices Commission (MRTPC) in India to focus on curbing monopolies.[12] A monopoly was defined purely in terms of the market share, which was then equated with dominance and its abuse. By contrast, the Competition Act 2002 steers away from structure as a determinant of market power, instead focusing on conduct. India's modern competition law owes its intellectual debt to the US Sherman Act, 1890, and the great mass of interpreting case law around it built over the years by regulatory intervention. While it is tricky to draw a single conclusion from the mounds of case law, it is fair to state that over time antitrust is less prone to punish big and successful companies in the US just because they are big and successful.

Similarly, Section 4 of the Indian Competition Act, 2002 prohibits and punishes only abuse of a dominant position. It does not condemn dominance *per se*. The problem arises when there is abuse of dominance (AoD). AoD is however one of the challenging areas of competition law; firms can become big through a host of legitimate business practices and many practices that appear on the surface to be anti-competitive can serve genuine pro-competitive objectives. Thus, in a particular case, different competition authorities may reach different conclusions, e.g., the divergent decisions in the Microsoft cases in the US and Europe.[13]

Following the practice of the New Empirical Industrial Organization (NEIO) and the tradition established by competition law in the US, we begin by analyzing structural aspects of the server market in India insofar as structural dominance is a necessary although not sufficient condition for establishing AoD by incumbents. Two measures of seller concentration are used. These are the Hirschman Herfindahl Index (HHI) and the concentration ratio.

$$H = \sum_{i=1}^{N} s_i^2$$

HHI varies between a lower limit of 0 and 1 (Monopoly) and the closer it is to 1, the more concentrated the industry. If there are N equal-sized firms, then HHI= 1/N The inverse of HHI, 1/HHI is the equivalent number of

9.   The interpretation and conceptual foundation of SCP studies has been questioned (i) over whether the relationship between structure and performance is expected in the long run or the short run, (ii) over whether a correlation between concentration and profitability reflects differential efficiency or market power, (iii) over the assumption that structure causes performance, and (iv) over the implied assumption of symmetric effects.

10.   Williamson, "The Economic Institutions of Capitalism", 1985.

11.   Demsetz, "Barriers to Entry", 1982.

12.   MRTPC Act 1969. MRTP Act is a grim reminder of the "licence-quota-permit-raj" of the 1970s & 1980s. The Act became redundant post-July 1991 when the new economic policy was announced and Chapter III of the MRTP Act dealing with restrictions on M&A activities was made inoperative. The MRTP Commission will continue to handle all the old cases filed prior to September 1, 2009 for a period of 2 years. It will, however, not entertain any new cases; these will be handled by CCI.

13.   United States v Microsoft Corp, Civil Action No 98-1232 (DDC filed 18 May 1998) (Complaint) available at www.usdoj.gov/atr/cases/f1700/1763.htm and Case T-201/04, Microsoft v Commission [2007] ECR.

equal-sized firms in the market that results in the same HHI. HHI is also equal to

$$HHI = \frac{1}{N} + N\sigma^2$$

where σ^2 is the variance of firm size. This indicates that changes in HHI arise from changes in the absolute number of firms and the size distribution of firms. The larger the variance of firm sizes – indicating a wider distribution of firm sizes around the mean – the larger the HHI. If market shares are measured in percentages, then the HHI is scaled by 10,000. Alternatively, we order firms in descending order – Firm 1 being the largest, 2 the second largest etc. Then S_1, S_2, S_3, S_4, S_5. The "m" firm concentration ratio is the sum of the market shares of the largest "m" firms.

$$CR_m = \sum_{i=1}^{m} si$$

Commonly-used measures are the four-firm (CR_4) and the eight-firm concentration ratio (CR_8). Concentration ratios do not adjust, as the HHI does, for variation in firm sizes. A finding of very high market shares however will not provide a robust assessment of AoD. [*] For that, we rely on evidence of firm conduct gathered from users and other secondary sources. Usually the assumption that buyers are unconcentrated is reasonable. However, just as seller concentration is thought to be important because it raises prices, buyer concentration may well make it difficult for sellers to exercise market power. We explore the nature and extent of countervailing buyer power in the Indian

server market and the degree to which it provides a cushion against AoD by the vendor.

Finally, a comment about the nature of the market we are investigating. Two reasons why high-tech industries create special antitrust worries have attracted a lot of interest. One is the idea that such industries are subject to "ever-increasing returns". If there is a winner in the race for technical standards, it will not only dominate the market but also create successful entry barriers. The second idea relates to "network externalities". Purely by being so widely used, products such as Windows, with its customer base of 100 million people, present a high barrier against competitors' entry. Any customer who wants to change to another product would need to spend a fortune re-training staff, replacing software and so on. We explore both these ideas in our analysis of the Indian server market. The rest of the report is organized as follows. The next section defines the segmentation of the server market from the supply and demand sides for the purpose of our analysis. Section IV presents data for the Indian server market to establish its relative importance in GDP and also draws comparisons with Asia Pacific countries. It also offers a forecast of market size until 2012. Section V analyses the market structure based on HHI and C4 estimates from secondary data. Section VI juxtaposes the results of Section V with those obtained from the extensive primary survey of Indian users. Section VII examines the issue of competition in the server market in India from a competition law perspective. Since there is no history of cases against vendors in India, a review of the causes and consequences of regulatory intervention in the US market are invoked and lessons drawn for India. Section VIII is on abuse of dominance by vendors in the presence of network effects and high switching costs. Section IX provides concluding observations.

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14. **HHI Limits**

> Herfindahl index below 0.1 (or 1,000) indicates an unconcentrated market

>? A Herfindahl index between 0.1 to 0.18 (or 1,000 to 1,800) indicates moderate concentration

> A Herfindahl index above 0.18 (above 1,800) indicates high concentration.

FTC and Justice Department in US use HHI for evaluating Mergers; if post-merger HHI increases by 100 or more, then scrutiny is done.

C4 Limits

>? Perfect competition, with a very low concentration ratio,

>? Monopolistic competition, below 40% for the four-firm measurement,

>? Oligopoly, above 60% for the four-firm measurement,

>? Monopoly, with a near 100% four-firm measurement.

The concentration ratio of an industry is used as an indicator of the relative size of firms in relation to the industry as a whole. It is calculated as the sum of the percent market share of the top n firms. Four-firm concentration ratio, or C4, consists of the market share, as a percentage, of the four largest firms in the industry.

III. Coming to grips with the relevant market from the Supply and Demand Side

It is common in high-technology industries to see products as ineffective unless they are combined into a system with other products: hardware cannot be used without software, DVD players are useless without content, and operating systems are useless without applications.[15] These are all examples of complements, that is, goods whose value depends on their being used together. In the server market, hardware and operating systems do not by themselves add value for the user unless these are used together with application software. Many of the users we interviewed for the study responded that choice of hardware and the corresponding OS was more often than not dictated by the choice of application. It is common in this industry that some applications are optimized for certain Operating Systems. For example, we were frequently told that DB2, the IBM proprietary data base management system, has been optimized for z/OS, i.e., the bundle works best. Sun Microsystems has recently declared that it will develop Oracle in a manner that it works best with Solaris, the OS developed by Sun.[16] Ideally, therefore, our relevant market should be a combination of computer hardware, OS and application software. Annual data on application software is however not available since this could be shipped independent of the hardware. In addition, system integration could be done by the manufacturer, the end user, or some intermediary, such as TCS or Satyam InfoTech, making it difficult for a secondary source such as Gartner to capture application software data and map it to the computer hardware and OS data.[17]

The secondary data that we subject to analysis, therefore, covers computer hardware and the OS for the Apac (Asia Pacific, including India) market. If we were conducting a

differences in structure. Not only do we feel that size is an unsatisfactory proxy for market power (for the reasons stated above), but our primary survey unambiguously points to the enormous heterogeneity in the server market. Differences due to technology, price and nature of OS are too important to ignore. Having said that, there is no single universally acceptable 'standard' for segmenting the server market and it remains a thorny issue.[18] There are at least five traditional ways of segmenting this market.

i.   By server hardware brands, e.g., IBM, HP, Dell, Fujitsu, Sun etc.

ii.   By server selling price.

iii. By server operating system, e.g., Windows Server, Linux, Unix, i5/OS, z/OS.

iv.   By types of processors – by 4 main types of processors: x86, RISC, EPIC and CISC.

v.   By the number of processor sockets in the server.

Keeping the objective of the study in mind, i.e., an examination of issues relating to competition in the server market, we decided to adopt the first two definitions. Focusing on firms or *brands* is critical to any study of competition and average selling price enables us to slice the market into small, medium and large. As we demonstrate later, there are fundamental differences between the small or volume market and the high-end enterprise server market. The midrange and high-end markets are referred to collectively as the enterprise server market.[19] IT market research firms such as Gartner and IDC also classify the server market by average selling

Table 1 : Taxonomy of the market based on selling Price

Prices (US$), at current prices	
<25,000	Entry-level servers also known as volume server market
>25,000 - 100,000	Mid-range enterprise server market
>100,000	High-end enterprise server market, including mainframes

traditional S-C-P study, then looking at the server market as a homogeneous entity would be appropriate. Concentration in the server market could be compared with concentration in other markets and differences in conduct and performance could be attributed to

price and, therefore, this taxonomy makes it easier to compare our findings for India with the findings for the

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15. Hal Varian op cit

16. Dramatically Improving Sun's system by tightly integrating Oracle software with Sun hardware. Larry Ellison. Available at: http://www.oracle.com/features/suncustomers.html

17. Gartner was unable to provide us with meaningful software data that we could map to the hardware and O/S. The economic impact of application software on users is thus limited to the evidence we obtain from the primary survey.

18. Jeff Gould via email exchange

19. Worldwide and Regional Server 2008-2012 Forecast; March 2008, IDC.

give rise to positive feedback. Many of our respondents, especially in the public sector, specified 'number of other users' as part of their evaluation criteria for choice of OS and application software. If there is a 'critical mass', positive feedback kicks in and the product will be successful. But if the product never reaches a critical mass of adoption, it will inevitably result in failure. Once a product achieves wide acceptance, it becomes more or less entrenched. In our sample, the only product that 'threatened' to display such characteristics was Oracle. More detail on this is provided later.

A number of organizations in a wide array of sectors such as banking, manufacturing, government, defense, retail distribution, health care, transportation, telecommunications and public utilities are using server systems and applications in India. Based on our primary survey we are of the opinion that this will only increase as the level of automation in a range of organizations increases. One user with multiple locations in India in the healthcare sector is in the process of migrating from standalone servers to a centralized facility to be located in Hyderabad. The reasons for the shift are improved security, efficiency and database management as well as improved customer interface. There are scores of organizations in India that are looking to either upgrade their existing computing infrastructure or to install one for the first time. As such, they constitute natural target customers for the leading vendors, namely, IBM, Hewlett-Packard, Sun Microsystems, Microsoft and Oracle. One could suppose that these rival vendors would make aggressive efforts to acquire new customers or to displace existing vendors. We examine this issue later.

Our focus group for the primary survey consisted of organizations using either the mainframe platform or enterprise-level servers across many verticals including government. These are naturally large organizations; we divide them on the basis of their employee size and type

of application. The latter is not a way of classifying customers, but of classifying their servers in terms of the applications they are running. We do this not for the entire Indian market but for the companies that we cover in the primary survey. The findings from the demand-side analysis are reported in Section VI.

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20. **Interoperability** is a property referring to the ability of diverse systems and organizations to exchange information and to use effectively the information that has been exchanged. whereas **compatibility** refers to the ability of a program or hardware to function in the same way as other programs or hardware. Although both the terms are used interchangeably, compatibility does not consider the efficiency of running a program on other systems.

IV. Indian Server Market : Prospects

The new economics of industrial organization that has emerged over the past 25 years has recognized that particular industries have been dominated by networks, either in terms of physical layout (identifying infrastructural links and nodes) or as virtual features through the provision of complementary products and services. High investment and usage of Information and Communications Technologies (ICT), a sector that demonstrates substantial network economies, in mature markets has played an important role in their becoming information societies and reaping its benefits. Like electricity, ICTs have been recognized as a 'General Purpose Technology' (GPT) that transforms economic relations, enhances productivity and creates new services and markets.[21] A number of studies have shown that expansion of the ICT sector not only contributes to GDP directly but also contributes to network effects (such as

expenditure. Table 2 above shows that China's ICT expenditure is higher than in any other Asia Pacific country, although relative to GDP it is comparable with India. Singapore at about 11 percent sets the benchmark.

Servers and the applications that run on it are crucial to the smooth functioning of user industries. The dramatic growth in Information Technology (IT) and Information Technology-enabled Services (ITES) exports from India 'overshadowed the latent opportunities unlocked and growth observed in the domestic market over the past few years'.[24] Domestic demand for IT in India is witnessing a gradual transformation, from being predominantly hardware driven towards a solutions-oriented approach, resulting in a growing emphasis on services. What is more, revenue growth in the services segment alone has reported faster growth than that for the overall domestic

Table 2: Total ICT Expenditure US $Million, Asia Pacific

Year	India	China	Malaysia	Philippines	Singapore	Australia	Korea Rep.
2002	19,997	62,376	6,437	4,258	8,613	26,697	35,852
	(4.17)	(4.71)	(7.31)	(5.98)	(10.08)	(7.02)	(6.56)
2003	25,692	75,400	7,273	4,740	8,922	34,247	40,547
	(5.06)	(5.19)	(7.64)	(6.17)	(10.13)	(8.06)	(6.67)
2004	36164	97658	8589	5502	10316	40 509	46 751
	(6.03)	(5.95)	(8.26)	(6.91)	(11.17)	(7.43)	(6.87)
2005	46438	117632	9130	6885	11,014	45,676	54,443
	(6.63)	(6.09)	(7.32)	(7.92)	(10.25)	(6.93)	(6.88)
2006	55304	142313	10137.2	7863	122.99.3	49,947	58,769
	(6.83)	(6.34)	(7.42)	(7.97)	(10.54)	(6.77)	(6.62)

Source : World Development Indicators, 2008.
Note. Figures in parentheses are relative to GDP.

lower transaction cost and rapid innovation); this increases the efficiency and productivity of user sectors and thus indirectly contributes to GDP.[22] There is no doubt that the pervasiveness of ICT coupled with its constant improvement spawns innovation and makes it easier to invent and produce new products or processes.[23] The steep decline in ICT prices also encourages investment, at times shifting investment away from other assets.

Recognizing the importance of ICT for development, many developing countries have increased such

IT market (including hardware, software and services) over the past few years.[25] According to NASSCOM this trend is

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21.   World Telecom Development Report, ITU 2006.

22.   Information Technology & Development: Beyond "Either/Or" by James Steinberg

23.   Breshahan T. and Trajtenberg M. (1995). General Purpose Technologies: Engines of Growth? Journal of Econometrics, Vol 65 No.1.

24.   NASSCOM-IDC study on Domestic IT Opportunity, 2006.

25.   Ibid

Chart 1 : Server Market Growth Forecast
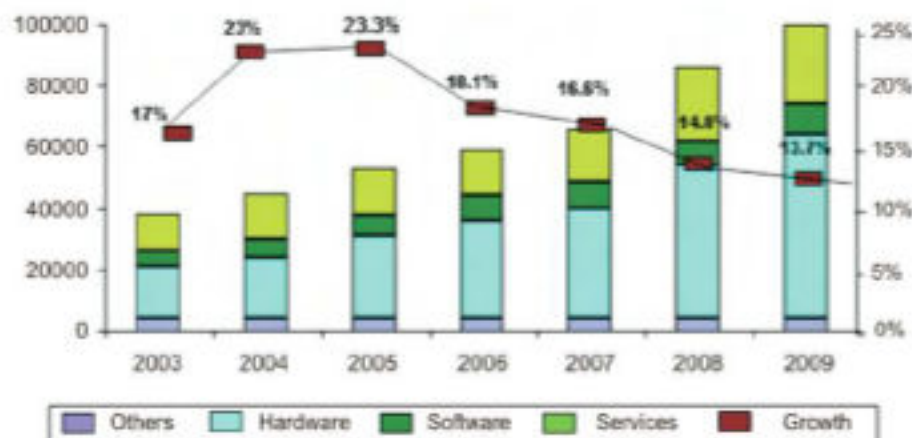
Source: NASSCOM-IDC 2006

affect India's server market (with an annualized decline of 29.4% during the first half of 2009); the second half of 2009, however, is expected to be relatively better. The government, post-2009 elections, and telecom, due to infrastructure rollout in relation to the 3G initiatives, are likely to be large buyers of IT services.[27] Gartner expects the server market will follow closely on the heels of the economy. The Indian server market is predicted to grow at an average yearly rate of 10% annually until 2012[28].

As a percentage of GDP (see Chart 2) the Indian server

countries immediately above it, rather than with Singapore[28].

Our primary survey revealed that one of the major impediments to adoption of servers is cost. Servers are expensive to install and operate. Servers do not last forever and typical replacement cycles are 5 years for all but the most basic of functions. In addition, servers need regular maintenance services, which could be a significant cost item. Many of the respondents stated that maintenance could be the leading cost item over the

Table 3: Revenue and Shipment growth for Asia Pacific

	2008	2009	2010	2011	2012	2013	2014
Revenue Growth							
India	12.81%	-3.18%	5.67%	7.90%	11.19%	9.12%	5.71%
Asia Pacific	-2.78%	-5.73%	4.91%	4.12%	7.17%	4.53%	1.90%
Shipment Growth Rate							
India	8.64%	3.29%	7.70%	10.43%	10.57%	7.58%	4.64%
Asia Pacific	6.54%	1.10%	6.04%	6.21%	6.28%	4.65%	4.04%

Source : Gartner Forecast

market still lags behind comparator countries by a substantial amount. Singapore's server sector contributes the highest share of GDP, followed by China, Australia and Malaysia, respectively. Given the growth forecast of 10% for the server market, its contribution to GDP in India will increase over time, thus reducing the gap with the

useful life of the server. As a result, introduction and/or upgrades of server infrastructure are likely to be a carefully

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26. Ibid

27. Dataquest Insight: Server Forecast Assumptions, Asia/Pacific, 2009-2014, Gartner October 2009.

28. Ibid

Chart 2 : Server Market Growth as percentage of GDP
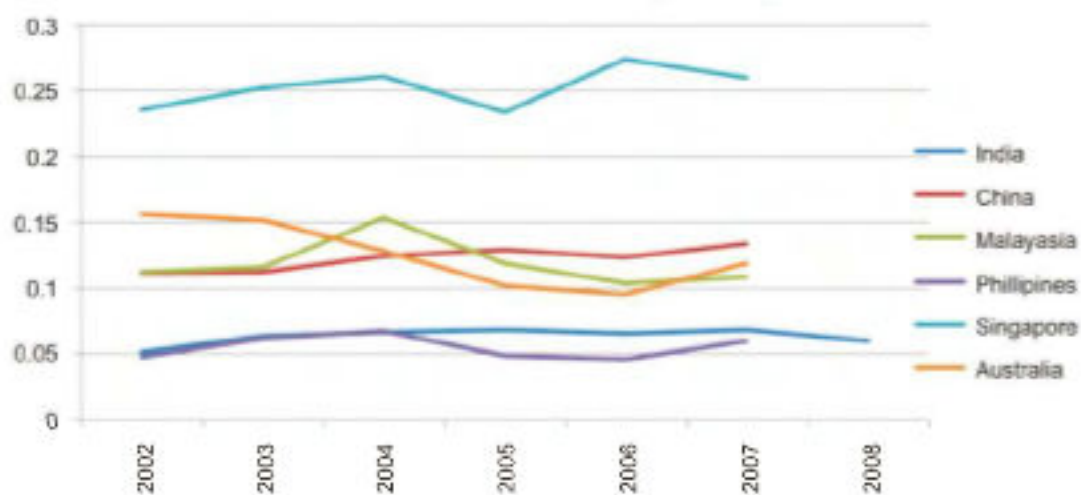
29. GDP is forecasted to grow at 5.4% and 6.4% for 2009 and 2010, respectively. See World Economic Outlook at http://www.imf.org/external /country/IND/index.htm

30. Interview with Intel.

V. Structure of the Server Market in India and APAC

No matter the issue at hand, economists begin their analysis of competition by asking a single question: what is the relevant market that is the subject of investigation? The server market is one that is capable of performing a variety of functions including web applications, e-mail/messaging, front-end Webserving, streaming media, high-performance computing (HPC), data warehousing, online transaction processing (OLTP) and running infrastructure applications. This is not an exhaustive list, but these server workloads cover the entire range of server functions of the respondents in our survey (see Annex III for a description of each of these server functions). In fact all respondents reported using most or all of these workloads since, as stated earlier, our sample consisted of large organizations using enterprise-level servers. The data on servers available from secondary sources includes computer hardware and the OS bundled with it. Importantly, this excludes the non-OS software and although we attempted to collect information for the latter and map it back to the underlying system, it was an exercise fraught with error and risk.[31] We, therefore, consider revenue and shipment data for all hardware internal to the server enclosure, including all internal components, such as system memory (RAM), hard disk drives (HDD), processors (CPU) and network interface cards (NICs). Operating system revenue is included but any non-OS software, such as management tools and applications, as well as external storage is excluded.[32] In the case of blade servers, revenue includes the cost of the blade chassis, distributed as a proportion across each reported server blade. Shipments data is the number of servers sold[33].

In addition to defining product characteristics, it is crucial to define the geographic market especially from an assessment of competition point of view. Our examination of the Indian market did not reveal any region-specific bias on the part of vendors; if anything there may be vertical-specific bias. This is a point we examine later in Section VI. Moreover, data from Gartner on vendor revenue and

shipments is available only on a national rather than a regional level; even if the latter data were available it would not add value to the analysis. Structural estimates of concentration (HHI and C4) are accordingly presented for the national level in this study.

We are unable to calculate structural estimates of market concentration for the 'mainframe' segment since there is no competitor to IBM in India.[34] In fact, the only other manufacturer of mainframes in the world today is Fujitsu, which does not yet market these computers in India (see Annex IV: IBM's timeline in India). Indeed what defines a mainframe computer these days is vastly different from, say, its characteristics a decade ago because of technological progress. Every generation of the mainframe gets better, faster, more efficient, and carries more and more of the data load for business and industry all over the world.[35] As a corollary, tasks that the mainframe performed earlier can now be efficiently executed by x86-based server platforms.[36] In addition, IBM's revenue from mainframes in India is minuscule compared to its overall revenue; on the other hand, it is higher in China and APAC (See Table 4). In the early 90s there were no mainframes in India or China. Mainframe installations and skills are growing in India, not only for running financial market transactions but also to support millions of lines of programming code that are being developed for the rest of the mainframes circling the globe.[37] IBM's India-specific revenue from all its businesses crossed $1 billion in 2009. IBM had a revenue of $1.13 billion from domestic business in India for fiscal 2009, up from $1.05 billion in fiscal 2008 and $0.77 billion in fiscal 2007. The data show that mainframe demand is extremely variable from one year to another.

While it is premature to write the epitaph for the mainframe, their sales are not big enough in India to permit a meaningful treatment on their own; we therefore club it with the high-end enterprise segment for the structural analysis[38]. Many of our respondents were of the

31. Corroborated by Gartner and their analysts.

32. See Gartner data.

33. All secondary data used in this report is from Gartner, unless otherwise specified. Secondary data from Gartner is available for the period 2000-2009(1Q). Gartner is a leading market research company that provides statistics on technology, market and also works as a business consultant. A numbers of public and private organizations consult with Gartner prior to purchase. During the survey our respondents disclosed that information provided by Gartner can be considered as reliable and objective.

34. If there is only one mainframe supplier, according to the formula for market concentration this just implies HHI = 1. But more importantly, if mainframes and high-end servers occupy distinct albeit related markets, then it implies a role for competition policy in the monopoly segment. This aspect is addressed in the policy section.

35. *Mainframe Executive*, "Mainframe Sales Increasing in Southeast Asia, India and China": Joe Clabby, March 19, 2009. www.mainframe-exec.com/articles/?p=107.

36. Interview with Intel September 2009. Corroborated by IBM.

37. The z10 is Not Your Father's Mainframe. **A modern assessment. Terry Keene Integration Systems LLC**

38. For an interesting and controversial debate around the demise of the mainframe, see Terry Keene op cit, "The Story about the IBM Mainframe Makeover" www.hp.com and others

Table 4: Share of Mainframe in IBM's Total Revenue for India, China and APAC

Year	Mainframe share (% IBM total revenue) India	Mainframe share (% IBM total revenue) China	Mainframe share (% IBM total revenue) Apac
2002	1.48	20.42	22.32
2003	2.32	20.33	20.77
2004	2.30	20.98	21.89
2005	1.66	11.33	15.47
2006	3.52	7.48	13.46
2007	9.33	11.48	17.01
2008	2.54	7.57	14.59
2009	1.10	17.44	20.21

Source : Gartner 2009.

opinion that in terms of functionality HP's superdome and Sun's SPARC system, among others, are capable substitutes for the mainframe[*].

We measure concentration with the Herfindahl-Hirschman Index, which is determined by adding the squares of the market shares of all firms and C4 (market share of the top 4 firms in the segment). We do this for both revenue and shipment data for the APAC region as a whole and for individual countries. The results for APAC are shown in Table 5. If the Herfindahl is low, there are many competitors and exercising market power should be

difficult; a high Herfindahl, on the other hand, results in a concentrated market in which price rises may be easier to sustain. The numbers show that the high-end server market on average is more concentrated than the mid-range market, which in turn is more concentrated than the entry-level or volume market. The levels of concentration over time have not altered much either. The levels of concentration reduce slightly if we use shipment data instead of revenue, although the qualitative result does not change, i.e., the high-end and medium-range markets are persistently more concentrated than the low or volume market (see Table 6).

Table 5: HHI for Asia Pacific (APAC) by Vendor Revenue

Year	Total market	Entry-Level segment	Mid-range Segment	High-End Segment
2002	0.259	0.204	0.307	0.379
2003	0.262	0.209	0.320	0.380
2004	0.259	0.198	0.319	0.389
2005	0.251	0.192	0.330	0.423
2006	0.250	0.203	0.348	0.379
2007	0.265	0.223	0.331	0.431
2008	0.275	0.226	0.313	0.465
2009 Q1	0.269	0.215	0.279	0.429

Table 6: HHI for Asia Pacific (APAC) by Shipment

Year	Total market	Entry-Level segment	Mid-range Segment	High-End Segment
2002	0.173	0.172	0.306	0.336
2003	0.172	0.172	0.318	0.327
2004	0.162	0.162	0.312	0.341
2005	0.166	0.165	0.338	0.402
2006	0.178	0.178	0.347	0.384
2007	0.187	0.187	0.330	0.426
2008	0.196	0.196	0.337	0.437
2009 Q1	0.189	0.189	0.297	0.381

39. See the SBI case study later for example. However, there could be an alternate and legitimate view that mainframes and high-end servers are, in fact, separate markets although as stated in the main text the data for India do not permit them to be analyzed separately. As we show later, hardware platforms for new workloads (where mainframes and high-end servers can effectively compete) are different from legacy workloads, for which mainframes do not have viable substitutes.

Chart 3 : HHI for India by Vendor Revenue

HHI for India by vendor revenue
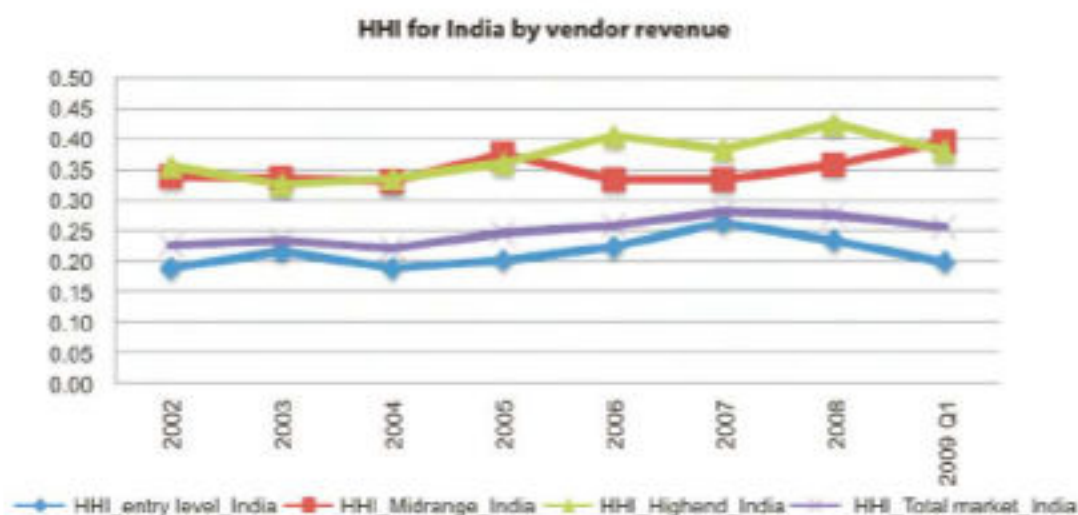
Estimates of C4 are not much different; the high-end market continues to be the most concentrated compared to the mid and entry levels and interestingly, C4 for enterprise level servers (high and medium range) is close to 100. This implies that there are 4 firms that serve the entire market. This pattern is replicated in the revenue and shipment data for individual countries as well.[40] Here we show the results for India and draw a comparison with China. Chart 3 shows that the enterprise-level server market is more concentrated than the volume market and Chart 4 shows that there are only 4 firms that exist in these two segments in India.

The nature of the result does not change when the analysis is done for shipments instead of revenues. Comparing the estimates for HHI and C4 for India reveals an interesting result. For both the high- and medium-range markets, C4

is 100 for almost the entire period, while HHI fluctuates (see Chart 3), albeit within a narrow band. The fact that the number (and identity) of firms in the enterprise segments does not change while the HHI fluctuates implies that firms have traded market shares over the period. One can conjecture that the dominance of IBM in the high-end market is being challenged (because its share in these segments has declined over time). We also test this argument based on our responses to the primary survey. The only significant difference between China and India is the lower concentration seen in China in the mid-range segment in 2009Q1, due to the entry of a new competitor in this segment. *In China too, four firms dominate the enterprise market, while the volume or entry-level market supports a larger number of firms and has a correspondingly lower measure of concentration.*

Chart 4 : C4 for India by Vendor Revenue

C4 for India by vendor revenue
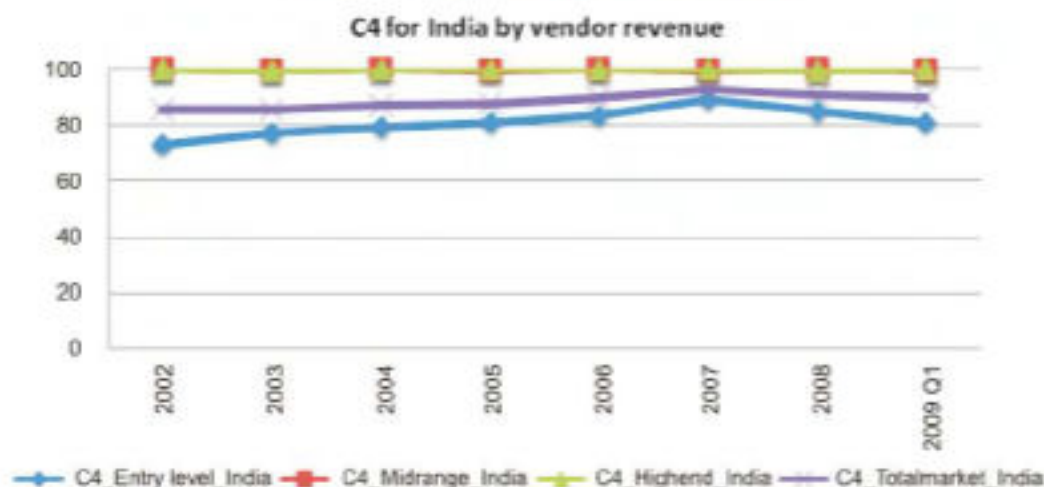
40.   Estimates of HHI and C4 for all countries across the three defined segments are available in Annex V.

Changes in HHI arise not only from changes in the number of firms and their market shares but also due to variance in the shares. We measured variance for the three segments for India, separately for revenue and shipments (Annex VI). These results show that variance on average is greater in the high-end server market than the variance in the mid-range server market, which is greater than the variance in the entry-level market. High variance results in a higher HHI, reinforcing the earlier empirical finding that HHI is greater in the high-end market than in the mid-range and entry-level markets.

The two key building blocks of servers, the processor and the OS, are often bundled with other hardware by vendors. Customers exercise their choice over a specific type of processor and operating system (the performance of the OS depends upon the number of processors in a multiprocessor environment and the performance of the application software largely depends on the choice of OS), database management software (industry experience says the performance of the database varies across

of processor, which will give us an indication of the 'revealed preferences' in the server market in India.[42]

The preferred processor for the entry-level market is the x86 processor; in fact, Dell's entire range of servers is sold with the x86 range. x86 is an open technology architecture that enables wider choices for the client. About 90 percent of all IBM servers sold in India in 2009 included x86 processors. Only Sun Microsystems sold more servers with a RISC processor than with an x86; however, Sun Microsystems current market share in India at 15% is quite low. Across the three segments that we are studying, the x86 processor dominates the entry-level market across all vendors. For example, 90 percent of IBM's systems come bundled with x86 processors in the entry-level market. This number progressively decreases to about 40 percent and 0 for the mid and high end market segments, respectively.[43] According to Intel, the performance of x86 processors has improved manifold over the past 10 years providing benefits of "value and standardization". At the entry level, the dominance of x86 processors can be

Chart 5 : Share of CPU by Shipment, 2006-08

Share of CPU by Shipments, 2006-08
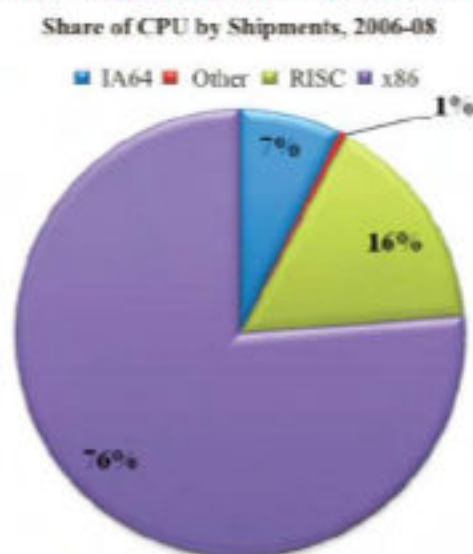
sectors), application software and other technical specificities.[41] Depending on these needs, a customer can choose a single vendor or opt for a multivendor arrangement. Although it is important to analyze each preference type, it is nearly impossible to track all the information for each firm across each vertical. We, therefore, limit our analysis to the choice of OS and choice

attributed to the customer's choice for open technology. x86 processors offer flexibility to the customer in the choice of OS and applications. In addition, according to industry experts, one high-end server can replace number of entry-level servers. In other words, by clubbing multiple small servers, one can get performance akin to high-end computing. This indicates that a cluster of 'small servers'

41. All the processors considered here (Intel x86 & x64, Intel Itanium, RISC chips such as Sun SPARC, and the processor chip in IBM z10 mainframes) are designed for general purpose business computing. Each processor family offers a particular set of price and performance points that overlap partially but not completely between families.

42. In modern server operating systems such as Linux, Unix or Windows Server, it is possible to assert that application performance is as much a function of the hardware as the OS. For legacy applications such as those on the z/OS, performance is closely tied to the OS.

43. See Annex VII for the distribution of processors by vendor across the three identified segments.

may provide incipient competition to high-end servers, especially for new workloads[44].

The same analysis on the basis of revenue rather than shipments shows that the share of x86 in overall revenue is about 55 percent. This implies that the average price of the x86 processor is lower than that of other processors[45] (see Charts 5 and 6). To understand this competition, ideally one should analyze the demand for servers in each segment of each vertical. But due to the paucity of data, we limit our analysis of processor types to the 3 segments defined in our study. We, however, seek answers to this question from the survey of users reported in Section VI.

It is noteworthy that the high-end market is effectively a triopoly between IBM, HP and Sun Microsystems with the last a distant third. Market share for the IA64 processor (Itanium) in HP machines has increased, while that of the RISC processor in HP has declined since HP stopped selling servers based on its RISC chip in 2008. The HP server with Itanium processor is known as the 'Superdome' and is believed to have competencies that can match IBM's mainframe/high-end servers.[46] Both IBM and HP competed for the SBI core banking contract which eventually was won by HP Superdome over the mainframe/P series configuration of IBM (see Case Study in Annex VIII).

Our survey of users unambiguously reveals that the choice of OS is dictated by the application software. Since use of application software varies across verticals, the choice of OS will also vary across verticals, especially between verticals that support large enterprises, such as banking, insurance and telecommunications. Overall Windows OS has the largest share in the entry-level segment, while UNIX dominates the mid- to high-level segments[47].

Interestingly, LINUX deployment has been increasing in the past three years and had 20 percent market share in terms of shipments and 11 percent market share in terms of revenue in 2008. IBM's proprietary mainframe operating system, z/OS, commands less than 5 percent market share. Across segments, the results are intuitive. In the mid range, in the case of HP the share of installed Linux OS is increasing over time; the share of its own UNIX OS is declining along with a declining share of installed Windows OS. In the case of IBM, the share of installed Windows OS is declining[48].

In the high-end market, the share of installed Linux is very low, whereas the share of proprietary OS provided by hardware vendors is comparatively higher. Our survey reveals that users prefer a bundled purchase of hardware and OS in the enterprise-level segment.[49] This finding, however, needs to be juxtaposed with the fact that, in

Chart 6 : Share of CPU by Revenue, 2006-08

Share of CPU by Revenue, 2006-08

■ IA64 ■ Other ■ RISC ■ x86
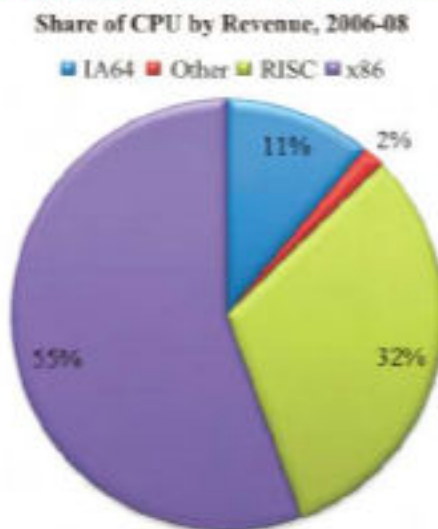
44. For legacy workloads, this will be true only if the applications and operating system running on the high-end server are compatible with the small servers in the cluster. Although the Sun, HP and IBM versions of Unix that run on their high-end servers are not compatible with cheaper x86-x64 servers that run Linux or Windows Server, very often the applications that run on Unix (such as Oracle database or SAP ERP) are compatible with the less expensive processors. However, the older (legacy) applications and mainframe-only operating systems used on IBM mainframes are not compatible with RISC-based Unix servers or with x86-x64 servers. Therefore, where these legacy mainframe applications are concerned, high-end servers cannot provide competition for mainframes. Such competition is possible only where new applications are concerned.

45. Windows' share is 75 percent by shipment and 43 percent by revenue

46. We must again distinguish between new and legacy workloads. While the Superdome's hardware performance can match that of IBM mainframes for new workloads (e.g., those based on Oracle or IBM relational database software), users of IBM mainframe operating systems and their associated legacy workloads are pretty much locked in, since Superdome cannot support these latter types of software.

47. Although there are separate OS for desktops and for servers from Microsoft, here we are using Windows OS to mean OS for the server only.

48. See Annex IX.

49. Users opt for a bundle of hardware and software from the vendor, since it eliminates the possibility of conflict between the hardware and software and also makes it convenient to get service in the future.

Table 7: Percentage Share of Operating System by Vendor in the High-end Market by Shipment

Vendor	2002	2003	2004	2005	2006	2007	2008	2009Q1
Hewlett-Packard	100	100	100	100	100	100	100	100
Linux	0	0	13.0	10.7	0	0	0	20
Others	25.0	42.9	13.0	14.3	19.0	18.2	25.0	10
UNIX	75.0	57.1	60.9	53.6	81.0	81.8	75.0	70.0
Windows	0	0	13.0	21.4	0	0	0	0
IBM	100	100	100	100	100	100	100	100
AIX	28.6	21.1	25	29.4	48.5	50	53.8	50
Linux	0	0	0	0	6.1	0	5.1	0
UNIX	57.1	63.2	50	52.9	30.3	26.7	30.8	33.3
Z/OS/OS390	14.3	15.8	25	17.6	15.2	23.3	10.3	16.7
Sun Microsystems	100	100	100	100	100	100	100	100
UNIX	100	100	100	100	100	100	100	100

most cases, the vendors allow no other choice. If one buys a high-end RISC server from IBM, HP or Sun, your only server OS choice is (usually) the variant of Unix sold by that vendor (respectively AIX, HP-UX and Solaris). One cannot choose to run Sun Solaris or HP-UX on IBM Power hardware. Moreover, one cannot run Windows OS on IBM Power or Sun SPARC hardware (though one can on the Intel Itanium-based versions of HP Superdome). The data supports our conjecture, which shows that in the case of HP the larger share of installed OS goes to its own UNIX base OS, whereas in the case of IBM the larger share goes to its own AIX OS. Likewise for IBM mainframes, in most cases they only use IBM's mainframe operating systems such as z/OS. The only exception to this general rule for

high-end servers and mainframes is Linux, which can run on all these types of hardware machines (though in the case of IBM mainframes, Linux supports only new workloads, not legacy workloads, thus confirming the observation that legacy mainframe workloads are subject to monopoly lock-in on IBM mainframe hardware).

From the discussion above it is clear that the choice of processor or choice of OS varies across segments. No single processor technology or operating system dominates across all segments, although clearly x86 and Windows OS is the preferred mix for the entry-level server market. This implies that *a priori* the extent of 'lock-in' for entry-level users is likely to be less than for the other two segments. We pursue this argument in Section VII.

VI. Primary Survey : Results

Our primary data was collected through a sample survey conducted by ICRIER and TekPlus in India (see questionnaires in Annex X). The goal of this primary survey was to collect qualitative and quantitative information from vendors as well as users across verticals. Our sampling technique was purposively stratified and consisted of 71 subjects from vendors, chipmakers, service providers and a representative cohort of medium and large enterprises from different verticals. A break-up of the subjects is provided in Annex XI. Our choice of users was restricted to medium and large enterprises since the aim of this study is to examine the nature and extent of competition in the high-end market, which is largely served by the 'Big Three' in India, namely IBM, HP and, to a lesser extent, Sun Microsystems. We first report results for vendors followed by the user responses.

In India the activities of server vendors are not region-specific. Almost all servers sold by MNC vendors in India are imported from other manufacturing locations, which implies that they are covered by the import duty regime. A few low-end x86 servers, especially one-way servers, are manufactured locally in India. Some large MNC vendors leverage their desktop/ notebook capabilities to produce low-end volume servers. Local Indian server vendors, of course, do the PC and server manufacturing in India. Indian production is limited to the low end; for example, HCL has its manufacturing capabilities in Chennai and Puducherry. Almost all these servers are in the low-range category of x86 (Intel/AMD) servers[50].

None of the vendors follow a vertical-specific strategy, although it could happen that a vendor may experience network effects in a specific domain. For example, Sun Microsystems had become very popular in the telecom vertical in the billing and customer care segments. In fact, Reliance Communications still uses the Sun Microsystems platform for 70 percent of its telecommunications applications. A successful adoption leads to positive feedback and others adopt the tested solution, thus creating network effects.[51] As a result of this direct network effect, an increase in the number of users on the same network (platform) raises the consumption benefits for everyone on the network (platform). Sun's dominance in the telecommunications vertical in India was broken by IBM, which made a breakthrough in 2004 with a highly publicized US$750 million deal with Airtel, one of India's leading integrated telecommunications operators (see Bharti Case Study in Annex XIII). In fact, IBM is using its Unix servers (AIX on Power) to challenge Sun worldwide in the telecom market, as well as in other high-value verticals such as financial services. In the latter vertical IBM mainframes have a dominant position for legacy applications, while new workloads have typically gone to Unix or, more recently, Linux.

Most vendors consider *lower TCO, interoperability/openness* and *better service* as important factors that differentiate their product from rivals. Competition in the technology space pushes firms to innovate and introduce new product lines. In India vendors usually refresh their product cycle within 1-2 years. This shorter product refresh cycle indicates competition in the technology space. Our survey reveals that factors considered important in product refresh cycle by vendors are *technology demand, price competitiveness* and *market vision*. This indicates that main objective of the product refresh cycle is to provide better technology that can meet future demand at a lower price.

Pricing of a system includes the cost of hardware, software and services. Often hardware vendors bundle software with their hardware and charge accordingly. Our survey shows that all the vendors provide system software and management software with their hardware. Six out of eight vendors also provide application software and four provide security software. The aim of bundling software with the hardware is to reduce the amount of coordination for a client across different vendors, as well as saving on distribution costs. On the other hand, bundling often results in price discrimination and creates lock-in for users. A key factor in this context – perhaps the most important from the vendors' point of view – is that software enjoys significantly higher profit margins than hardware. This is due to the fact that: (a) the marginal cost of each additional copy of a software product is very close to zero, and (b) the opportunities for proprietary differentiation are generally greater with software than with hardware. Thus, large system vendors such as IBM, HP and Sun have a powerful incentive to bundle complex software such as server operating systems and middleware with their server hardware. Indeed, vendors such as Dell who produce only server hardware and lack their own proprietary software offerings are far less profitable than the high-end system vendors; Dell can only resell software provided by third-party firms, which offers lower profit margin opportunities.

The standard model for enterprise software vendors in most markets is to charge a single upfront fee known as a "perpetual license" and then to charge an additional recurring annual fee known as a "maintenance charge" (typically 15% to 22% per year of the perpetual license fee). The maintenance fee usually provides the customer with the right to receive all upgrades and new releases of the software. There are some exceptions to this rule. For example, IBM mainframe operating systems and middleware are sold through a monthly license fee that varies with the size and usage of the mainframe hardware. Another exception is Sun's Solaris (Unix) operating system and its Java middleware, which are now sold only through

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50. See Annex XI for duty structure and the corresponding SIC codes.

51. As is indeed the case worldwide, Sun has always had significant share in the global telecom segment. The network effect here is thus a truly global and not only a local phenomenon.

annual subscriptions. Microsoft also has a somewhat different model, which is however fairly close in practice to a subscription model for most large customers. Oracle, SAP and IBM (for non-mainframe software), however, adhere to the strict perpetual license + recurring maintenance fee model. And, of course, all the vendors offer negotiated discounts that depend on the bargaining power and long-term desirability (i.e., profit potential) of the customers. Typically, these discounts are offered on the upfront license price and not on the recurring maintenance fees. This reflects the fact that once a

vendors deal with the client for the software installed in the system, but for any services required the client needs to contact the software vendor. The introduction of a new product line makes the existing product outdated. To induce clients to purchase new products, vendors usually offer a buy-back option. In India, 5 of 8 hardware vendors offer leasing option and 7 out of 8 offer buy-back options while offering new products. The survey also revealed that vendors usually lease the older generation products to the lower-end market, but do not sell refurbished servers in India.

Table 8: Extent of Competition in the three segments

Market segment	Number of vendors (scale of 1-10. 1= high, 10 = low)					
	1	2	3	4	5	6
High-end	2	0	2	0	2	1
Mid-range	3	0	5	0	0	0
Entry-level	7	0	1	0	0	0

customer has committed to a particular type of enterprise software (server operating system, middleware, database, packaged application, etc.), the costs of switching to other kinds of software are quite high. In the case of Linux, Unix and Windows Server, switching costs reduce but do not eliminate the customer's option to change vendors. However, in the case of legacy workloads on IBM mainframes, these switching costs are generally so high that they prohibit migration for all but the simplest (and generally least important) applications.

Our survey of vendors reveals that 5 of 8 vendors offer unlimited licensing, which means the client has to pay only once to use the software. Only one user in our sample, however, was able to successfully negotiate a 'once in a lifetime license fee' for a specific software; others claimed

According to vendors, the extent of competition in the higher end is the least while it is the highest in the volume segment. Table 8 below reports vendor perceptions. The greatest number of vendors perceive high competition in the entry-level market. In the mid range, competition is expectedly more than in the high-level segment, but less than that perceived in the entry level.[52] In the high-end segment, competition is lower not only because of fewer players but also because of greater customization of products. However, as emphasized right through this study, smaller numbers in the high-end market do not necessarily indicate lower intensity of competition, especially in the presence of countervailing buying power. We examine this point later. For the moment we report that respondents perceive competition is lower in the mid to high range compared to the entry-level segment.

Table 9: Intensity of competition in the submarkets

Market segment	Number of vendors (scale of 1-10. 1 = high, 10 = low)					
	1	2	3	4	5	6
Hardware	7	0	0	0	0	0
Software	1	0	2	1	3	0
Maintenance (including services)	3	0	3	0	1	0

to be charged according to a variety of methods. For example it could be per user, per core or per CPU or number of simultaneous users. There is no one-size approach in this regard in the industry and the actual price is the result of extended negotiation. Hardware vendors may have an agreement with the ISV (Independent Software Vendors) and charge for the software installed in their hardware from the client. In this case, hardware

An interesting characteristic emerging from our analysis of vendor data relates to the perception that competition is lower in software services than in maintenance and hardware services. Many user respondents corroborated this feature, claiming that Oracle tends to create a greater 'lock-in' than does IBM. It is, however, important to note that IBM has a broader product line than Oracle (at least prior to the anticipated completion of Oracle's acquisition

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52. At entry-level 7 vendors ranked the level of competition as 1 (highest); at mid-range 3 they ranked it as very high (1) while 5 others ranked it as 3 on a 10-point scale.

of Sun). In practice, IBM and Oracle can reasonably be compared for two specific software products: relational databases and Java-based middleware. For both these types of products, the sales practices and extent of lock-in potential are very similar for IBM and Oracle. However, since Oracle is likely to have a larger share of the database market on non-mainframe servers (especially Unix), it is not surprising that customers perceive its software to possess greater lock-in effects than similar software from IBM. Another reason for this could be that the entry-level server market has to a large extent been commoditized and may have influenced the responses. In addition, 6 of 8 server vendors mentioned that they do not collaborate with their competitors. Only 2 vendors mentioned that government policies are not conducive to reducing price for end-users and one of them mentioned that it is not creating a level playing field.

Technological advancement in this rapidly progressing industry has meant that the power of the chip has exploded in the past decade. It was thought that the mainframe would be rendered redundant by the faster computing power now available. Yet the market share for the IBM mainframe in the past 7 years worldwide has increased from 17% to 34%.[53] In the past one year, mainframes have acquired 54 brand new customers across the world, of which 5 are from India.[54] Traditionally, the US, Europe and Japan are big IBM mainframe users, but recently China has emerged as a big market for the mainframe.[55] The reason for low coverage in India, according to IBM, is that most companies do not have large databases. The mainframe is an enterprise class server that provides capability for extensive workload management and uninterrupted performance and security and thus suits extremely large workload requirements. The total number of mainframe users in India including the newly added five is 25. That is not a large base compared to mainframe customers worldwide and it is reflected in the low revenue that IBM generates from mainframe sales in India. Interestingly, only two of the five users have opted for the z/OS; the rest are on LINUX.

IBM naturally disputed claims that the mainframe creates 'lock-in'. One of the myths that got broken (in India) by new sales was that most mainframe sales are upgrades or modifications.[56] Of the five sales, only HDFC was using a legacy system, AS-400.[57] HDFC claims that acquisition of the Z mainframe for their credit card operations was independent of the prevailing system being used by the bank and was based on a technical evaluation of the alternatives available. Faced with almost similar requirements, another major private sector bank, ICICI, opted for a non-mainframe solution, citing the huge price differential, shortage of technical skills and limited application software compatible with the mainframe ecosystem.[58]

The mainframe market in India needs to be distinguished from the global market. According to IDC there are 8,000-10,000 IBM mainframe customers in the world. Of these, very few are new users. The vast majority of revenue generated by IBM from its mainframe business, therefore, represents upgrades to or replacements of existing mainframes. The low installed base of mainframes in India suggests that new sales dominate in contrast to the global market. For "legacy" mainframe applications – mostly very large custom COBOL programs that mainframe customers have developed over years or decades – the lock-in effect is very strong, which is why most sales globally are upgrades. For the "new workloads" which can run on mainframe Linux or reduced cost mainframe "specialty engines" – and these would typically be applications that use Java (e.g., on IBM's WebSphere application server), IBM's relational database DB2, or certain packaged software such as SAP – the mainframe lock-in factor is weaker. But these new workloads represent a fairly small proportion of the total number of applications running on mainframes globally. Therefore, for the five new mainframe customers in India, lock-in is likely to be weak.

Most users were divided on the need for retaining flexibility (being able to switch to another platform to preempt lock-in) and addressing their immediate requirements. All vendors, and not just IBM, try to create a 'lock-in' and it arises due to technology was how one user put it. 'Exit' from a proprietary technology like the z/OS is indisputably more resource-intensive (in terms of both time and money) than from a UNIX or Open Source environment.[59] IBM mainframes unquestionably have greater lock-in on average than Unix servers or x86 servers running Linux or Windows Server. But to be fair, this is not because HP, Sun, Microsoft or Red Hat are less interested in lock-in than IBM, but because the legacy applications and legacy operating systems (e.g., z/OS) running on mainframes are on average older than those running on the more modern platforms. The applications, middleware and databases running on Linux, Unix and Windows

53. Gartner data.

54. From www.ibm.com

55. Bank of China is a good example of a recent acquisition for IBM. z/OS is used for the core banking solution delivering 9,445 business transactions per second (tps) on one box in real-time based on more than 300 million accounts with 3 billion transaction histories. According to IBM, these volumes are not possible in Linux: z/OS is the most cost effective in such situations.

56. Interview with system integrator. However since the installed base in India is low, new sales are more likely to be new acquisitions rather than upgrades.

57. AS/400 is a proprietary IBM mini-computer, not a mainframe although it is not unreasonable to combine it with mainframes for the purpose of this study.

58. Interview with ICICI Bank.

59. We examine the impact of Open Source later in the study.

Table 10: Mainframe Clients added in 2008 in India

Organization	Details of System z used for deployment	OS	Workload deployment	Consolidation/ Virtualization, if any	Benefits
Bajaj Allianz	System z10 BC with 1 IFL and 6 Capacity Backup IFLs, 1 z9 BC with 7 IFL processors	Linux	Bajaj Allianz in India has deployed its data warehousing applications alongside DR on System z.	The workloads were unable to be completed in time on other hardware. Oracle license reduction to almost one-sixth.	TCO benefits due to SW license reduction, simplicity in management. Performance of batch applications has improved.
Satyam		Z-OS			
Anna University	z9 BC with 26 MIPS, and 3 IFL processors	Linux	Anna University, Coimbatore has becomes one of the world's first educational organizations to offer a Masters in Technology program with a Mainframe Technology specialization; at the same time it has installed a new System z z10 BC running z/OS and Linux to support university workloads, while offering direct student access to the university's technology engine.	Wants to be the hub for all colleges in Coimbatore for MF training and also wants to start virtualization and consolidation around zLinux.	For training students on mainframe platforms and automating server production with virtualized servers on System z.
HDFC Bank	System z10 EC 216 MIPS, z10 BC for DR	Z-OS	Credit Card applications	Batch window problem in other environments could not be solved. This is now a real-time application.	Continuous availability, reliability, scalability and security of applications and data. Performance was a major factor
EL-COT	System z9 EC - 4IFLs and 64 GB Memory in each machine	Linux	One System z is deployed in the data center and another one is used for mirroring all hosted applications at the DR site.	The organization has consolidated from 96 cores of Intel Xeon servers to eight IFLs running at about 30-40% peak utilization.	Power consumption is contained even if the workload grows to 15 times the current volume of transactions and data.

Source : http://www.expresscomputeronline.com/20090413/market01.shtml

Server are more likely to share common standards and best practices (Java, relational data models, clean separation between data and programming logic, etc.). This greatly reduces switching costs compared to the mainframe, where the operating systems, programming methods and middleware were developed before many of these standards and best practices were fully evolved. We did not find evidence in support of users choosing a particular platform based on the perceived ease of migration were they to become dissatisfied with system performance in the future. Instead, choice was usually based on a vector of price and performance.[60]

It is well established and widely known that while the server market 'may be' competitive *ex ante*, it could be monopolized *ex post* resulting in high switching costs to

vendor can be mitigated by a multi-vendor and multi-OS approach. Although none of our users seemed to be explicitly following this particular route, each deployment being decided on a case-by-case basis, some felt that this helped create competition among vendors.

Of the 41 users we covered in diverse verticals such as *healthcare, retail, transport, banking, utilities, telecommunication, process manufacturing, insurance* and *government*, almost all the users put their server infrastructure to a wide variety of workloads while making use of multiple vendors and multiple technologies[62].

Lock-in or a high exit barrier for users also manifests itself in high price. Many reports suggest that IBM-mainframe prices are relatively higher than other similar systems that deliver the same functionality. We did find support for this

Table 11 : Vendors providing servers to the organization

Brand	Number of users
IBM	29
HP	30
Sun Microsystems	23
Dell	5
HCL	5
Wipro	2
Fujitsu	0
Other	3

Table 12: Main Uses of Server infrastructure

Types of Workload	Number of Users
Web hosting	25
Mail server	39
File & Print server	36
Security applications	19
IT & network management	24
Cross-industry applications (ERP, CRM, etc.)	33
Core application (banking, telecom, etc.)	35
Messaging & collaboration	30
Others	1

the user. In our sample of firms, we came across only one user who switched from IBM to HP following dissatisfaction with performance.[61] Apart from migration, which is a 'last resort', 'lock-in' to a specific technology or

claim during our interviews, although it was at times countered by statements like "there is no competitive benchmark to the IBM mainframe".[63] Our attempt to test the higher price hypothesis with figures, however, was

60. Again, one must distinguish between users choosing a platform for a new application (workload), and users who own large legacy applications that were created many years ago using custom mainframe software tools. In the latter class, there are very few customers in India and, therefore, the primary form of mainframe lock-in is likely to occur only in a small number of cases.

61. Numerous attempts to contact Vishal Mega Mart were unsuccessful. Details of the migration are, therefore, not available.

62. This fact can be inferred from Tables 11 through 14 read along with the profile of the companies in our sample in Annex XI. For example, 33 of 41 firms use multiple vendors. This indicates that there is no brand-specific bias in purchase.

63. There are no standard benchmark results comparing the performance of IBM mainframes with Unix RISC machines or Linux/Windows Server x86 machines because IBM mainframe sales contracts expressly forbid the publication of any such comparative data. Even Microsoft, which owns an IBM mainframe for testing purposes, is not allowed to publish any benchmark data for that machine. Note that IBM's ban on publication of hardware benchmark results concerns only their mainframes. They publish many benchmarks for their Power-based Unix servers and their x86-x64 servers and frequently use them for competitive marketing purposes against HP, Sun and Dell.

Table 13 : Predominant Server Architecture used by Organization

Architecture	Percentage of users
X86	97.56
RISC	82.93
EPIC/Itanium	17.07
Other	0.00
Total	**100**

Table 14 : Operating Systems running on the Servers

Types of OS	Number of users
Open Source Only	0
Proprietary Only	15
Open Source and Proprietary	26

thwarted due to paucity of data on actual "deal" price. Interaction with different vendors did not help either. IBM provided no data based on standard, cross-platform benchmarks, citing that each customer situation is different and has to be studied independently. It is a fact that the Indian server market like others is highly customized and prices are negotiated between clients and vendors. Further, such price information is not publicly available. What we were able to ascertain though is that significant discounts ranging from 50-99% on the list price are offered. The extent of discount varies across clients.

Even if we were to accept the high price hypothesis, a high price does not inevitably translate into anti-competitive conduct or AoD. As one user said "they will charge what the market can bear". IBM disputes that their prices in India are high. Prices are perceived to be high because in India the focus is on total cost of acquisition (TCA) rather than on total cost of ownership (TCO). According to IBM, TCO for them is low because of scale. While this may be true in the case of small enterprises, it certainly is not true for the enterprises we surveyed. Our survey, conducted as it was among large enterprises, did not suggest that buyers focus only on TCA. On the contrary, we came away

with a strong sense that Indian buyers were knowledgeable about the market and were technically well informed. The modal refresh cycle in our sample is 5 years or more. 12 or roughly 30 percent refresh when the need arises (see Table 15). We take this to mean that server infrastructure investment is made for the long rather than short term.

Although we do not have an exact estimate of the elasticity of demand in this market, we know elasticity is a function *inter alia* of the number of substitutes available and countervailing power buyers are able to exercise in the market. Three attributes stand out in this context. One, knowledgeable Indian clients are able to oppose exercise of market power by any vendor including IBM. Coopers and Lybrand once famously remarked that IBM works best in an environment where the hosts know little.[64] This is certainly not true for our sample. Two, HP's acquisition of SBI's core banking contract on the superdome platform demonstrates that banks can use a mainframe alternative for their core processing.[65] Last, India missed the computer age and is a late starter in this area. As a result there are few, if any, legacy mainframe applications and, coupled with the fact that it is a high growth economy, vendors,

Table 15 : Frequency of Upgrading / Replacement of Existing Server Infrastructure

Years	Number of Users
Less than 3 years	0
3 – 5 years	7
More than 5 years	18
As and when need arises	12
3 – 5 years and more than 5 years	4

64. The negotiating skills of knowledgeable Indian clients vis-à-vis IBM may not be relevant to the small number of Indian users who have older (legacy) mainframe applications. It is this latter group of customers who are the victims of IBM's mainframe market power. They constitute the vast majority of the worldwide mainframe installed base, but are perhaps only a minority of the smaller and younger mainframe-installed base in India.

65. See case study (Annex VIII). More than 100 million accounts are processed daily in SBI.

Table 16 : Server Infrastructure used to Run Mission-Critical Data

Percentage	Number of Users
1 – 25	0
26 – 50	10
51 – 75	21
76 – 100	10

including IBM, have little incentive or ability to exercise market power.

It is widely believed that open source software can be an alternative to proprietary software to reduce cost and increase transparency. Therefore, Open Source Software (OSS) plays an important role, especially in emerging economies. A recent study by IIM Bangalore analyzed the economic impact of FOSS (free and open source software) in India that was based on 20 case studies of Indian organizations drawn from government departments, private sector firms and educational institutions. The conclusions are mainly based on guesstimates. The assumption of zero cost for OSS for servers departs from reality. According to one of our respondents, OSS comes bundled with a cost and the "overall TCO of running Linux is no different" because it needs to be put through a grueling test cycle before implementation and requires maintenance support. Other criticisms of OSS articulated by our respondents ranged from it being suitable for research universities rather than for an organization running mission-critical applications to its fluid nature being disadvantageous for large firms. Industry experts mention that customers use OSS in parallel on a trial basis, but rely on proprietary platforms to run mission-critical application. They claim that OSS fails when the number of transaction/instruction crosses a certain limit and, hence, question its reliability and scalability. For critical applications, the majority of our survey respondents (21) use 51-75 percentage of their server infrastructure, whereas 10 clients use 76-100 % of their server infrastructure (Table 16). Interestingly, none of our respondents rely exclusively on open source software; at the same time, the majority (26 out of 41) run mission-critical applications on proprietary OS, while using open source to run less critical applications.

VII.   Analysis of Competition in the High-end Server Market in India: Is it Adequate?

Competition policy and economic regulation are based on the premise that the "public interest" or "social good" is best served when markets work efficiently. If markets work efficiently, economic or regulatory intervention can do more harm than good.[66] The conditions for the markets to work efficiently, however, are so stringent that in practice that they are almost never satisfied even at the best of times. The server market, with high entry (and exit) barriers and tremendous network effects, can scarcely be described as the best of conditions for markets to work efficiently. The questions we investigate in this study are whether IBM has exercised market power in the server market in India by charging high prices and whether it has denied customers the benefits of innovation.

Chicago School economists left a legacy of free market principles that defined competition policy for many years, at least in the US. First, they said that governments should stop worrying about size and ask only whether a firm can

(based on IBM's proprietary z/Architecture and using IBM's proprietary z10 microprocessors) actually participates in two separate computer markets that are defined by their operating systems: the legacy mainframe market (z/OS), and one segment of the high-end server market (Linux). Legacy mainframe workloads cannot switch to high-end servers, because they are tied to an operating system (z/OS) that cannot run on these servers. Note that it is in fact technically possible for z/OS to run on servers with Intel/AMD x86 or x64 chips using software emulators. There are several such mainframe emulators available, all quite mature and with excellent performance. However, IBM refuses to license z/OS for use on these emulators and has acted to suppress them, either by acquiring them (PSI), or threatening them with patent litigation (T3, Hercules)[67].

At the high end, IBM had almost 50 percent market share, with HP holding around 33 percent share and Sun Microsystems 17 percent (Table 17). During the MRTP days

Table 17 : Market Shares in the High-end Segment

Vendor \ Year	2002	2003	2004	2005	2006	2007	2008	2009 Q1
Fujitsu/ Fujitsu Siemens	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00
Hewlett-Packard	35.47	28.89	29.79	44.47	45.39	36.58	46.91	33.79
IBM	18.25	35.93	28.71	36.47	43.48	48.39	44.90	48.81
SGI	1.73	0.54	0.00	0.00	0.00	0.00	0.07	0.50
Stratus Computers	0.00	0.73	0.85	1.08	0.72	2.57	0.00	0.00
Sun Microsystems	44.56	33.91	40.65	17.97	10.40	12.45	7.87	16.90
Total	100	100	100	100	100	100	100	100

exert market power. Second, even if a firm gains market power, the effect will usually be temporary, because high profits will attract new competitors. Hence, markets will erode most monopolies more quickly and effectively than will governments.

To start with, let us look at structure in the high-end market; it make sense to start here rather than with just mainframes because customers can switch to other high-end servers at least for new workloads. In the case of new workloads such as Java or Linux-based applications, it is possible to switch from mainframes to high-end servers and vice-versa. On the other hand, for legacy workloads, the shift from mainframe to high-end servers of HP, Sun or IBM is more challenging. This implies that the mainframe

this would have been sufficient to launch investigations against IBM because of its size. Competition Authorities, influenced by Chicago, no longer believe that the relation between a high market share (or a high HHI) and market power is obvious. We, therefore, need to further probe IBM's conduct and ask whether it has denied customers the benefits of technological innovation and whether it charged above market prices for IBM solutions, including the mainframe in India.[68] These are the very questions that IBM is being investigated for in the US at present. In fact, IBM has a history of antitrust investigations against it in the US.   A summary of these is provided in Annex XIV. Microsoft and Intel, two large companies with high market share and pervasive network effects, also have a history of antitrust cases and violations in the US.

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66.   Robert Bork, "The Anti Trust Paradox". Identified with the Chicago School.

67.   See the policy section for more detail in this regard. Also see Annex XIV for antitrust litigation against IBM in this matter.

68.   In a paper commissioned by Microsoft examining the alternative mainframe technologies, Walter F. Tichy, a professor of computer science at the University of Karlsruhe in Germany, concluded that, as a result of IBM's actions, "customers have been denied the benefits of technological innovation and must instead pay above-market prices for IBM mainframe solutions and premium wages for a dwindling mainframe workforce."

There can be no doubt that there are huge entry barriers in the high-end server market worldwide, including India and only a company like Cisco can overcome these barriers. A glance at the advertising and R&D expenditures of IBM, Sun Microsystems and Cisco confirms this. R&D cuts both ways. Sun spends almost 15 percent on R&D, followed by IBM, which spends a little more than 6 percent. One might hypothesize that IBM's comparative underinvestment in R&D is the behavior of a monopolist, although the reality must certainly be more complex than this, since we know that the legacy mainframe business (monopolistic) is only one part of IBM's business, and that other parts (non-mainframe software and services) are in highly competitive (albeit oligopolistic) markets. While serving as an entry barrier, R&D helps bring the benefits of innovation to the market place. Whether and in what form the innovation reaches the customer is in part determined by the extent of competition **in** the market, given that competition **for** the market is almost non-existent because of the high entry barriers[69].

Our survey is optimistic about the extent of *ex ante* competition that exists in the Indian market. Mainframe workloads can be moved to other high-end servers like Unix servers made by Hewlett-Packard and Sun, and IBM itself. The SBI case provides evidence for this made by Hewlett-Packard and Sun, and IBM itself.[70] The SBI case provides evidence for this feature. Oracle's planned purchase of Sun will combine software and hardware expertise, making it a formidable competitor to IBM. Cisco, the world's biggest network equipment maker, has also recently entered the server market.

Ex ante competition in the market is no solace to a client who finds himself locked into a particular platform and after purchase has very little option to migrate. Our study provides little evidence of lock-in because of some unique features of the Indian market, namely, a growing market, well informed and knowledgeable clients, a fortuitous multi-vendor multi-platform approach, and a late start in the computer age thus allowing leapfrogging of many

Table 18 : R&D and Advertising for the Big Three

Sun Microsystems	2007	2008
Net revenues ($ million)	13873	13880
R&D expenditure ($ million)	2008	1834
R&D expenditure as % of revenue	14.47	13.21
Advertising expenditure ($ million)	25	32
Advertising expenditure as % of revenue	0.18	0.23
Number of employees	34200	34900
Revenue per employee ($ thousand)	405.64	397.71
IBM		
Revenues ($ million)	98786	103630
R&D expenditure ($ million)	6153	6337
R&D expenditure as % of revenue	6.23	6.12
Advertising expenditure ($ million)	1242	1259
Advertising expenditure as % of revenue	1.26	1.21
Number of employees	386558	398455
Revenue per employee ($ thousand)	255.55	260.08
CISCO		
Net sales ($ million)	34922	39540
R&D expenditure ($ million)	4598	5325
R&D expenditure as % of net sales	13.17	13.47
Sales and marketing expenditure ($ million)	7401	8690
Sales and marketing expenditure as % of net sales	21.19	21.98
Number of employees	61535	66129
Revenue per employee ($ thousand)	56.75	59.79

Source : Company websites.

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69. Some experts claimed that cloud computing could become a competitive threat for incumbents. At the high end, however, due to security features that are absent or lacking, it is unlikely to create much competitive pressure.

70. Again, this is only true for new workloads, mainly those based on Linux or Java. Legacy mainframe workloads, for reasons already discussed, cannot be easily moved to Unix servers (or to Linux or Windows Server machines).

legacy applications. In US a switch takes time and is costly particularly in the case of custom applications written specifically for the IBM mainframe. What about price? Our study is less clear-cut on this issue. While revenue-sharing deals between IBM and Airtel take initial price out of the equation,[71] prices in general were not available for the Indian market. In the concluding section we report a price comparison between India and China for the mainframe based on secondary (Gartner) data with interesting results. Prices for the mainframe in India are comparatively lower than for China and, combined with evidence from Europe where IBM seemingly acts monopolistically,[72] it points to a strategy in which IBM is using price discrimination to penetrate new markets while continuing to "lock-in" older markets. This evidence is, however, only suggestive and more data from these markets would be necessary to conclusively prove this hypothesis. Moreover, none of the mainframe or high-end IBM buyers in our sample actually felt 'over-charged' by IBM.

Finally, there is the more difficult question of proprietary technology. This is not a question just for the Indian market but one that concerns the entire server platform the world over. A few years ago, IBM made the decision to discontinue all licensing of mainframe software for use on non-IBM systems (Annex XV). When we asked IBM the reason, we were told that the Z/OS can only run on IBM mainframes and they were not aware that the OS used to be licensed a few years ago! Users mostly refused to comment on this aspect. The ones who did, saw nothing improper in it since it is IBM's IP.

The z/OS is a proprietary system unlike UNIX or Linux. Linux or UNIX applications can easily be moved to virtually any hardware vendor's platforms. Windows applications too can run on servers from any of the leading server manufacturers. On the other hand, a mainframe application can only run on an IBM mainframe with IBM system software. In the US where the mainframe market is big and growing, licensing the z/OS would confer benefits all around.[73] The benefits would be in the form of market expansion and perhaps lower prices, especially in markets where the installed base of mainframe applications is high. For a market such as India, this is not an immediate worry for competition authorities. But if we take a longer-term view, the concerns in the US may become concerns in India as well as the base of mainframe users grows.

At the beginning of this section we observed that 'social good' is best served when markets work efficiently. In case they do not, competition policy, with its widely accepted principle of consumers' welfare being the only meaningful gauge should support a judgment in favor of opening up the mainframe market. The question, however, is how this can be achieved and, more importantly, whether we are overplaying the dangers of monopolization of the mainframe market by IBM. Rather than taking a static approach that looks at this issue only with reference to what obtains in this market in India at present, we take a slightly longer-term perspective to identify any potential competition concerns in this growing market and suggest remedies for improving overall welfare. The proposed remedies are cast within the framework of competition law in India.

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71.   Idea and Vodafone are expected to sign similar contracts with IBM.

72.   Jeff Gould op.cit Benefits of Mainframe Competition for the European Economy' January 15, 2009.

73.   Analysts estimate that a quarter of IBM's US$100 billion in revenue comes from the mainframe.

VIII. Abuse of Dominance in the Presence of Network Effects and High Switching Costs

Old habits die hard. There can be little doubt that IBM has in the past engaged in a concerted series of actions designed to erect barriers to mobility and entry against competing providers in the global market and, hence, protect its market power from a variety of threats.[74] In the US and the EU this resulted in frequent antitrust actions against IBM.[75] IBM's strategy simply revolved around protecting its mainframe monopoly. How they did this is described ahead. While the law in the US (and India) allows creation of a monopoly, it proscribes certain practices that have no commercial justification in an effort to further entrench the monopoly. For example, in the celebrated antitrust case against Microsoft in the US, the appeals court held that Microsoft went beyond the boundary of normal commercial practice. Specifically, the fact that Microsoft withheld or threatened to withhold its operating system, Windows, or what are called "applications program interfaces" (APIs) from other competitors was considered to be a manifestation of exclusionary conduct.[76] This meant that if any customer—whether an Internet service provider or a computer manufacturer—dealt with Netscape, a principal competitor, Microsoft withheld Windows, charged a higher price, or penalized that customer in some other way.

These sorts of activities are precisely those prohibited for a firm with market power. Under competition law, firms with market power need to be cautious about exercising it. A firm could conceivably charge a price that the market would bear without actually violating the law. But any actions that entrench the monopoly are liable to be punished. Technologically, dynamic markets like the one we are investigating are characterized by network effects, which means that one product or standard may tend towards dominance since the utility a user derives from consumption increases with the number of other users consuming the good or service. Once a product receives wide acceptance, it becomes more or less entrenched. Competition, in such cases, therefore becomes **"for the field"** rather than **"in the field"**. Microsoft Windows won the battle for desktop OS and became the dominant standard.

One of the arguments against breaking up Microsoft – it was one of the proposed remedies – was that for certain applications, consumers like the fact that there is a single standard. Breaking up Microsoft would have fractured the standard. In the desktop market, Microsoft owns the operating system standard and predictably dominates the market. Linux remains a distant third and Mac OS at second with 5% market share[77]. The larger question in this case was the barrier to entry issue. In the judgment against Microsoft, a reference was made to the *applications* barrier to entry[78]. Since applications writers have to write their programs to mesh with operating systems, and since Microsoft dominates the desktop operating systems market, applications writers, the verdict stated, "have an overwhelming incentive to write for Microsoft's Windows as opposed, for example, to Apple's Macintosh".[79] That in itself is not illegal. But along with *additional* activities such as exclusionary conduct, Microsoft was successfully able to further entrench the applications barrier to entry and in fact raise it. Linux, the alternative platform, has been unable to make much headway in the desktop operating systems market. Microsoft overwhelmingly dominates and has been able to successfully frustrate competition. There is a broad-reaching presumption that Microsoft's hold on the market stifled innovation over the long run[80].

Some economists, however, contend that in the long run, market forces would win out and therefore there is no need for an antitrust law to police such practices. Due to rapid innovation, entrenchment of a particular standard may be temporary. It is claimed that innovation has the capacity to alter the field altogether.[81] Long ago, Joseph Schumpeter argued that the pursuit of monopoly power would drive innovation and become the central driving thrust of the 'new economy'. In this model of the "new economy", inefficient monopolies may not survive for long, in contrast to monopolies in the old economy. Because technology such as software requires huge fixed investment up-front, but involves trivial marginal costs, it is highly likely that competition will result in "fragile monopolies" being created, with single companies dominating segments for a time, until they are toppled by rivals.[81]

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74. A barrier to entry is the cost borne by an entrant and not by an incumbent that tends to discourage competition.

75. See Annex XIV.

76. APIs are important in the operating systems market because they are the hooks that allow applications programs to mesh with operating systems software.

77. Market share for Windows is 95%, while for Linux it is 1%.

78. http://www.justice.gov/atr/cases/f3800/msjudgex.htm

79. http://www.nabe.com/publib/be/002245.pdf

80. Robert Litan, Legal and Economic Aspects of the Microsoft Case, Business Economics, April 2000 http://www.nabe.com/publib/be/000245.pdf

81. Bagley, Constance (2001). "Note on Application of Antitrust laws to the New Economy: An Analysis of United States v. Microsoft Corporation", *Harvard Business Review*, September 2001.

On the other hand, it has also been observed that the notion that antitrust enforcement is not needed in the new economy rests on the erroneous assumption that technological change is exogenous, that is, independent of an industry's structure[83]. Yet the Microsoft case suggests that a sufficiently powerful incumbent could act as a barrier to innovation. Although it may be desirable to wait and see if a monopoly proves only temporary before acting, it is not right to dispense with antitrust enforcement in the new economy. In fact antitrust laws have a built-in premise that the wait can be too long if companies have market power combined with a willingness to exercise it. Antitrust action can thus reduce the exercise of market power and potentially improve the welfare impact.

The recent antitrust finding against Intel, a maker of computer chips, is a case in point. Following an investigation into its alleged anti-competitive practices, the European Union (EU) in May 2009 fined Intel €1.06 billion ($1.44 billion) for illegally using its muscle to price AMD, a rival chipmaker, out of the market.[84] Intel used rebates that kicked in if customers gave the firm between 80% and 100% of their business that were often conditional on the exclusion of its rival, AMD[85].

The Microsoft and Intel cases are crucial in establishing that antitrust has a role to play in the 'new economy'. The conduct of Microsoft in seeking to stifle innovation and of Intel in pricing AMD out of the market are particularly blatant examples of AoD. In many instances involving new technologies, it may be difficult to uncover transgression, since a degree of temporary monopoly may be part of innovation. Another difficulty is to predict how the sector will develop in the event of antitrust action against a dominant firm. Striking the right balance, therefore, will be a key challenge for the CCI (Competition Commission of India) if it seeks to investigate the mainframe market in India for current or potential abuses of competition.

Against this background we evaluate IBM's mainframe 'monopoly', the evolving market in India and suggest ways for tackling this thorny issue based on secondary and primary information. As stated above, 'network effects' make it difficult for rivals to enter an industry already dominated by an incumbent with an established network of users. Network effects allowed Microsoft to create the 'applications barrier to entry', which was a big element in

the case against it. On the other hand, in the mainframe market IBM allows sale of its mainframe software (the z/OS) only with its mainframe hardware – a concept known as tying[86]. In addition, due to the proprietary nature of the z/OS, the possibility of customers moving off the mainframe to other platforms is not easy. The proprietary nature of the OS and the corresponding lack of interoperability with other vendor systems makes the 'switching costs' very high. The attendant 'lock-in' of the customer can be exploited in any number of ways, including by high price and expensive service contracts. Indeed, IBM has been prosecuted for anticompetitive tying and exclusionary conduct in both the US and the EU.[87] In these markets, mainframe products cost substantially more than comparable products from non-mainframe server providers. For example, one gigabyte of memory for an IBM mainframe costs US$6,000, while the same amount of memory for a Linux, UNIX or Windows server costs less than US$200.[88] Lack of options also inflates service and maintenance costs in these markets, since IBM requires all mainframe customers to have IBM maintenance agreements for their mainframe software, which ties the customer to expensive service from IBM.[89]

It is useful to compare the sources of market power for Microsoft and IBM. While network effects were paramount in the case of Microsoft, IBM's source of market power is largely linked to its proprietary operating system standard, which is not compatible with the products of other system vendors. A client on the mainframe platform would therefore face higher 'switching' costs compared to being on a platform that is compatible with others. Microsoft's almost total dominance in market for desktop operating systems resulted in more and more applications being written for the ubiquitous Windows, thus creating the 'application barriers to entry'. On the other hand, IBM's closed and incompatible system creates an 'application barrier to exit' for the client, i.e., an application running on the mainframe is difficult to port to another system or standard. Table 20 compares the key elements that have made these two pieces of intellectual property, Microsoft's Windows and IBM's z OS, dominant in their respective market segments.

IBM is not new to antitrust. As IBM became more and more dominant in the computing industry in the second half of the twentieth century, its actions came under the scrutiny of the Department of Justice (DoJ). The question was

82.   "The new enforcers", October 5, 2000. The Economist print edition

83.   Endogenous Technological Change, by Paul M. Romer, Journal of Political Economy, Vol. 98, No. 5, "Part 2: The Problem of Development: A Conference on the Institute for the Study of Free Enterprise Systems." (Oct. 1990), pp. 71-102.

84.   The Unkindest Cuts, August 20, 2009, The Economist print edition

85.   Intel in an out-of-court settlement will pay AMD $1.25 billion in cash, allow its rival to outsource the production of its chips (which are based on Intel patents) and abide by a set of "business-practices provisions". In return, AMD will drop all litigation against Intel and withdraw all of its regulatory complaints worldwide. http://www.economist.com/businessfinance/displaystory.cfm?story_id=14885938&fsrc=rss

86.   IBM was forced by the Department of Justice to license mainframe operating system software to other hardware vendors. IBM stopped all such licensing in 2007. See fn 71 also.

87.   See for instance "Understanding IBM's Mainframe Monopoly". Available at http://openmainframe.org/research-resources/understanding-ibms-mainframe-monopoly.html

88.   Ibid

89.   During our survey we were informed that dwindling mainframe skill sets in the US and EU are also responsible for the high costs.

whether IBM was using anti-competitive and illegal tactics to monopolize the business computing market. The legal proceedings that followed led to a consent decree with the United States DoJ which imposed conduct remedies on IBM in the mainframe market; the charge against IBM was one of tying i.e., allowing the sale of its mainframe software only with its mainframe hardware – a practice also followed by Microsoft when it 'bundled' its browser with the operating system.[90] Meanwhile, IBM was also investigated by the Directorate General for Competition at the European Commission, which led to an Undertaking by IBM in 1984. Both actions, the *consent decree* in the US and the Undertaking in Europe, were aimed at reducing the extent of tying in the selling of mainframe computers and creating a more open ecosystem around the proprietary standard. Thus IBM agreed to i) supply

non-IBM systems[91]. As a result, IBM plug compatibles have disappeared from the market giving IBM a virtual monopoly in the mainframe segment and, therefore, the ability to charge more for its mainframe hardware. IBM was initially induced to license its mainframe operating systems for use on other vendors' machines by pressure from the U.S. Department of Justice. A large and competitive market for IBM-compatible mainframes from vendors other than IBM existed for 25 years (from approximately 1975 to 2000). Through its actions, IBM has prevented alternative mainframe solutions from being viable and, as a result, it now controls 100% of the mainframe market. With no competition in the mainframe platform market, prices have remained high and customers have fewer choices than if there were more vendors creating and selling alternative solutions. It is

Table 19 : Sources of Market Power for Microsoft and IBM

	Microsoft	IBM
Operating System	Windows	z/OS
Hardware	PC desktop system	Mainframes
Market Share	90%	100%[*]
Network Effects	Very strong	Weak
Switching Cost	High	Enormous
Nature of Barrier	Application barrier to entry, where application writers would choose to write for windows because of 90% market share	Once on mainframe cannot port easily, huge barrier to exit for clients
Remedy	Unbundling Operating System from browser, ban on exclusive dealing	Provide Interface Information (API), ban on exclusive dealing and license z/OS to other hardware & software vendors

Source : Authors' compilation

[*] If we consider the entire server market, IBM mainframes constitute roughly 5% of the total server market (by revenue). Since we have argued earlier that IBM z/OS mainframes in fact belong to a unique market, the relevant share becomes 100%.

interface information for its mainframe computers in a reasonable and non-discriminatory manner (RAND), ii) offer an unbundled version of its mainframe computer processing units without main memory and iii) allow the sale of its system software for use on other manufacturers' mainframe computers[91].

The mainframe has now again become increasingly proprietary. Two years ago, IBM made the decision to discontinue all licensing of mainframe software for use on

crucial to distinguish unambiguously these two cases, as indeed you begin to do in the second paragraph following the table.

Notwithstanding the monopolization of the mainframe market by IBM, our interaction with experts in the field leads us to the inescapable conclusion that mainframes are servers in a class of their own. The applications use unique languages, systems and interfaces that simply do not exist together on other platforms. The mainframe

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90. Bundling and tying are related. Microsoft used its muscle in the OS market to effectively destroy Netscape in the browser market by bundling its own browser Internet Explorer with Windows, a practice frowned upon by most competition authorities.

91. See for instance "Understanding IBM's Mainframe Monopoly" op cit.

92. This refers to IBM's refusal to continue licensing its older 31-bit mainframe operating systems for use on the FLEX mainframe emulator, formerly resold by T3. After the migration from 31-bit to 64-bit mainframe hardware and software in 2001, which coincided with the end of the DoJ Consent Decree, IBM never subsequently agreed to license its 64-bit operating systems for use on non-IBM hardware. It continued licensing its older 31-bit software until 2007.

offers unparalleled reliability, availability serviceability, performance and security.[93] Mainframe professionals who write applications or administer mainframe systems have unique skills that take years to develop and are different from skills required for any other platform. In Europe and the United States, these skills are becoming increasingly scarce and expensive[94]. For legacy applications that run only on the mainframe and where the switching costs are high, IBM charges high prices to perhaps 'cross-subsidize' markets that are more competitive. In fact IBM has developed an elaborate price discrimination scheme that sets different prices for the very same mainframe hardware depending on whether the intended application is locked-in legacy (unable to migrate) or a so-called "new workload" (that could run anywhere).[95] For new workloads, IBM sells its mainframe hardware at discounts exceeding 90% of the price it sets for legacy workloads.

An implication of this pricing scheme is that while high-end servers from HP and Sun Microsystems can provide competition to 'new' mainframe workloads, for legacy applications mainframe customers have little choice. According to data available from IDC, there are somewhere between 8,000 and 10,000 total IBM mainframe customers in the world, mostly in the US and Europe. IBM's reports show that about 2,000 new mainframes were sold in 2008 but the vast majority were bought by customers who were already using mainframes. Interestingly, there were only 54 new customers, implying that the majority of the new mainframes were sold to existing users of mainframes, representing 97.5% of the sales. Therefore, it is plausible that by far the greatest portion of IBM's approximately $5 billion in 2008 mainframe hardware sales (and virtually all of its $9 billion in mainframe software sales) came from existing customers. The vast majority of these purchases represented upgrades to or replacements of existing mainframes, corroborating IBM's monopolization of the legacy mainframe market[96]. In the US and Europe, legacy applications on the mainframe outnumber new acquisitions by a huge margin, raising concerns about IBM's dominance in this segment. If we define this segment as the relevant market under competition law, then IBM is *a priori* dominant and therefore needs to be tried and a remedy imposed under the law. How this will be done is a moot point and we do not get into the nature of the remedy here. What is interesting however is whether defining the relevant market as "legacy

mainframe market" will pass legal muster. It *is* possible however to find a parallel circumstance in the telecom market. Mobile call termination is often defined as the relevant market by many telecom regulators around the world and regulated since termination is considered a monopoly[97]. The similarity between the mainframe and the telecom market is in the nature of *ex ante* and *ex post* competition. While the mobile market is largely competitive *ex ante*, call termination is regarded as a monopoly because of the lack of alternatives in terminating a call on a unique mobile number. This is quite similar to the situation observed in the mainframe market described above.

One estimate of the excess cost borne by Europe as a result of the mainframe monopoly of IBM is of the order of **$48 billion over a 20-year period.**[98] The main reason for such a high estimate is the large installed base of IBM legacy applications in Europe. Indeed, this will be true of any market that has a sizeable installed base of mainframe legacy applications. On the other hand, in a market such as India, where the installed base of mainframe legacy applications is small, the lock-in and corresponding dead-weight losses will be lower. It is useful to recall the reasons for the high costs associated with mainframe legacy applications. A large number of applications running on the proprietary z/OS cannot migrate to other operating systems because of technical complexities.[99] Combined with IBM's restrictive policy on z/OS licensing, this means that clients are effectively tied to IBM's z system hardware to run z/OS software and applications. Lack of interoperability (a proprietary standard) and a restrictive licensing policy together generate a closed system, severance from which involves prohibitive costs. If this is common knowledge among clients, they will be cognizant of the risks of going down this inflexible path and, therefore, take decisions that allow for low-cost course corrections in the future. This would, for example, involve choosing an open standard such as Linux or Unix to begin with. Interestingly, IBM itself is offering an Integrated Facility for Linux (IFL) on its mainframe hardware, which outsold the z/OS in India in 2008. In fact, overall, IBM has shipped more open standard mainframe systems in India than with the proprietary z/OS, resulting in a low cumulative market share for the z/OS. Although z/OS's cumulative market share in India is small, industry experts are convinced that its advanced features and exceptional performance are unquestionable. As the Indian market grows and server deployments increase

93. P.J. Koul, Deputy General Manger of IT Department of Air India and Massimo Pessanini, analyst from Gartner

94. Ibid.

95. Jeff Gould.

96. For so-called "legacy" mainframe applications – mostly very large custom COBOL programs that mainframe customers have developed over years or decades – the lock-in effect is very strong. For so-called "new workloads" which can run on mainframe Linux or reduced cost mainframe "specialty engines" – and these would typically be applications that use Java (e.g., on IBM's WebSphere application server), IBM's relational database DB2, or certain packaged software such as SAP – the mainframe lock-in factor is weaker.

97. Although mobile phone access is a competitive industry in many countries, mobile termination is regulated as a monopoly. See ITU publication on this.

98. Jeff Gould (2009), "Benefits of Mainframe Competition for the European Economy," January 15 2009 v6.8 10, op cit

99. Ibid

across the range of government, public and private enterprises, both clients and the regulator in India need to be aware of the potential risks of lock-in to a proprietary standard. This study provides some insights into how real these costs could be and how these can be mitigated. Certain exogenous developments in the server space such as cloud computing and government procurement in India could change the nature of competition within the server industry. In the next and concluding section of this report, we discuss these aspects and the corresponding implications for the conduct of future competition policy, keeping in sharp focus IBM's conduct in Europe and the US in the mainframe segment.

IX. Conclusion: Future Market Development, Competition Policy and role of CCI

It is indeed fortuitous in some sense that India, despite its recognized prowess in producing skilled information technology professionals, was a relatively late starter in stitching together IT systems for its companies. The enterprise IT market as a result is still young, albeit growing very rapidly. Forecasts from Gartner, IDC and NASSCOM

However, diffusion of IT in India currently remains at low levels[100]. IT-intensive sectors like telecommunications, banking, insurance, and retail were belatedly liberalized and Foreign Direct Investment (FDI) restrictions were eased at different points in time across sectors due to varying degrees of political economy pressures (Table 20).

Forecast: IT expenditure by verticals
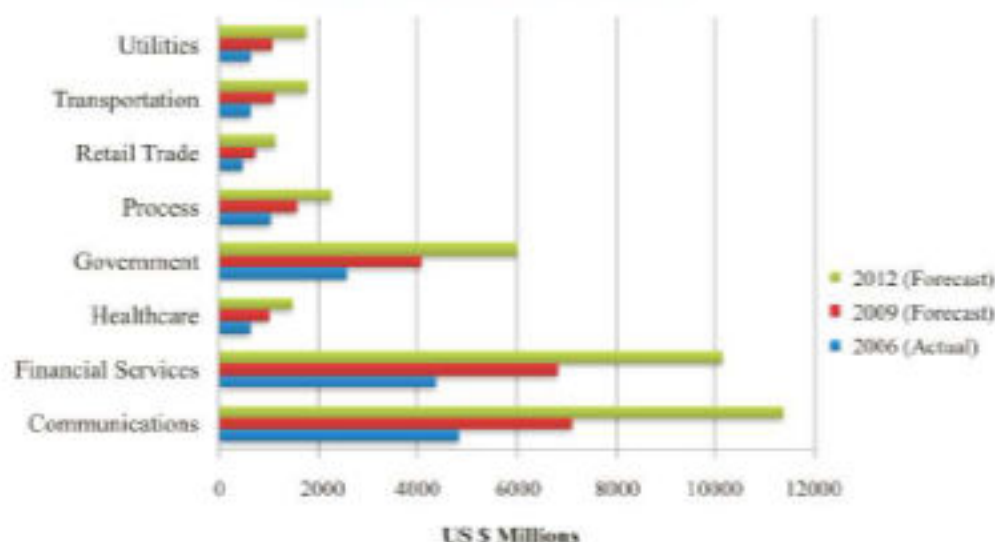
US $ Millions
IT expenditure includes expenditure on
Hardware, Software, Telecommunications, Internal services and IT services

cited in the Ureport are optimistic about the future deployment of IT infrastructure in public and private enterprises and in government. At a macro level, the CAGR until 2012 is predicted to be of the order of 14% and the corresponding dollar value of the market is estimated to be about US$50 billion. Chart 7 below shows the growth of IT expenditure by verticals until 2012 (also see Annex XVI).

Academic research has shown that IT investment has a positive and significant impact on both partial and total factor productivity in the adopting sector[101]. Although India lost out on the productivity benefits of IT diffusion, an unintended by-product of being a late starter has been the ability to leapfrog legacy mainframe applications.

Table 20 : Sector-Specific Policy for FDI in India

Sectors	FDI Equity Cap	Year of Liberalization
Banks -Private Sector	74%	1990
Insurance Companies	26%	1999
Process Manufacturing	100%	
Retail Trade *	51 %	2006
Services (Telecommunications)	74%	1998
Transportation	49%	1991

Source : Ministry of Commerce.

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100. Analytically, the contribution of IT to the economy can be thought of as possessing two interrelated features - IT growth itself and growth as a result of IT diffusion. The former refers to the contribution in output, employment and export earnings arising from the production of IT-related goods and services and the latter refers to IT induced development through enhanced productivity, competitiveness, growth and human welfare on account of its diffusion into different sectors of the economy and sections of society. See also Ashok Jhunjhunwala.

101. Information Technology and Productivity: Evidence from India's Manufacturing Sector by K. J. Joseph and Vinoj Abraham, September 2007.

The server industry's landscape has changed significantly in the past few years. IBM may not have had a lot of direct competition in the enterprise IT market in the past but the story is different now. Last year Hewlett-Packard (HP), the world's biggest computer-maker, bought Electronic Data Systems (EDS), a big provider of computer services, giving HP more manpower to help its customers build more advanced data centers and effectively compete with IBM in the entire value chain. Likewise, Oracle's acquisition of Sun Microsystems will also create an integrated IT provider, thereby matching IBM in the breadth of offerings.

The IT industry has also benefitted from 'Moore's Law'. Rapid innovation has seen the power of the microprocessor clock a nine-fold increase in performance over the past decade.[102] The shrinking size of transistors has meant that 1.8 billion of these can now be tightly packed into a microprocessor, while quad core has become familiar jargon in the computing industry[103]. (See Annex XVII for Intel's technology development timeline for the microprocessor.) The increasing power of the chip, widespread use of technology, and standardization paved the way for 'commoditization', a term commonly applied to the PC industry. Servers also quickly commoditized, albeit in the entry-level segment. On the other hand, the mid and high-end servers proved a little more resistant to commoditization, partly because these powerful data-serving computers often run "mission-critical" applications using proprietary operating systems.

In the early days of computing, companies either had to buy a mainframe for their high-end IT requirements, which cost millions of dollars, or share one with someone else. When Indian companies began buying servers in the late 1990s and the early part of this century, they were confronted with a wider choice of vendors and technology across all segments of the server market. At the entry level, competition became intense, while the enterprise-level segment also witnessed increased competition due to the emergence of HP and Sun in the category once dominated by IBM. EPIC architecture-based Itanium processors are now deployed as an alternate computing platform for both IBM P-Series RISC servers and the IBM Z series mainframes[104]. In addition, the Internet boom created

additional demand for high-end computers, providing space to accommodate multiple vendors and technologies. The emergence and popularity of the Linux platform for servers resulted in IBM slashing the prices for its System z mainframe engines that are set up to exclusively run Linux, the so-called Integrated Facility for Linux (IFL) specialty engines. These are sold at lower prices than standard mainframe engines, just like other specialty engines designed to accelerate WebSphere middleware (zAAPs) and DB2 database routines (zIIPs)[105].

As a result of these developments, the number of Z mainframe users in India is only 25. A break-up of these by operating system is not available, although in the past 5-6 years the number of mainframes with Linux is increasing, because this provides cheaper computing. A number of legacy applications (COBOL, PL/I, Assembler etc) are on z/OS and these result in additional sales, but a number of customers look for hosting current generation applications on a combination of z/OS and Websphere.[106] According to IBM, Websphere is one of the best selling application platforms, which is also available on z/OS. Because of this, in addition to legacy applications even newer applications are being run on the z/OS. We were informally told that about 60 percent sales of the mainframe in India are due to legacy, while the rest are new applications. Within new sales, Linux is more popular than the z/OS. What this implies is that the dangers of lock-in to the proprietary standard z/OS on the mainframe are likely to be low for India, albeit they do exist. Contrast this with system Z sales worldwide where the vast majority of sales are upgrades.

During our survey, we found that two large Indian private sector banks were faced with a similar decision in the early 2000s for their credit card application. One of the banks chose to run the application on the Z mainframe with z/OS, while the other chose a Unix environment on the HP Itanium server. In addition, India's largest public sector bank, the State Bank of India, chose the HP superdome hardware and HPUX as the OS over alternative solutions including IBM's mainframe. One critical reason cited against the mainframe was its high price, although none of the respondents including those who had opted for it were willing to share price information with us. IBM too did

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102. Interview with Intel India.

103. The power of the chip increases as the number of cores per chip increases. Eight cores in a chip are in the development stage.

104. HP Integrity range of servers, which competes with IBM P-Series RISC servers, and HP Non-Stop Server line-up, which competes with IBM Z-series mainframes. Accessed from http://www.03.ibm.com/systems/z/?cm_re=masthead_products_sys_zseries and http://h20223.www2.hp.com/NonStopComputing/cache/307853-0-0-0-121.html

105. Timothy Prickett Morgan, "IBM halves mainframe Linux engine prices: Feeling the Nehalem Xeon pinch" Posted in Servers, 17th August 2009. The various IBM "specialty engines" (IFL, zAAP, zIIP) are all exactly the same physical microprocessor as the standard z10 processor (which IBM calls a "general purpose processor"). The only difference between the specialty engines and the GPP is that the functionality of the specialty engines has been limited by small changes in the microcode, which prevent the execution of legacy workloads on these engines. In this example of price discrimination, IBM is able to sell exactly the same product to the same customers at prices varying in a ratio of 1 to 10, based purely on the extent to which the applications running on these processor face or do not face high exit barriers. (Also see Gartner "Specialty engines are key factors in IBM mainframe viability").

106. An exact break-up of z/OS and Linux on mainframes in India is not available (interview with IBM). Note that even when running on z/OS, WebSphere, which is Java application server software, is entitled to use the less expensive zAAP specialty engines. In effect, WebSphere is a piece of middleware that executes applications written in Java. WebSphere competes with Oracle's WebLogic and Red Hat's JBoss (which are also Java application servers). More broadly, Java application servers compete with Microsoft's .Net application server (which is similar in conception but uses a slightly different language, C#).

not disclose prices. Our survey, however, does reveal that the mainframe is an expensive system compared to the others, albeit also one with a perception of higher quality.[107]

The small set of Indian IBM mainframe customers running z/OS implies that the current 'losses' from lock-in are likely to be low. In addition if one is forewarned about the dangers of lock-in, it would weigh heavily against IBM's z/OS. One of our respondents was of the view that users would be well advised to create a *mainframe users club* to exchange relevant information among them to create countervailing pressure on IBM[108]. If the installed base becomes larger and the z/OS remains a proprietary standard, the deadweight losses could be higher like in the case of Europe cited earlier. We discuss this later in this section along with other developments likely to occur in India.

as an expensive brand, is reviving efforts to gain entry into the young Indian market even by 'under pricing' its products compared to other markets. This conjecture gains some credence if one considers the strategic contracts that IBM has inked with telecom companies such as Airtel, Idea and Vodafone. In all three cases, IT infrastructure is wholly outsourced to IBM (see Airtel case study in Annex XIII), although interestingly the platform used by IBM is the P-series AIX instead of the Z mainframe and z/OS which, as we have shown, results in greater lock-in.

Our study clearly demonstrates that the high-end server market in India is highly concentrated and dominated by Unix machines from IBM, HP and Sun. A related finding is that the lower end of the market is dominated by x86 machines, and is significantly less concentrated than the high-end or mid-range segments. Increasing

Table 21 : Average Prices of Mainframes and Superdome in India and China

Country	Year	Brand	OS	Average price (US$)
India	2007	HP 9000 Superdome	HP-UX	1,963,721
India	2007	Superdome	HP-UX	868,467
India	2007	System z9 BC	zOS/OS390	1,040,691
China				2,047,661
India	2007	System z9 EC	zOS/OS390	1,382,140
China				2,816,574
India	2008	HP 9000 Superdome	HP-UX	1,498,466
India	2008	Superdome	HP-UX	732,976
India	2008	System z9 BC	zOS/OS390	484,747
China				885,330
India	2008	System z9 EC	zOS/OS390	1,194,313
China				1,557,941
India	2009	HP 9000 Superdome	HP-UX	1,044,253
India	2009	Superdome	HP-UX	449,918
India	2009	Superdome	Linux	288,766
India	2009	System z9 EC	z/OS- OS390	450,128
China				4,985,029

Source : Gartner data

Mainframe usage in India is lower than in China, but it is growing. Our primary survey did not provide any insights explaining why mainframes are more popular in China. We, therefore, compared the average price of mainframes shipped with the z/OS in India and China from secondary data. The results are astonishing. The average price of the mainframe with z/OS is one and a half to ten times more expensive in China. On the other hand, the price of the mainframe is comparable to the price of an HP Superdome 9000 series in India (see Table 21). Based on this sparse information one can conjecture that IBM, widely regarded

commoditization of the entry-level segment means that vendors in this space compete mainly on cost. On the other hand, the enterprise-level segment has proven to be more resistant to commoditization. A technological development called 'cloud computing', however, could do to the enterprise segment market what commoditization has done to the entry level, i.e., create pressure for cost reductions as enterprises shift to services 'in the cloud'. The idea is that computing will increasingly be delivered as a service, over the Internet, from vast warehouses of shared machines. Documents, e-mails and other data will be

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107. For example, we were told that if you were looking for an artificial heart, would you go for the one with the lowest price?

108. A consultant once famously remarked that IBM works best in an environment where the clients know little. See Section V above.

stored online, or "in the cloud", making them accessible from any PC or mobile device.[109] Many things work this way already, from e mail and photo albums to calendars and shared documents.

While cloud computing is an attractive concept, the technology is still new and will take several years to mature and grow to be robust. One expert we interviewed put a lower bound of three years to this.[110] As with any new and untested technology, there are many risks. First is the well-known risk of technological lock-in as rival companies promote their own, mutually incompatible, standards and formats, as they have done in the past. If one cloud is not compatible with the others, the danger of lock-in is merely transferred from one technology to another. Second is the risk to privacy. Finally, and most importantly for enterprises running mission-critical applications, is the risk to the safety and security of their data.

Cloud computing, as it stands today, is therefore unlikely to displace the dominance of the big three in the enterprise-level segment for the next three or, realistically, for the next five years in India. IBM, HP, Sun and, to a certain extent Cisco, will dominate this segment. The former two are integrated IT companies and (along with Oracle-Sun in the future) will increasingly dominate the enterprise server market in India. Entry barriers in this segment are high and competition from cloud computing seems a long way off. Regulators need to be therefore cautioned about the existential dangers of such dominance extending to software and professional services. Our survey suggests that large enterprises prefer to buy hardware bundled with the operating system. Unless the application software is standardized and available off the shelf from another software provider, the integrated IT vendor has a comparative advantage in providing not only the software but also maintenance and support services to the client. Our study has shown that the presence of a skilled in-house IT team can go a long way in reducing the monopoly power of the vendor in certain cases. All the large public sector units and government departments we interviewed placed a high degree of reliance on their own IT departments. Government procurement in India uses a tender approach and has a life on average of about 5 years after which fresh bids are invited with no apparent benefit to the incumbent IT provider.

In-house IT support is, of course, of no use if the specific skills required for maintenance are lacking. For example, it is becoming increasingly rare to find IT staff with the necessary skills to administer mainframes. Most IT professionals globally and in India are more focused on learning volume platforms based on open systems where their skills are more portable from job to job. Since IBM is the only vendor of IBM-compatible mainframes, it has a virtual monopoly in support and maintenance. Other things being the same, it is therefore a good idea for IT solutions to be based on open systems in an organization since service support is more easily available. However, given that there are still many businesses and government departments that have to rely on mainframe systems, regulators can take certain actions to address abuse by the monopoly provider under competition law. This is discussed ahead.

It is noteworthy that the Government of India (GoI) has been advocating open source software, a movement that is still in its infancy. As discussed in the report the lock-in and the corresponding switch from an open standard is easier compared to a proprietary standard. It is widely believed that open source software (OSS) can be considered as an alternative to the proprietary software to reduce cost and increase transparency.

A recent study conducted by IIM Bangalore analyzed the economic impact of FOSS (free and open source) in India.[111] The study was based on 20 case studies of Indian organizations drawn from government departments, commercial firms and educational institutions. Without going into the merits of the methodology adopted by the study, the conclusion that FOSS will result in huge cost savings is a claim that needs to be treated with some skepticism, especially in the market segment we studied. Our respondents, bar none, were of the opinion that the TCO of OSS is no different from proprietary Unix-based software. In addition, the larger organizations in our sample were unwilling to risk running mission-critical applications on OSS.[112] Some firms were running OSS in parallel on a trial basis, but relied exclusively on the proprietary platform to run mission-critical applications. Some claimed that OSS fails when the number of transactions/instructions crosses a certain limit, hence casting doubts on its reliability and scalability.

It is important to distinguish between open source and open standard. In Open source software (OSS) anyone can look at the source code. OSS must not be confused with "free" software that is distributed free of cost. OSS is 'free' software in the sense of 'free' speech or 'free' ideas but not free of cost. The free nature of OSS allows users to customise software according to their needs without moving away from an open standard. Although there is no general consensus about the definition of open standard, in general an open standard is a format that is publicly available and has various rights to use associated with it. It can be implemented by number of players or users for their own specific purpose. Therefore, interoperability is an important issue in formulating a standard.[113] No single

109. Battle of the Clouds, The Economist, October 15, 2009. http://www.economist.com/opinion/displaystory.cfm?story_id=14644393

110. Massimano Passini, Analyst Gartner.

111. Rahul De, "Economic Impact of Free and Open Source software – A Study in India", IIM Bangalore.

112. There was a fair amount of skepticism relating to OSS among the respondents that manifested itself in statements like "we cannot run an organization on somebody else's passion" and "we are running a business not a research organization".

113. http://sutor.com/newsite/drupal/osvsos

individual or company controls the open standard. *While all open source is open standard, all open standard is not open source.*

Like other developing countries the Government of India encourages the use of open source, but as yet there is no clear mandate or policy that directs the use of OSS [114]. At the same time, a few states (Chhattisgarh, Kerala, National Capital Territory of Delhi, and Tamil Nadu) have a separate ICT policy that recommends the use of OSS, although it is not mandated in any of the states. A government diktat to use only OSS will be a big blow to the monopoly of proprietary systems like the z/OS, because government deals are important for vendors not only for their own sake but also to bolster subsequent bids. Since both central and state governments in India are likely to generate huge demand for servers both for public enterprises and more importantly for citizen services, a mandate to use only OSS could be a tool to address the monopoly of a proprietary OS [115]. How effective this will be will depend on various factors, including the quality of OSS. This issue has already come up for debate in India in the context of the Unique Identifier (UID) project that will create huge demand for server's hardware software and applications. The government has appointed Infosys founder and vice chairman, Nandan Nilekani, as the head of the Unique Identification Authority of India (UID-AI) with an initial budget Rs 120 crore. The first set of unique identity numbers will be issued in the next 12-18 months and the UID-AI plans to cover 600 million people within four years.

Biometrics (which includes fingerprint, face and iris recognition) and computing power hold the keys to the UID project which is estimated to offer a Rs 15,000-20,000 crore opportunity to computing, database, smartcard and storage vendors, besides systems integrators. For every rupee of IT spend on the UID project, industry experts estimate, around 60 percent of the spending will go to hardware vendors. While the UID project will generate massive demand for IT, it will still be a small percentage of the total demand for IT from the government over the next few years, underlining India's potential demand for computing. The technical specifications of the project are not available but openness and interoperability are likely to be the basic requirements, since closed standards would create serious patent and interoperability complications. Vital data of this nature should be stored in formats that are open and free of all constraints like royalties and patent claims. For example, storing large data sets and performing online verification on IBM mainframe z/OS will be eminently possible, but the risk

would be in ceding some control over the information to IBM as a result of the proprietary standard. [116]

It is unlikely that a company like IBM will change its business practices, given that it has successfully extracted huge profits from proprietary mainframe offerings for so long and, if public action is insufficient to reign in the monopoly, the only alternative course of action is under competition law [117]. The focus of analysis on IBM's conduct should naturally be from the perspective of whether or not there is or has been *abuse of dominance* (AoD). An enterprise is said to be in a *dominant position* [118] under the Competition Act when it is in a position of strength, which enables it to:

(a) Operate independently of competitive forces prevailing in the relevant market; or

(b) Affect its competitors or consumers or the relevant market in its favor.

The primary concern of the law, therefore, is with unilateral conduct abuses principles of competition. The Act recognizes that such unilateral conduct can be exercised by an enterprise acting on its own, or by two or more enterprises acting as a 'group'. Annex XVIII provides the framework within which any enterprise is investigated for AoD.

In this study we have shown that the high-end market is dominated by the big three. The Competition Act does not define any specific degree or percentage of market share that is relevant to be considered as important in the analysis to establish AoD. The approach of the EC, Canada and the US on the issue of market share could be instructive in this regard and is summarized below for reference:

- In the EC, a recent Discussion Paper on Article 82 (which deals with the subject of abuse of dominance), the analysis of the Commission is as follows: "It is very likely that very high market shares, which have been held for some time, indicate a dominant position. This would be the case where an undertaking holds 50% or more of the market, provided the rivals hold a smaller share of the market. In the case of lower market shares, dominance is more likely to be found in the market share range of 40-50%, than below 40%, although some undertakings with market shares below 40% could be considered to be in a dominant position. However, undertakings with market shares no more than 25% are not likely to enjoy a (single) dominant position on the market concerned." [119]

114. Central governments have advised the Indian Railways to use FOSS in their desktops and laptops. The National Policy on ICT in school education gave preferential treatment to FOSS. MICT came up with a draft policy on multiple open standards for the e-governance project.

115. While the government is willing to promote OSS and Open standard to lower entry barriers and hence increase competition, industry experts still prefer to rely on proprietary software to reduce risk and uncertainty. At the same time, they are not willing to give up the functionality of proprietary software just by considering the lower cost of OSS.

116. Financial institutions in the US on the z/OS have been locked into the legacy application for many years at high cost.

117. Neon sues IBM over 'anticompetitive' mainframe tactics, December 15 2009.
http://www.theregister.co.uk/2009/12/15/neon_zprime_ibm_lawsuit/

118. Explanation to Section 4(2), Competition Act.

119. DG Competition Discussion Paper on the Application of Article 82 of the Treaty to Exclusionary Abuses, European Commission, December 2005.

- In Canada, the Competition Bureau's approach has been that a market share of less than 35 percent will generally not give rise to concerns of market power or dominance. But a market share of 35 percent or more will generally prompt further examination.

- In the United States, courts have held that a market share below 50% precludes finding monopoly power[120], and the leading treatise suggests that a share of over 70-75% for at least five years is required[121].

Based on the above assessment, and relying on the EC's and Canada's approaches, an arguable case could be made that the market share of IBM in India is sufficient to warrant a closer scrutiny since it clearly has the largest market share. Further nuance in defining the relevant market by workload type (new versus legacy) gives IBM almost certain structural dominance in the market[122].

However, market share in itself is only one of the factors for assessment of dominance. It is important to note here that there are no strict demarcations as to when an inquiry into a 'dominant position' gets over and analysis of whether there is an 'abuse' begins. In fact, in several situations, competition authorities in other jurisdictions have found themselves in positions whereby a finding on a 'dominant position' is supported by evidence relating to its abuse. These concepts cannot therefore be looked strictly as distinct elements; rather they would constitute part of a holistic analysis. The holistic analysis will necessarily include size and resources of IBM and its competitors; economic power of IBM including commercial advantages over competitors (including technological lead; its IPRs, etc.); vertical integration of IBM and of course market structure and size of market.

India's Competition Act draws on principles from competition law in the U.S. and the EU. If, therefore, the CCI finds that there is a case of abuse of dominant position it may pass all or any of the following orders:

> Order for discontinuation of the abuse of dominant position[123].

> Order of penalty of not more than 10 percent of the average turnover for the last 3 financial years upon each person/ enterprise which is a party to the agreement or abuse[124].

> Direct the enterprises concerned to abide by _such other orders as the CCI may pass_ and comply with directions including payment of costs if any;[125]

> _Pass any such other order or issue directions it may deem fit;_[126]

The scope of the orders italicized in the last two points above indicates the vast nature of powers that the CCI potentially has in designing remedies to address the specific case at hand. In addition to this, the CCI is also empowered to direct division of an enterprise enjoying a dominant position to ensure that the enterprise does not abuse such a position.[127] Theoretically, therefore, it would be possible for the CCI to design remedies appropriate to each set of circumstances. **In this regard, potential remedies include orders relating to: (i) unbundling of software from the mainframe server; (ii) actions necessary to ensure interoperability; (iii) licensing of IBM's software on terms that are determined to be reasonable and non-discriminatory; and any other remedy that will ensure competition in the market.**

As we stated above in the report, old habits die hard. In the US and Europe, IBM is alleged to have successfully extracted huge profits from proprietary mainframe offerings for long and it is unlikely that this will change in the near future. Several instances of IBM's abuse of its monopoly position, such as charging high prices and stifling innovation, are well known (see Annex XIV). On the other hand in India, due to various reasons, there are no indications of IBM having conducted business as it has in the West. That is no assurance, however, that it is precluded for all time to come. Therefore, steps should be taken to ensure that this market remains open to multiple suppliers and platforms. IBM has a considerable stake in the new technology known as "cloud computing". A format war is likely to be played out over the next few years in this domain and to nip any monopolization effort in the bud, a cloud manifesto has been released. The "manifesto" calls for computing firms not to fall back on bad old habits by trying to lock in customers. Since there will be many different computing clouds, the manifesto points out, customers should be able to move their data and applications easily from one to another. One of the main players behind the manifesto is IBM. It would indeed be ideal if the cloud manifesto's principle that data and applications should be allowed to move freely were applied everywhere in enterprise IT and, in particular, in the mainframe and high-end server markets. Clearly, that is not the case today, and there is a striking contrast between the principles stated in the manifesto and the principles that IBM practises in the mainframe market.

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120. See, e.g., _Blue Cross & Blue Shield United of Wisconsin v. Marshfield Clinic_, 65 F.3d 1406, 1411 (7th Cir. 1995) (Posner, J.) (Fifty percent is below any accepted benchmark for inferring monopoly power from market share.

121. See _Colorado Interstate Gas Co. v. Natural Gas Pipeline Co. of America_, 885 F.2d 683, 694 n.18 (10th Cir. 1989) (To establish monopoly power, lower courts generally require a minimum market share of between 70% and 80%.); _Exxon Corp. v. Berwick Bay Real Estate Partners_, 748 F.2d 937, 940 (5th Cir. 1984) monopolization is rarely found when the defendant's share of the relevant market is below 70%).

122. See Section V.

123. Section 27(a) of the Competition Act.

124. Section 27(b) of the Competition Act.

125. Section 27(c) of the Competition Act.

126. Section 27(g) of the Competition Act.

127. Section 28(1) of the Competition Act.

Because the Indian enterprise IT market is entering its high-growth phase, CCI has an excellent opportunity to avoid the pitfalls into which the more mature IT markets have fallen. **Unbundling hardware and software, i.e., to require that the sale of enterprise class server hardware shall not be tied to the sale of enterprise software (in particular, the crucial server operating systems) is the first policy recommendation.** Tying operating systems to a particular brand of hardware is the fundamental mechanism by which all the high-end enterprise system vendors – not just IBM – seek to lock in their customers and raise switching costs.

The report finds that since there are few z/OS mainframes in India, the consequences of IBM's tying the z/OS to its own mainframe hardware (to the exclusion of would-be competitors seeking to offer IBM mainframe emulation on Intel servers) have been somewhat limited so far. However, the report also points out that the high-end server market as a whole in India is highly concentrated. In fact, the leading Unix vendors such as IBM and HP do compel users of their Unix operating systems to purchase their brand of server hardware.

For reasons already documented in this report, a competitive IT sector will confer substantial direct and indirect benefits to the India economy. India would be better off if CCI is able to successfully uncouple the lock-in strategy of the large server vendors before they come to completely control the market. It would probably be healthier for Indian IT and for the Indian economy if enterprises developed their complex business applications on server operating systems that are not tied to a particular brand of hardware. Today this is obviously the case with Linux (open source), Windows Server and to some extent Sun's Solaris (which runs on Intel or AMD servers as well as on Sun's proprietary SPARC servers). It could theoretically be the case with HP-UX (HP version of Unix), since HP's SuperDome servers are based on Itanium processors. It could even be the case for z/OS, because mature mainframe emulation software products have existed for a number of years, which allow z/OS to run on Intel server hardware. Such products include FLEX and TurboHercules. IBM itself has also recently introduced such a mainframe emulator, but limits its use to software developers and refuses to sell it to production customers. **Customer choice can be enhanced if server operating system vendors (all of them, not just IBM) are required to license their software on RAND terms (Reasonable and Non-Discriminatory) These terms, however, would in no way restrict the right of vendors to earn fair revenue and profits from the sale of their proprietary software. This is our second policy recommendation.** This is nothing new. In fact this would merely be a return to the decades-long practice of U.S. and European regulators with respect to IBM, as pointed out earlier in the report.

Interoperability is a more complex issue but it is partially addressed in the two policy recommendations above. Requiring IBM to reveal its source code *a la* Microsoft is not a pragmatic solution, so we refrain from making it. If customers are allowed to purchase the server hardware of their choice for use with the server operating system of their choice (unbundled hardware and software), there may be nothing wrong with the fact that z/OS is not compatible with more modern operating systems. Customers should be allowed to choose z/OS (or HP-UX, or Windows Server, or Linux, etc.) if they wish, on the basis of their own criteria of performance and functionality. But vendors should not be in a position to force customers to purchase only their brand of server hardware once the choice of server operating system has been made. To the extent that there is no inherent technical barrier to running z/OS on non-IBM hardware (e.g., on Intel or AMD servers using emulators such as TurboHercules), customers should be allowed to make this choice.

India has an opportunity to leapfrog the more mature IT-using economies by adopting a forward-looking regulatory stances that prevents IT system vendor lock-in from establishing itself as the norm in the Indian economy. Although we cannot quantify the economic benefits to India of such "pre-emptive" action, these are likely to be large indeed in the long term, and rather significant even in the short term.

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Annex I

Definitions

In the study we analyzed the server hardware market, its corresponding Operating System (OS), Middleware and Application software. For the study and to define the relevant market, we used the following definitions.

A **server** is a computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries. Servers are often dedicated, meaning that they perform no other tasks besides their server tasks.

Server hardware is the physical component of the system on which a set of instructions, namely, software is installed. Depending on the shape, size and architecture, servers are classified into several groups. Over time, technology advances have made the existing hardware obsolete. The current focus now is to reduce downtime and increase the productivity of the system.

An **operating system** is the software component of a computer system that is responsible for managing the various activities of the computer and the sharing of computer resources. It hosts the several applications that run on a computer and handles the operations of computer hardware. Users and application programs access the services offered by the operating systems by means of system calls and application programming interfaces. Users interact with operating systems through Command Line Interfaces (CLIs) or Graphical User Interfaces (GUIs). In short, an operating system enables user interaction with computer systems by acting as an interface between users or application programs and the computer hardware.

Middleware is computer software that connects software components or applications. The software consists of a set of services that allows multiple processes running on one or more machines to interact. This technology evolved to provide interoperability in support of the move to coherent distributed architectures, which are used most often to support and simplify complex, distributed applications. It includes web servers, application servers, and similar tools that support application development and delivery. Middleware sits "in the middle" –between application software that may be working on different operating systems. It is similar to the middle layer of three-tier single system architecture, except that it is stretched across multiple systems or applications. Examples include EAI software, telecommunications software, transaction monitors, and messaging-and-queuing software.

Application software is a computer program that functions and is operated by means of a computer in order to support or improve the user's work. It employs the capabilities of a computer directly and thoroughly to a task that the user wishes to perform. This is different from system software (infrastructure) and middleware (computer services/ processes integrators), which are integrate a computer's various capabilities, but do not directly apply them in performing tasks that benefit the user. The term *application* refers to both the application software and its implementation. Typical examples of software applications are word processors, spreadsheets, media players and database applications.

Annex II

Players in the Indian Server Market

Vendor	Hardware	O/S	Middleware	Application Software	Maintenance
IBM	Yes	Yes	Yes	Yes	Yes
Hewlett-Packard	Yes	Yes	Yes	No	Yes
Sun Microsystems	Yes	Yes	Yes	Yes	Yes
Dell	Yes	No	No	No	Yes
Acer	Yes	No	No	No	Yes
HCL	Yes	No	Yes	No	Yes
Wipro	Yes	No	No	Yes	Yes
Fujitsu	Yes	No	Yes	Yes	Yes
Apple Computer	Yes	Yes	No	Yes	Yes
Lenovo	Yes	No	No	No	Yes
SGI	Yes	Yes	No	No	Yes
Stratus Computer	Yes	Yes	Yes	Yes	Yes
Unisys	Yes	Yes	Yes	Yes	Yes
Verari Systems	Yes	Yes	Yes	No	Yes
Zenith Computer	Yes	No	No	No	Yes
TCS	No	No	No	Yes	Yes
Satyam Info tech	No	No	No	Yes	Yes
Groupe Bull	Yes	No	No	No	Yes

Annex III

Server Functions

- **Web applications** — These applications typically run in the second tier of a three-tier server architecture. They manipulate information through a client interface accessed via the Web as opposed to merely providing static Web pages to clients on a network. An example is a shopping cart application accessed through a retail web site.

- **Infrastructure (excluding database management systems [DBMSs])** — Infrastructure software is used to build, run and manage the performance of IT resources. The software is used primarily by IT professionals. Examples include security, management, application development, and portal, process and middleware (PPMW) software.

- **OLTP DBMS** — This category represents OLTP database workloads. The focus is to process transactions that are linked to a relational database.

- **E-mail/messaging** — This category is composed of workloads designed to handle electronic mail and messaging. Examples include Microsoft Exchange and Zimbra.

- **Front-end Web servers** — These workloads provide HTTP responses in addition to optional data contents, typically in the form of Web pages, such as HTML documents and linked images and/or objects. Examples include Apache and Microsoft Internet Information Services (IIS).

- **Streaming media** — Servers running this workload provide audio and/or video playback to end-users over a network. Examples include Clipstream Video 3 and Wowza Media Server Pro.

- **HPC** — This workload is made up of parallel applications. These workloads divide different parts of a given dataset and process those pieces separately and simultaneously on different servers to ultimately provide the individual results to form a larger, combined result. Examples include digital content creation, crash simulation and seismic analysis software.

- **Data warehouse** — This is a repository of an organization's electronic data. It facilitates reporting and analysis through business intelligence tools.

Annex IV

Evolution of IBM in India
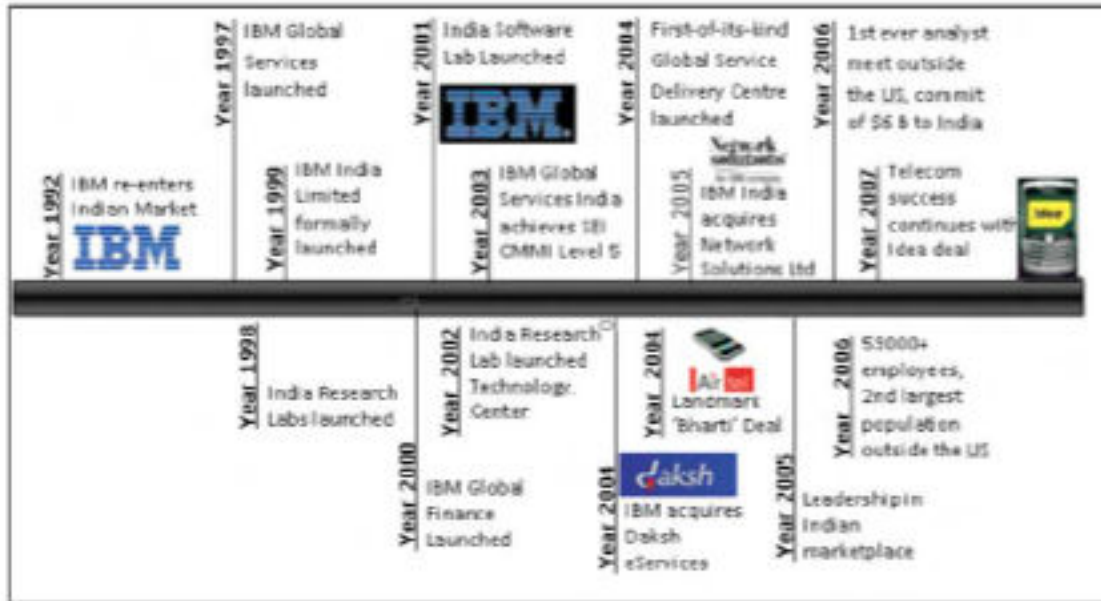
Annex V

Estimates of HHI and C4

Table 1: HHI for Asia Pacific region (APAC) by Vendor Revenue

Year	Total market	Entry level segment	Mid range segment	High end segment
2002	0.259	0.204	0.307	0.379
2003	0.262	0.209	0.320	0.380
2004	0.259	0.198	0.319	0.389
2005	0.251	0.192	0.330	0.423
2006	0.250	0.203	0.348	0.379
2007	0.265	0.223	0.331	0.431
2008	0.275	0.226	0.313	0.465
2009 Q1	0.269	0.215	0.279	0.429

Table 2: C4 for Asia Pacific region (APAC) by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	87.693	77.577	97.505	97.788
2003	87.837	78.380	98.042	97.265
2004	87.205	78.096	97.422	98.041
2005	86.129	77.989	96.856	98.721
2006	87.400	80.955	98.889	97.148
2007	89.978	84.263	99.201	98.334
2008	90.873	85.482	99.055	99.312
2009 Q1	90.219	84.911	96.013	99.800

Table 3: HHI for Asia Pacific region (APAC) by Shipment

Years	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.173	0.172	0.306	0.336
2003	0.172	0.172	0.318	0.327
2004	0.162	0.162	0.312	0.341
2005	0.166	0.165	0.338	0.402
2006	0.178	0.178	0.347	0.384
2007	0.187	0.187	0.330	0.426
2008	0.196	0.196	0.337	0.437
2009 Q1	0.189	0.189	0.297	0.381

Table 4: C4 for Asia Pacific region (APAC) by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end Segment
2002	74.597	74.895	97.207	97.697
2003	76.523	76.921	97.980	96.995
2004	73.430	73.678	97.140	98.082
2005	74.304	74.307	97.462	98.532
2006	76.781	77.020	98.916	98.481
2007	77.145	77.293	99.358	98.892
2008	78.837	78.919	99.322	99.596
2009 Q1	78.557	78.717	97.132	99.736

Table 5: HHI for India by Vendor Revenue

Year	Entry-level segment	Mid-range segment	High-end segment	Total market
2002	0.188	0.340	0.358	0.226
2003	0.217	0.338	0.328	0.234
2004	0.189	0.332	0.336	0.222
2005	0.201	0.376	0.363	0.246
2006	0.224	0.335	0.406	0.261
2007	0.264	0.334	0.384	0.281
2008	0.233	0.359	0.428	0.277
2009 Q1	0.201	0.397	0.381	0.257

Table 6: C4 for India by Vendor Revenue

Year	Entry-level segment	Mid-range segment	High-end segment	Total market
2002	73.22	100.00	100.00	85.33
2003	77.24	99.79	99.46	85.66
2004	79.07	100.00	100.00	86.88
2005	80.87	99.96	100.00	87.85
2006	83.57	100.00	100.00	89.54
2007	89.21	99.85	100.00	92.86
2008	85.06	100.00	99.93	90.59
2009 Q1	80.89	99.71	100.00	89.80

Table 7: HHI for India by Shipment

Year	Entry-level segment	Mid-range Segment	High-end segment	Total market
2002	0.204	0.350	0.347	0.168
2003	0.168	0.337	0.347	0.182
2004	0.182	0.330	0.337	0.169
2005	0.168	0.382	0.349	0.183
2006	0.181	0.343	0.529	0.198
2007	0.197	0.331	0.419	0.222
2008	0.223	0.339	0.447	0.205
2009 Q1	0.185	0.429	0.363	0.187

Table 8: C4 for India by Shipment

Year	Entry-level segment	Mid-range segment	High-end segment	Total market
2002	71.94	100.00	100.00	71.54
2003	75.48	99.79	99.66	75.03
2004	74.12	100.00	100.00	73.91
2005	79.84	100.00	100.00	79.87
2006	82.42	100.00	100.00	82.02
2007	85.92	99.88	100.00	85.53
2008	83.70	100.00	100.00	83.52
2009 Q1	80.60	99.81	100.00	80.76

Table 9: HHI for Australia by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.302	0.333	0.353	0.405
2003	0.286	0.292	0.347	0.393
2004	0.282	0.255	0.342	0.400
2005	0.262	0.227	0.348	0.387
2006	0.250	0.244	0.387	0.349
2007	0.253	0.276	0.371	0.357
2008	0.270	0.283	0.358	0.478
2009 Q1	0.223	0.240	0.590	0.386

Table 10: C4 for Australia by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	95.574	93.732	98.836	98.767
2003	93.259	89.600	99.420	98.363
2004	92.754	87.923	99.361	99.854
2005	92.934	88.107	98.512	99.765
2006	94.493	89.691	99.227	100.000
2007	94.925	91.812	99.670	99.757
2008	95.191	92.430	99.739	99.961
2009 Q1	92.408	87.930	100.000	100.000

Table 11: HHI for Australia by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.244	0.243	0.406	0.392
2003	0.210	0.209	0.353	0.367
2004	0.202	0.202	0.346	0.387
2005	0.212	0.213	0.324	0.355
2006	0.229	0.232	0.370	0.346
2007	0.239	0.242	0.351	0.343
2008	0.245	0.248	0.349	0.408
2009 Q1	0.210	0.214	0.592	0.321

Table 12: C4 for Australia by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	84.343	84.898	99.179	98.540
2003	81.583	82.026	99.460	97.863
2004	80.839	80.972	99.399	99.530
2005	92.934	83.423	98.532	99.298
2006	85.601	86.232	99.165	100.000
2007	85.777	86.431	99.650	99.385
2008	86.751	87.204	99.777	99.807
2009 Q1	82.540	83.327	100.000	100.000

Table 13: HHI for China by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.257	0.174	0.323	0.441
2003	0.251	0.167	0.347	0.467
2004	0.252	0.178	0.354	0.464
2005	0.244	0.181	0.400	0.477
2006	0.255	0.202	0.429	0.419
2007	0.266	0.212	0.352	0.517
2008	0.269	0.209	0.362	0.492
2009 Q1	0.275	0.218	0.269	0.444

Table 14: C4 for China by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	83.931	71.540	97.018	98.673
2003	83.794	73.711	98.302	98.868
2004	84.838	75.351	98.617	99.981
2005	84.455	75.812	99.358	99.941
2006	87.238	80.087	99.246	99.538
2007	88.322	82.194	99.066	99.164
2008	88.158	81.733	99.803	99.336
2009 Q1	88.334	83.549	94.739	99.900

Table 15: HHI for China by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.151	0.149	0.333	0.362
2003	0.152	0.152	0.349	0.397
2004	0.148	0.148	0.338	0.376
2005	0.153	0.153	0.417	0.459
2006	0.168	0.167	0.416	0.351
2007	0.171	0.170	0.362	0.498
2008	0.177	0.177	0.411	0.428
2009 Q1	0.186	0.186	0.296	0.395

Table 16: C4 for China by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	68.607	68.253	96.714	98.080
2003	70.963	70.839	98.007	98.867
2004	69.775	69.879	98.656	99.953
2005	70.801	70.552	99.309	99.937
2006	74.290	74.275	99.595	99.160
2007	75.417	75.367	99.413	99.240
2008	76.896	76.838	99.911	99.606
2009 Q1	78.170	78.170	95.077	99.919

Table 17: HHI for Korea by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.284	0.191	0.288	0.365
2003	0.263	0.209	0.319	0.298
2004	0.243	0.196	0.258	0.308
2005	0.244	0.186	0.213	0.388
2006	0.219	0.162	0.262	0.339
2007	0.263	0.182	0.314	0.415
2008	0.320	0.246	0.375	0.455
2009 Q1	0.333	0.243	0.326	0.514

Table 18: C4 for Korea by Vendor Revenue

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	89.370	77.873	99.059	95.601
2003	91.438	79.021	97.663	95.344
2004	88.554	73.881	94.648	93.884
2005	83.310	66.447	89.139	95.881
2006	80.615	64.441	95.920	94.118
2007	85.446	69.447	99.246	97.279
2008	91.569	83.037	97.690	99.661
2009 Q1	92.732	81.246	100.000	100.000

Table 19: HHI for Korea by Shipment

Year	Total market	Entry-level segment	Mid-range segment	High-end segment
2002	0.209	0.218	0.284	0.321
2003	0.203	0.210	0.318	0.288
2004	0.182	0.186	0.257	0.299
2005	0.170	0.171	0.212	0.382
2006	0.159	0.159	0.257	0.382
2007	0.185	0.185	0.315	0.396
2008	0.224	0.223	0.330	0.444
2009 Q1	0.223	0.223	0.319	0.407

Table 20: C4 for Korea by Shipment

Year	Total market	Entry Level segment	Mid range Segment	High-End Segment
2002	74.855	75.779	99.320	96.104
2003	76.895	78.833	97.509	95.487
2004	69.935	71.558	93.017	93.797
2005	68.735	69.165	89.907	95.484
2006	69.952	70.668	94.552	97.363
2007	77.005	77.382	99.122	97.568
2008	80.387	79.879	97.906	99.934
2009 Q1	82.206	82.513	100.000	100.000

Annex VI

Variance

Variance estimates on the basis of Revenue

Year	Entry-level segment	Mid-range segment	High-end segment
2002	0.009	0.022	0.027
2003	0.011	0.028	0.026
2004	0.009	0.020	0.022
2005	0.010	0.035	0.028
2006	0.012	0.021	0.039
2007	0.015	0.028	0.034
2008	0.012	0.027	0.046
2009 Q1	0.010	0.039	0.033

Variance estimates on the basis of Shipments

Year	Entry-level segment	Mid-range segment	High-end segment
2002	0.007	0.025	0.024
2003	0.008	0.027	0.029
2004	0.007	0.020	0.022
2005	0.008	0.036	0.025
2006	0.010	0.023	0.070
2007	0.012	0.027	0.042
2008	0.010	0.022	0.049
2009 Q1	0.008	0.046	0.028

Annex VII

Vendor-wise percentage distribution of Processors in India

A. Entry-level Server Market

Vendor-wise CPU	2002	2003	2004	2005	2006	2007	2008	2009
Acer	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100
Apple Computer	0	100	100	100	100	100	100	100
RISC	0	100	100	100	100	100	50	0
x86	0	0	0	0	0	0	50	100
Dell Inc.	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100
Fujitsu/Fujitsu Siemens	0	0	0	0	0	100	100	100
IA64	0	0	0	0	0	14.3	8.3	0
x86	0	0	0	0	0	85.7	91.7	100
Groupe Bull	0	0	0	100	0	0	0	0
IA64	0	0	0	100	0	0	0	0
HCL Insol	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100
Hewlett-Packard	100	100	100	100	100	100	100	100
IA64	0	9.1	3.9	7.1	3.3	3.8	5.8	7.4
RISC	7.8	8.2	8.7	5	3.6	4.0	2.5	3.2
x86	92.2	82.7	87.4	87.9	93.0	92.2	91.7	89.4
IBM	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
RISC	0.0	1.2	3.8	9.2	4.7	11.5	16.0	11.5
x86	100.0	98.8	96.2	90.8	95.3	88.5	84.0	88.5
Lenovo	0	0	0	0	0	0	0	100
x86	0	0	0	0	0	0	0	100
Other Vendors	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100
SGI	100	0.0	100	100	0.0	0.0	100	100
RISC	100.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0
x86	0.0	0.0	0.0	0.0	0.0	0.0	100.0	100.0
Stratus Computer	100	100	100	0	0	100	100	0
x86	100	100	100	0	0	100	100	0
Sun Microsystems	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
RISC	100.0	77.8	61.0	72.7	45.8	45.7	41.4	32.7
x86	0.0	22.2	39.0	27.3	54.2	54.3	58.6	67.3
Unisys	0	0	0	100	100	0	0	0
x86	0	0	0	100	100	0	0	0
Verari Systems	0	0	0	0	100	0	0	0
x86	0	0	0	0	100	0	0	0
Wipro	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100
Zenith Computers	100	100	100	100	100	100	100	100
x86	100	100	100	100	100	100	100	100

B. Mid-range Server Market

Vendor-wise CPU	2002	2003	2004	2005	2006	2007	2008	2009
Fujitsu/Fujitsu Siemens	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**100**
IA64	0	0		0	0	0	0	100
Groupe Bull	**0**	**0**	**0**	**100**	**100**	**100**	**0**	**0**
IA64	0	0	0	100	100	100	0	0
Hewlett-Packard	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
IA64	0	13.3	44.4	43.1	64.2	70.6	83.3	93.3
RISC	71.9	63.3	25	43.1	24.5	13.7	16.7	6.7
x86	28.1	23.3	30.6	13.7	11.3	15.7	0	0
IBM	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
IA64	0	0	0	21.4	0	0	0	0
RISC	56	52.9	46.7	42.9	38.9	57.1	82.4	57.1
x86	44	47.1	53.3	35.7	61.1	42.9	17.6	42.9
SGI	**100**	**100**	**100**	**100**	**0**	**100**	**100**	**100**
IA64	0	0	80	100	0	50	100	100
RISC	100	100	20	0	0	0	0	0
x86	0	0	0	0	0	50	0	0
Stratus Computers	**0**	**100**	**0**	**0**	**0**	**100**	**0**	**0**
x86	0	100	0	0	0	100	0	0
Sun Microsystems	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
RISC	100	100	86.7	94.4	73.7	81.0	100	100
x86	0	0	13.3	5.6	26.3	19.0	0	0

C. High-end Server Market

Vendor-wise CPU	2002	2003	2004	2005	2006	2007	2008	2009
Fujitsu/Fujitsu Siemens	**0**	**0**	**0**	**0**	**0**	**0**	**100**	**0**
IA64	0	0	0	0	0	0	100	0
Hewlett-Packard	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
IA64	0	0	26.1	32.1	23.8	36.4	45.8	70
RISC	100	100	73.9	67.9	76.2	63.6	54.2	30
IBM	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Other	14.3	15.8	25	17.6	15.2	23.3	15.4	16.7
RISC	85.7	84.2	75	82.4	84.8	76.7	84.6	83.3
SGI	**100**	**100**	**0**	**0**	**0**	**0**	**100**	**100**
IA64	0	100	0	0	0	0	100	100
RISC	100	0	0	0	0	0	0	0
Stratus Computers	**0**	**100**	**100**	**100**	**100**	**100**	**0**	**0**
RISC	0	100	100	0	0	0	0	0
x86	0	0	0	100	100	100	0	0
Sun Microsystems	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
RISC	100	100	100	100	100	100	94.7	100
x86	0	0	0	0	0	0	5.3	0

Annex VIII
SBI Case Study
SBI

Business Challenges

The State Bank of India is the oldest and largest bank in India, with more than $250 billion (USD) in assets. It is the second-largest bank in the world in terms of the number of branches. Additionally, SBI has controlling or complete interest in a number of affiliate banks, resulting in the availability of banking services at more than 14,600 branches and nearly 10,000 ATMs. Unlike private sector banks, SBI has a dual role of earning a profit and expanding banking services to the population throughout India. This led the bank to build an extensive branch network in India that included many branches in the low-income rural areas. SBI and its associated banks computerized their branches in the 1990s, but it was losing market share to private-sector banks that had implemented more modern centralized core processing systems. To remain competitive with its private sector counterparts, in 2002 SBI began the largest implementation of a centralized core system ever undertaken in the banking industry.

Solution

SBI has set up different IT systems for different types of work. They mainly have core banking, ATM facilities, Internet banking and networking.

Core banking. Recognizing the need for large-scale centralized systems expertise in the year 2002, a tender was called for a core banking solution and Infosys was asked to help SBI. After Infosys backed out, HP & TCS, and IBM & Altec bid for the tender. The tender called for hardware and software bundled together, where only the technical score was considered. Both bidders were found eligible on technical performance. pricing was taken into account. The pricing system follows the usual government guidelines[128]. After verifying the bid SBI selected HP and TCS to provide the core banking solution. SBI preferred the real-time processing architecture of FNS's BaNCS system over the IBM consortium's memo post/batch update architecture. In fact, SBI mentioned that IBM did not cooperate to perform the scalability test of FNS's BaNCS on their machine.

Today SBI has 4 HP Superdome hardware and HPUX as OS. SBI has largest single HPUX installed to date with 120 CPUs each.

ATMs. SBI has 8,500 ATMs that are known as switches. These switches are basically non-stop servers. A separate tender was called for this and HP (it was Compaq on that time) got the tender. Due to the development of technology, the cost of a switch dropped from 14 lakh in the year 1987 to 4 lakh in the year 2009. The cost varies depending on the number of dispensers it has. Over time, depending on the availability of new advanced ATMs at cheaper prices, SBI trans-ships its old ATMs to rural branches where there are fewer transactions.

Internet Banking. Initially, Satyam provided the broad vision and written application software in Java. SBI sent their staff to Satyam to be trained in the particular programming language and software application, so that if anything happened to Satyam, SBI staff would be able to run the application.

Networking. For data transfer, SBI uses its own network, because it does not want to depend on a single service provider and wants to reduce the possibility of lock-in.

Use of Open Source

SBI did not find open source appealing due to the lack of a good service provider, especially for the enterprise version. Also, the enterprise version of OSS is considered to be expensive. According to SBI, large-scale operations cannot be ported to open source; SBI has a huge subscriber base and cannot risk any failure merely to save expenses.

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128.   Hardware and software for 3 years and AMC for 2 years. The total is 5 years.

Benefits

HP was able to break the myth that IBM is the only solution for large transactions by establishing a network of 400 regional processing centers for all metro and urban branches. HP was able to prove that efficient perfromance in high-end computing is not an IBM monopoly. By deploying HP servers, SBI reversed the trend of customer attrition and is now gaining new market share.

Cost

There is always the possibility that one vendor can blame other vendors for inefficient perforomance of the system. HP is trying to provide end-to-end solutions to its clients by collaborating with EDS, but this collaboration is yet to fire.

Why it matters

SBI is aware of the latest technology in the market and wanted to deploy the best technology suitable for its work. Although SBI believes that exploitation is a matter of perception, as a user SBI makes every effort to reduce the possibility of lock-in and being exploited by vendors. Due to competition in the market and advances in technology, prices are falling and they always get a better price than their previous purchase. Coordination among the different vendors can increase the level of competition and further reduce the price.

Annex IX

Vendor-wise percentage distribution of OS installed at Entry-level

	2002	2003	2004	2005	2006	2007	2008	2009
Acer	100	100	100	100	100	100	100	100
Linux	6.3	17.8	31.9	21.2	25.0	36.8	50.0	50.0
UNIX	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Windows	83.3	82.2	68.1	78.8	75.0	63.2	50.0	50.0
Apple Computer	0	100	100	100	100	100	100	100
UNIX	0.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Dell Inc.	100	100	100	100	100	100	100	100
Linux	0.0	0.0	0.0	0.0	0.0	2.1	0.9	25.9
UNIX	0.0	0.0	0.0	0.0	66.7	63.8	65.4	48.1
Windows	100.0	100.0	100.0	100.0	33.3	34.0	33.6	25.9
Fujitsu/Fujitsu Siemens	0	0	0	0	0	100	100	100
Linux	0.0	0.0	0.0	0.0	0.0	14.3	4.2	16.7
Windows	0.0	0.0	0.0	0.0	0.0	85.7	95.8	83.3
Groupe Bull	0	0	0	100	0	0	0	0
Linux	0.0	0.0	0.0	**50.0**	0.0	0.0	0.0	0.0
Windows	0.0	0.0	0.0	**50.0**	0.0	0.0	0.0	0.0
HCL Insol	100	100	100	100	100	100	100	100
Linux	40.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Windows	60.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Hewlett-Packard	100	100	100	100	100	100	100	100
Linux	18.8	42.7	41.7	44.3	22.3	22.9	28.3	31.9
Others	19.5	4.5	1.9	0.7	0.0	0.0	0.0	0.0
UNIX	20.8	10.9	10.7	5.0	52.6	51.5	46.1	41.5
Windows	40.9	41.8	45.6	50.0	25.1	25.6	25.6	26.6
IBM	100	100	100	100	100	100	100	100
AIX	0.0	1.2	3.8	9.2	3.1	7.1	11.1	7.7
Linux	35.3	38.6	29.1	34.7	21.2	25.8	27.6	28.8
Others	16.2	14.5	19.0	6.1	0.0	0.0	0.0	0.0
UNIX	0.0	0.0	0.0	0.0	50.2	43.1	35.0	36.5
Windows	48.5	45.8	48.1	50.0	25.5	24.1	26.3	26.9
Lenovo	0	0	0	0	0	0	0	100
Linux	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**50.0**
Windows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**50.0**
Other Vendors	100	100	100	100	100	100	100	100
Linux	0.0	30.0	39.6	50.0	25.0	25.0	25.0	40.0
Others	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIX	0.0	0.0	0.0	0.0	50.0	50.0	50.0	40.0
Windows	70.0	70.0	60.4	50.0	25.0	25.0	25.0	20.0
SGI	100	0	100	100	0	0	100	100
Linux	0.0	0.0	0.0	0.0	0.0	0.0	60.0	50.0
UNIX	100.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0

	2002	2003	2004	2005	2006	2007	2008	2009
Windows	0.0	0.0	0.0	0.0	0.0	0.0	40.0	50.0
Stratus Computers	**100**	**100**	**100**	**0**	**0**	**100**	**100**	**0**
Windows	100.0	100.0	100.0	0.0	0.0	100.0	100.0	0.0
Sun Microsystems	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Linux	0.0	13.9	20.3	18.2	25.0	26.7	21.1	25.0
UNIX	100.0	86.1	79.7	81.8	70.8	72.4	74.3	71.2
Windows	0.0	0.0	0.0	0.0	4.2	0.9	4.6	3.8
Unisys	**0**	**0**	**0**	**100**	**100**	**0**	**0**	**0**
Linux	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0
Verari Systems	**0**	**0**	**0**	**0**	**100**	**0**	**0**	**0**
Linux	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
Windows	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
Wipro	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Linux	12.5	27.3	50.0	50.0	50.0	50.0	50.0	50.0
Windows	87.5	72.7	50.0	50.0	50.0	50.0	50.0	50.0
Zenith Computers	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Linux	20.0	37.5	50.0	33.3	33.3	33.3	40.0	50.0
Windows	80.0	62.5	50.0	66.7	66.7	66.7	60.0	50.0

Vendor-wise Percentage distribution of OS installed in the Mid-range Server Market

	2002	2003	2004	2005	2006	2007	2008	2009
Fujitsu/Fujitsu Siemens	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**100**
Windows	0	0	0	0	0	0	0	100
Groupe Bull	**0**	**0**	**0**	**100**	**100**	**100**	**0**	**0**
Linux	0	0	0	50	57.1	50	0	0
Windows	0	0	0	50	42.9	50	0	0
Hewlett-Packard	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Linux	3.1	6.7	33.3	23.5	20.8	29.4	33.3	40.0
Others	12.5	10.0	2.8	3.9	0.0	0.0	2.8	0.0
UNIX	71.9	66.7	30.6	39.2	54.7	49.0	58.3	53.3
Windows	12.5	16.7	33.3	33.3	24.5	21.6	5.6	6.7
IBM	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
AIX	44.0	47.1	46.7	28.6	22.2	35.7	47.1	28.6
Linux	16.0	23.5	26.7	28.6	16.7	0.0	11.8	0.0
UNIX	12.0	5.9	0.0	14.3	44.4	50.0	35.3	57.1
Windows	28.0	23.5	26.7	28.6	16.7	14.3	5.9	14.3
SGI	**100**	**100**	**100**	**100**	**0**	**100**	**100**	**100**
Linux	0	0	80	100	0	100	100	100
UNIX	100	100	20	0	0	0	0	0
Stratus Computers	**0**	**100**	**0**	**0**	**0**	**100**	**0**	**0**
Windows	0	100	0	0	0	100	0	0
Sun Microsystems	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Linux	0.0	0.0	13.3	5.6	10.5	0.0	0.0	0.0
UNIX	100	100	86.7	94.4	89.5	100	100	100

Vendor-wise percentage distribution of OS installed in the High-end Market

	2002	2003	2004	2005	2006	2007	2008	2009
Fujitsu/Fujitsu Siemens	0	0	0	0	0	0	100	0
Windows	0	0	0	0	0	0	100	0
Hewlett-Packard	100	100	100	100	100	100	100	100
Linux	0	0	13.0	10.7	0	0	0	20
Others	25.0	42.9	13.0	14.3	19.0	18.2	25.0	10
UNIX	75.0	57.1	60.9	53.6	81.0	81.8	75.0	70.0
Windows	0	0	13.0	21.4	0	0	0	0
IBM	100	100	100	100	100	100	100	100
AIX	28.6	21.1	25	29.4	48.5	50	53.8	50
Linux	0	0	0	0	6.1	0	5.1	0
UNIX	57.1	63.2	50	52.9	30.3	26.7	30.8	33.3
zOS/OS390	14.3	15.8	25	17.6	15.2	23.3	10.3	16.7
SGI	100	100	0	0	0	0	100	100
Linux	0	100	0	0	0	0	100	100
UNIX	100	0	0	0	0	0	0	0
Stratus Computers	0	100	100	100	100	100	0	0
Others	0	0	0	0	0	100	0	0
UNIX	0	100	100	0	0	0	0	0
Windows	0	0	0	100	100	0	0	0
Sun Microsystems	100	100	100	100	100	100	100	100
UNIX	100	100	100	100	100	100	100	100

Annex X

Questionnaire for Server Vendors

Company –
Respondent–
Designation –

Section A

Benchmark of Your Product

01. In which market segments are your server products targeted the most?

    a) High end ☐
    b) Mid range ☐
    c) Entry level ☐

02. What is the benchmark you use to define the server market segments (high end, mid range and entry level)? Please provide details.

    a) Technology (no of processors/cores etc) ☐
    b) Price ☐
    c) No. of Employees ☐
    d) Types of workload ☐

03. Do you have full gamut of products applicable for your target segment/s?

    a) High end   YES ☐   NO ☐
    b) Mid range   YES ☐   NO ☐
    c) Entry level YES ☐   NO ☐

04. In which regions of India are you active?

    a) Across India   ☐
    b) Western Region   ☐
    c) Northern Region   ☐
    d) Eastern Region   ☐
    e) Southern Region   ☐
    f) Central India   ☐
    g) Selected cities   ☐

05. In which verticals are you active?

    a) Banking   ☐   g) Manufacturing   ☐
    b) Insurance   ☐   h) Transportation   ☐
    c) Telecom   ☐   i) Media & Entertainment   ☐
    d) Retail   ☐   j) Utilities   ☐
    e) Healthcare   ☐   k) Public Sector/Government   ☐
    f) Education   ☐   l) Any other, Please specify   ☐

Section B: Factors you consider most while offering your product

06. Please rank the following factors in terms of importance for the Indian Market.

Factors	RANK on the basis of priority [1-6]
1. Availability (business continuity)	
2. Reliability	
3. Features & Functions	
4. Energy efficiency, (low energy consumption)	
5. Cost reductions, (low maintenance cost)	
6. Others	

07. What are the key factors (USP) that differentiate your products from the competitors? Please illustrate.

Factors	High-end	Mid-range	Entry-level
Better price-performance			
Lower TCO			
Better/Quick ROI			
Unique features and functions			
Cost-effective			
Better Service			
Interoperability/ Openness			
Others (please specify)			

08. How frequent are your product refresh cycles?

a. Less than 3 months ☐
b. 3 months to 1 year ☐
c. 1 – 2 years ☐
d. More than 2 years ☐
e. Depends on sales target achieved ☐

09. What do you give importance to in your product refresh cycles? Please rate on scale of 1-5 [1= Most important, 5=Least important]

Factors	Rate on scale of 1-5
Technology demand	
Price competitiveness	
Inventory Availability	
Market share leadership	
Market vision	
Others	

Section C: Pricing & Bundling

10. A. Do you bundle software with your server? If so what kind of software do you bundle?

   a) No bundling ☐
   b) System software ☐
   c) Management software ☐
   d) Applications ☐
   e) Security software ☐
   f) Middleware ☐
   g) Others (Provide details) ☐

10. B. If the answer to Q10 A is yes then provide the charging mechanism.

   a) Unlimited License ☐
   b) License per seat ☐
   c) Periodic subscription ☐
   d) Usage based [SaaS model] ☐

11. When selling your server products do you provide the following options?

   a) Leasing ☐   b) Buy back option ☐

12. Do you sell refurbished server products in Indian market?

   YES ☐   NO ☐   Plan to sell in future ☐

13. Do you promote open source? If yes how?

   If not, why not?

14. What percentage of your server product lines enables open source software?

Server segments	%
High End servers	
Mid-range servers	
Entry Level servers	

15. In your product pricing, what percentage of price is associated with hardware, software and/or services?

Types of server	Hardware	Software	Services	Total
High end				100
Mid range				100
Entry level				100

Section D: Competition in the server market

16. What level of competition do you face in following segments? Rate the competition level on a scale of 1-10.

Market Segment	Rate on scale of 1-10. 1-high, 10 -low
High End	
Middle Range	
Entry level	

17. Where do you find *intensity of the competition* more – in hardware, in software or maintenance?

Market Segment	Rate on scale of 1-10.1-high, 10 -low
Hardware	
Software	
Maintenance (including services)	

18. Do you collaborate with your competitor/s? If so with whom and why?

19. A. Does the government policy help you…

To do business in India	Yes		No	
To create level-playing field	Yes		No	
To reduce product price for end-users	Yes		No	

B. Do you think providing grants & subsidies for setting up operations will help you? If so, how?

C. Do you think MNCs have any undue advantage in India? Why?

D. Do you think there should be restrictiveness on branding, advertising and other promotional spent to create level playing field?

E. Do you think there are any unfair trading practices that are hindering your product sales? Please describe.

Questionnaire for Users

Instructions:

a. Please check the relevant box/es   Yes ☒   No ☐

b. Please click where more than options are possible.

c. In case of rank, rank all options in order of relevant information in ascending order.

Section A: Organization setup and Server environment

1. Describe your organization by filling the boxes with relevant information:

No. of Employees	No. of Computers	Organization - sector

2. How many servers does your organization have?

   a)   1-9 ☐
   b)   10-49 ☐
   c)   50-99 ☐
   d)   100-499 ☐
   e)   500-999 ☐
   e)   1000 or more ☐

3. What are the main uses of your server infrastructure? Please tick all that apply.

   a)   Web hosting ☐
   b)   Mail server ☐
   c)   File & Print Server ☐
   d)   Security Applications ☐
   e)   IT & Network Management ☐
   f)   Cross-industry Applications (ERP, CRM etc.) ☐
   g)   Core Applications (Banking, telecom etc.) ☐
   h)   Messaging & Collaboration ☐
   i)   Others (Please specify) ☐

4. Which vendor/s provide servers to your organization? Please tick all that apply.

   a)   IBM ☐
   b)   HP ☐
   c)   Sun Microsystems ☐
   d)   Dell ☐
   e)   HCL ☐
   f)   Wipro ☐
   g)   Fujitsu ☐
   h)   Other (please specify) ☐

5. Which server architecture does your organization predominantly use?

   a)   X86 ☐
   b)   RISC ☐
   c)   EPIC/Itanium ☐
   d)   Other ☐

6. Please provide details of your server infrastructure.

Server Vendor	Model/ Family name	Number of Servers	Clock Speed	No. of Cores	No. of processors
Vendor A					
Vendor B					
Vendor C					

7. For how many years has your company been using the mentioned servers? Has there ever been change in the vendor? If so when and why?

8. What Operating System do you run on your servers (*Open source or proprietary*)? Please Specify

Windows NT ☐		Windows 2000 ☐		Windows 2003 ☐		Windows 2008 ☐	
Unix	Open ☐	Red Hat Linux	Open ☐	Sun Microsystems Solaris	Open ☐	SUSE Linux	Open ☐
	HP ☐/IBM ☐		Enterprise ☐		Enterprise ☐		Enterprise ☐
z/OS, z/OS.e, z/VSE, TPF ☐				Other (Please specify)			

9. Which Database software/s is your organization using?

a) Oracle ☐
b) MySQL ☐
c) Microsoft SQL ☐
d) IBM DB2 ☐
e) PostgreSQL ☐
f) Other (please specify) ☐

10. Approximately what percentage of your server infrastructure is used to run mission-critical data?

a) 1 – 25 ☐
b) 26 – 50 ☐
c) 51 – 75 ☐
d) 76 – 100 ☐

11. Do you use open source software? If yes identify two major constraints with respect to each

Open Source

Proprietary

Section B: Purchasing Decisions & Maintenance Policies

12. Do you have your own IT department or do you outsource services?

   a)   Own   ☐
   b)   Outsource   ☐ (mention Outsource service provider/s)

13. Purchase decision of server/software is made:

   a. Completely in-house by resident experts   Yes ☐ No☐
   b. Consultants involved / hired to evaluate tenders   Yes ☐ No☐
       If yes, who are the consultants?

14. How many quotations are usually invited?

15. Are decisions made solely on the basis of lowest bid (L1)?
   If not, please rank following factors based on their importance in decision making.

Factors	Rank(1-7)
Product features and functions (speed, scalability, etc)	
Vendor's reputation & Brand	
Vendor's size and financial stability	
Pre-sales & Post-sales services	
Total Cost of Ownership associated with the product (CAPEX + OPEX)	
Expected Return on Investment (ROI)	
Security	
Other (please specify)	

16. Is security of the server is provided by

   a)   The vendor   ☐
   b)   The third Party   ☐

17. While choosing Operating System/software what criteria are important? *(Rank in order of importance; for highest 1 and for lowest 10)*

   a) Integration ☐   b) License price ☐   c) Installer ☐
   d) Market share ☐   e) Documentation ☐   f) Clients support ☐
   g) Previous experience ☐   h) Interoperability ☐   i) Compatibility ☐
   j) Others

18. How frequently do you upgrade/replace the existing server infrastructure?

   a) Less than 3 years   ☐
   b) 3 – 5 years   ☐
   c) More than 5 years   ☐
   d) As and when need arises   ☐

19. Please state the reasons for upgrading/replacing the existing infrastructure.

    a. Financial situation improved in the organization ☐
    b. Processor(s) too slow/RAM Capacity too low ☐
    c. Company policy on hardware retirement/replacement cycle ☐
    d. Other hardware limitations ☐
    e. Poor reliability/ high failure rate ☐
    f. To save floor space/reduce footprint ☐
    g. Migration of server platform (e.g. RISC to x86 or Unix to Windows) ☐
    h. Others (Please specify)

20. How do you plan to increase utilization of current server infrastructure?

    a) Load Balancers ☐
    b) Virtualization ☐
    c) Consolidation ☐
    d) Other (please specify) ☐

21. Is your cost of maintenance higher than the cost of buying the bundle?

    Yes ☐   No ☐   Not Aware ☐

Section C: Customer Satisfaction

22. Are you satisfied with the performance of your server (mentioned in Q. 6)?

    From Vendor A   YES ☐   NO ☐
    From Vendor B   YES ☐   NO ☐
    From Vendor C   YES ☐   NO ☐

A. If YES, Please provide reasons (Rank in order of importance; for highest 1 and for lowest 8)

Reasons	Vendor A	Vendor B	Vendor C
It's an incredibly secure environment	☐	☐	☐
The performance levels are excellent	☐	☐	☐
The system is never down	☐	☐	☐
Disaster recovery and emergency management are extremely efficient	☐	☐	☐
Centralized management is relatively easy	☐	☐	☐
The cost per transaction is lower than other systems	☐	☐	☐
Low downtime cost	☐	☐	☐
Others (please specify)			

B. If NO, please explain why you are not satisfied with the performance of your server? *(Rank in order of importance; for highest 1 and for lowest 6)*

Reasons	Vendor A	Vendor B	Vendor C
High running cost (including cooling cost, salary for skilled personal, transaction cost)	☐	☐	☐
Not compatible with other application software provided by third party	☐	☐	☐
Maintenance cost is high	☐	☐	☐
Lack of skilled personnel who can run server	☐	☐	☐
Services offered by the company are not up to the mark	☐	☐	☐
Others (please specify)			

Applicable for Mainframe User

23. Do you think cost of buying a mainframe is too high or is the mainframe overpriced?

YES ☐   NO ☐   Not Aware ☐

24. Did you find that actual cost of using a mainframe is higher than the estimated (or expected) cost?

YES ☐   NO ☐   Not Aware ☐

–If your answer is yes, why is the actual cost higher?

Reasons	RANK
Hidden cost	
Cost of migration	
Less efficient then what was expected (running cost)	
AMC, License, Services	
Others (describe)	

Annex XI

Systems and OS deployment of firms profiled in our sample

User	Vertical	Size of Organizati on	Vendor	Use of server infrastructure	Operating System
Bombay Hospitals	Healthcare	3000	IBM, Sun Microsyste ms	Core applications. Used for hospital management software	IBM AIX, Sun Solaris Enterprise version
Max Healthcare	72 hcare	4000	IBM, HP, Sun Microsyste ms	Mail server, file & printer server, security applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, Red Hat Linux
Manipal Health Systems	Healthcare	7000	HP, Sun Microsyste ms	Mail server, file & printer server, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Sun Solaris - Enterprise
Fortis Healthcare	Healthcare	10000	HP	Mail server, file & printer server, security applications, IT & network management, core applications, messaging & collaboration	Windows 2000 Advanced, Windows 2003, Red Hat Linux
Wockhardt Ltd	Healthcare	7000	IBM, HP	Web hosting, mail server, file & printer server, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, IBM AIX, Red Hat Linux
Hinduja Hospital	Healthcare	4000+	IBM, Sun Microsyste ms	Mail server, file & printer server, security applications, core applications, messaging & collaboration	Windows 2000, Windows 2003
Max Healthcare (Delhi)	Healthcare	2000	HP	Mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Windows 2008
Shoppers stop	Retail	5000	IBM, Dell	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Windows 2008, IBM AIX, Red Hat Linux

User	Vertical	Size of Organizati on	Vendor	Use of server infrastructure	Operating System
Pantaloon Retail India Ltd.	Retail	22000+	IBM, HP, Sun Microsyste ms	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, IBM AIX, Sun Solaris
Spencers Retail	Retail	16000+	Sun Microsyste ms	Mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Sun Solaris 10
Croma (Infiniti Retail)	Retail	1600+	IBM	mail server, file & printer server, cross-industry applications, core applications	Windows 2003, IBM AIX
Trent Ltd. (Tata Retail chain)	Retail	1500+	IBM, HP, Wipro	Mail server, file & printer server, IT & network management, cross-industry applications, messaging & collaboration	Windows 2000, Windows 2003, Red Hat Linux-Enterprise
MobileStore	Retail	4500+	HP, Sun Microsyste ms	Mail server, file & printer server, cross-industry applications, core applications	Windows 2003, Sun Solaris
Aditya Birla Retail Ltd.	Retail	11000	HP, Sun Microsyste ms	Mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Windows 2008, HP UX, Sun Solaris, Red Hat Linux
Concor	Transportation	1150+	Sun Microsyste ms	Web hosting, mail server, cross-industry applications , core applications, messaging & collaboration	Windows 2000 Advanced, Windows 2003, Sun Solaris, Red Hat Linux
Credence Logistics	Transportation	300	IBM	Mail server, file & printer server, core applications	Windows 2003
Air India	Transportation	31000	IBM, HP, Unisys Mainframe	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Red Hat Linux, zO/S, OS 2200 (Unisys Mainframe OS)

User	Vertical	Size of Organization	Vendor	Use of server infrastructure	Operating System
ICICI Bank	Banking	30000+	IBM, HP, Sun Microsystems, Dell	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, Windows 2008, Sun Solaris- Enterprise version, IBM AIX, HP UX, Red Hat Linux- Open source and Enterprise version
HDFC Bank	Banking	37000+	IBM, HP, Sun Microsystems, Dell	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications , core applications, messaging & collaboration	Windows 2000, Windows 2003, Sun Solaris, IBM AIX, HP UX, Red Hat Linux, Novel software, z/OS
Allahabad Bank	Banking	20500	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, IBM AIX, Red Hat Linux- Enterprise version
IDBI Bank	Banking	10000	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Red Hat Linux, Linux AS 2.1, Solaris - Enterprise version
SIDBI	Banking	900	IBM, HP, HCL	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, IBM AIX, Red Hat Linux- Enterprise version
Central Bank of India	Banking	32000	IBM, HP, HCL, Acer	Mail server, file & printer server, security applications, core applications	Windows NT, Windows 2000, Windows 2003, HP UX, IBM AIX

User	Vertical	Size of Organization	Vendor	Use of server infrastructure	Operating System
BPCL	Utilities	14000+	IBM, HP, Sun Microsystems, Dell	web hosting, mail server, file & printer server, security applications, it & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, HP UX, IBM AIX, Red Hat Linux
HPCL	Utilities	14000	IBM, HP	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, IBM AIX, Red Hat Linux, Novell Suse Linux
Mahanagar Gas	Utilities	300+	HP, Sun Microsystems	File & printer server, security applications, cross-industry applications, core applications, messaging & collaboration	Windows 2003, HP UX, Red Hat Linux
Reliance Communications	Telecommunications	20000+	HP, Sun Microsystems	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Sun Solaris, Red Hat Linux
MTNL	Telecommunications	47400	IBM, HP, Sun Microsystems, Wipro	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, IBM AIX, Sun Solaris, Red Hat Linux, True64 UNIX
Idea Cellular Ltd.	Telecommunications	6100+	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, HP UX, IBM AIX, Sun Solaris

User	Vertical	Size of Organization	Vendor	Use of server infrastructure	Operating System
Tata Teleservices	Telecommunications	5000+	HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, Sun Solaris, Red Hat Linux
Major Telecom Operator	Telecommunications	18000+	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, HP UX, IBM AIX, Sun Solaris-Enterprise, Red Hat Linux Enterprise, Suse Linux Enterprise
Vodafone	Telecommunications	NA	IBM, HP, Sun Microsystems, Wipro	Mail server, file & printer server, IT & network management, cross-industry applications, core applications	Windows NT, Windows 2003, HP UX, IBM AIX
Asian Paints	Process Manufacturing	4700	IBM, HP	Mail server, file & printer server, IT & network management, cross-industry applications, messaging & collaboration	Windows 2003, HP UX, Red Hat Linux Enterprise, Suse Linux 7.0, FreeBSD
Britannia Industries Ltd.	Process Manufacturing	2600+	IBM, HP	Mail server, file & printer server, cross-industry applications, messaging & collaboration	Windows 2003, HP UX, IBM AIX
VIP Industries Ltd.	Process Manufacturing	1600	IBM	Mail server, file & printer server, cross-industry applications	Windows 2003, IBM AIX
Marico Industries	Process Manufacturing	1190	HP, HCL	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2003, Windows 2008, HP UX
Ambuja Cement	Process Manufacturing	3500+	HP, Sun Microsystems	Web hosting, mail server, file & printer server, IT & network management, cross-industry applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, Red Hat Linux Enterprise

User	Vertical	Size of Organization	Vendor	Use of server infrastructure	Operating System
IFFCO	Process Manufacturing	6728	IBM, HP, Dell	Web hosting, mail server, security applications, IT & network management, cross-industry applications, core applications	Windows NT, Windows 2000, Windows 2003, HP UX, IBM AIX, Red Hat Linux Enterprise
LIC	Insurance	70000	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003 Advanced Version, Windows 2008, Unix - open source, Sun Solaris, Red Hat Linux, Novel Suse Linux
Bajaj Allianz	Insurance	32000+	IBM, HP, Sun Microsystems	Web hosting, mail server, file & printer server, security applications, IT & network management, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, Sun Solaris, Red Hat Linux, z/OS and IFL
Oriental Insurance Company Limited	Insurance	16000	Sun Microsystems	Web hosting, mail server, core applications	Sun Solaris Enterprise version
General Insurance Corporation of India	Insurance	450+	IBM, HP, HCL, Acer	Web hosting, mail server, cross-industry applications, core applications, messaging & collaboration	Windows 2000, Windows 2003, HP UX, Linux-open source
Aviva Life Insurance	Insurance	2500+	IBM	Web hosting, mail server, file & printer server, security applications, cross-industry applications, core applications	Windows 2000, Windows 2003
Maharashtra State Electricity Board	Government	75000	IBM, HP, HCL	Web hosting, mail server, file & printer server, security applications, cross-industry applications, core applications	Windows 2003, HP UX, Red Hat Linux
MSRTC	Government	1.1 Lakh	IBM, Dell	Web hosting, mail server, file & printer server, IT & network management, core applications	Windows 2000, Unix - Open, IBM AIX, Red Hat Linux

User	Vertical	Size of Organization	Vendor	Use of server infrastructure	Operating System
CDAC	Government	800	IBM, HP, Sun Microsystems	Web hosting, others, R&D	Windows 2003, Windows 2008, Sun Solaris-Enterprise version, IBM AIX, Red Hat Linux- Open source and Enterprise version, SUSE Linux open
Department of Trade and Taxes	Government	60200	IBM, HP	Web hosting, mail server, file & printer server, security applications, IT & network management, core applications, messaging & collaboration, others-ERM/CITRIX/CODEX/DNS	Windows 2003, IBM AIX, Red Hat Linux-Enterprise
CRIS	Government	500+	IBM, HP, Sun Microsystems, Dell, HCL, Wipro	Web hosting, mail server, security applications, IT & network management, core applications	Windows 2003, Sun Solaris-Enterprise version, IBM AIX, HP UX, Red Hat Linux-Enterprise version
Mausam Bhawan	Government	8000	IBM, HP, Sun Microsystems, Dell, HCL	Web hosting, mail server, file & printer server, security applications, IT & network management, messaging & collaboration	Windows NT, Windows 2000, Windows 2003, IBM AIX, , Red Hat Linux-Enterprise version
RBI	Government	>20000	IBM, HP, Sun Microsystems, Dell, HCL, Wipro	Web hosting, mail server, file & printer server, security applications, IT & network management, core applications, messaging & collaboration	Windows NT, Windows 2000, Windows 2003, Windows 2008, Unix - Open, HP UX, , Red Hat Linux-Enterprise version, Sun Solaris-Enterprise version, z/OS

Annex XII

SIC Code	Industry Title
3570	Computer & Office Equipment
3571	Electronic Computers
3572	Computer Storage Devices
3575	Computer Terminals
3576	Computer Communications Equipment
3577	Computer Peripheral Equipment, NEC
3578	Calculating & Accounting Machines (No Electronic Computers)
3600	Electronic & Other Electrical Equipment (No Computer Equip)
5045	Wholesale-Computers & Peripheral Equipment & Software
5734	Retail-Computer & Computer Software Stores
7370	Services-Computer Programming, Data Processing, etc.
7371	Services-Computer Programming Services
7372	Services-Prepackaged Software
7373	Services-Computer Integrated Systems Design
7374	Services-Computer Processing & Data Preparation
7377	Services-Computer Rental & Leasing

NIC CODE: Division 72 Computer and Related Activities

Trade Policy

Electronic goods and computer hardware and software are classified under HS code 8505 and 8515 to 8545. Imports of most items are free. There are few items that require import licenses.

Industry Policy

Industrial undertakings manufacturing electronic goods and computer hardware are exempt from obtaining an industrial license to manufacture. The delicensed undertakings, however, are required to file an Industrial Entrepreneur Memoranda (IEM) with the Secretariat of Industrial Assistance (SIA). No further approval is required. There are no restrictions regarding the location of the manufacturing unit.

Customs Duty

Full exemption from customs duty on computer software

Tariff Item	Description of Goods	Unit	Rate of Duty
8541 50 00	Other Semi-conductor devices	U	Free
8541 60 00	Mounted Piezo-electric crystals	U	Free
8541 90 00	Parts	Kg.	Free
8542	Electronic Integrated Circuits		
8542 31 00	Processors and controllers, whether or not combined with memories, converters, logic circuits, amplifiers, clock and timing circuits, or other circuits		Free
8542 32 00	Memories	U	Free
8542 33 00	Amplifiers	U	Free
8542 39 00	Other	U	7.50%
8542 90 00	Parts	Kg.	Free

Annex XIII

Bharti Airtel: Case study

Bharti Airtel

Business Challenge

Bharti Airtel is India's largest private sector telecom operator and the only one to offer its services in each of India's 23 "circles". It is always challenging to maintain a wide service footprint and at the same time provide a high level of customer service. In order to keep up all the processes required to run its business – from order management and service activation to those processes involved in the operation of its core networks – it needs a reliable and secure IT infrastructure. Like all other telecoms, at the initial stage Airtel used a Sun Microsystems server with Sun UNIX as the OS. Over the years to offer better services to its rapidly growing base of subscribers and to meet the challenge of financial risks from a steady decline in India's average revenue per user (ARPU) for mobile telecom services, Airtel decided to outsource its IT infrastructure and, hence, move from the CAPEX model to an OPEX model.

Solution

Airtel signed a 10-year, $750 million revenue-sharing deal in 2004 with IBM to manage its core IT infrastructure. Its new platform provides a standardized framework for Bharti Airtel to integrate its channels and customer-facing processes, enabling a more seamless customer experience, higher customer satisfaction and more profitable growth. The deal is now estimated to have gone up to more than $1.5 billion, helped by robust growth in Bharti's subscribers and revenue. This model is the first of its kind in the world and IBM is trying to replicate the same model with IDEA.[129] Currently, Airtel is using more than 3,000 servers with an average of 16 processors in each server. IBM provides all hardware, software and services as per the requirement of Bharti Airtel. According to the deal IBM will always provide the latest technology required to meet Bharti Airtel's growing business needs by replacing the old IBM hardware.

Use of Open Source

IBM maintains the IT infrastructure and they deploy software mainly written by IBM and its partner vendor, which is proprietary.

Benefits

This model will help Bharti Airtel avoid huge capital expenditures and give IBM an opportunity to lease its hardware. This deal gave an opportunity to provide an end-to-end solution and set an example in the market. Outsourcing of technology enables Bharti Airtel to focus resources on its growing business. IBM is taking initiatives to help Bharti Airtel grow and increase its own revenue. This deal gave IBM an opportunity to secure a flow of income instead of receiving a lump sum.

Cost

According to the deal, IBM is precluded for two years from selling the technology developed for Bharti Airtel.

Why it matters

Clearly in this business model IBM will always have an incentive to run the system smoothly and flawlessly to help Airtel grow its business. Although in a revenue sharing model the benefits extracted depend on the bargaining power along with the growth of the player, both IBM and Airtel see this model as an opportunity to grow faster than their corresponding competitors. According to the deal, although IBM can replicate the business model with other telecom player, they cannot use the same technology until two years after it is installed in Airtel. Although the popularity of this revenue-sharing model largely depends on the success of the business partner, server vendors started considering this model as an alternative to the existing CAPEX model.

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129. IDEA is a private telecom operator in India.

Annex XIV

Examples of Mainframe legal cases

IBM does dominate when it comes to supplying mainframe systems that run on its own operating system by not licensing its z/OS on non-IBM hardware. For nearly 50 years the company operated under an agreement with the government that sought to limit IBM's power in certain markets.[130] On January 21, 1952, the government alleged that IBM had monopolized, attempted to monopolize and restrained trade in the tabulating industry, in violation of Sections 1 and 2 of the Sherman Act.[131]

Among other things, the Complaint alleged that IBM only leased, and refused to sell, tabulating machines. Through its lease agreements, IBM allegedly: charged lessees a single price for machine rental and repair and maintenance; limited machine uses; restricted attachments to, alterations in, or experimentation with such machines; and required grant backs of any inventions resulting from a breach of the prohibition on experimentation. By 1955, IBM had adopted the same lease-only strategy with respect to computers. The agreement, a so-called antitrust consent decree, was struck in 1956 to settle allegations of monopoly abuse in the market for electronic tabulating machines. It also covered computers, and parts of it gradually phased out until all provisions were dropped in 2001.

In January 1969 the US Justice Department brought an antitrust action against IBM for monopolizing the computer market. At the time IBM sold its hardware, software, training, and all services as a bundled product. That is, if someone wanted the mainframe software they also had to purchase hardware, training, and everything else from IBM. The suit alleged that IBM violated Section 2 of the Sherman Act by monopolizing or attempting to monopolize the general purpose electronic digital computer system market, specifically computers designed primarily for business. So in July 1969 IBM signed another consent decree to unbundle, which led to the development of hundreds of companies for supplying software (like University Computing and Computer Associates) and hardware (disk drives, memory, and the like). On May 19, 1975, the trial of *U.S. v. IBM* began and spanned a period of over six years. After 13 years of disputes, on January 8, 1982 the case was withdrawn by William F. Baxter, assistant attorney general in charge of the Antitrust Division, Department of Justice. Baxter signed a Stipulation of Dismissal that stated the government's charges were "without merit." On August 13, 1982 IBM petitioned for a writ of mandamus directing Judge David N. Edelstein to "conduct no further proceedings of any kind whatsoever with respect to the parties and issues in the case of United States v. International Business Machines Corp." and to vacate certain orders he had entered "requiring the parties ... to preserve documents." Alternatively, IBM sought for the second time an order from this Court directing Judge Edelstein to recuse himself from further proceedings.

By the late 1990s, all of the other mainframe makers decided to abandon the technology because it was too expensive to keep up with IBM's custom chips and software. In 2001 the consent decree of IBM was completely dissolved by the US Department of Justice. The Department made it clear that if IBM engaged in further "anticompetitive activity" they would be "immediately liable to suit".

On March 12, 2002, Compuware filed suit in the United States District Court for the Eastern District of Michigan against International Business Machines Corporation ("IBM") alleging, among other things, infringement of its copyrights and misappropriation of its trade secrets with respect to its mainframe software tools, intentional interference with contractual relations with its employees and former employees, antitrust law violations, tortuous interference with its economic expectancy and various state law violations. Compuware claimed that (i) IBM had copied and misappropriated portions of its mainframe software tools and had wrongfully used its technology to develop competing products; (ii) IBM made false representations regarding Compuware's software products in violation of the Lanham Act; and (iii) IBM was using its monopoly power to engage in unlawful tying arrangements and was subverting competition on the merits by denying critical information to Compuware and others in an effort to undermine Compuware's development efforts. The suit sought injunctive relief and unspecified monetary damages, among other things, from IBM. In 2004, IBM filed patent infringement claims against Compuware in the United States District Court for the Southern District of New York. On March 22, 2005, Compuware extracted a $400 million settlement from IBM.

It is worth noting that most of the case against IBM has gone on for years with different statements of objections but ends with no final resolution. This may be partly because of the complexity of the technical issues, the

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130. IBM Consent Decree: The primary purpose of the decree was "to establish in the United States a used machine market" to compete against IBM's new computers. The decree requires IBM to sell its computers as well as lease them and to service and sell parts for computers that IBM no longer owned. The other decree provisions generally were intended to reinforce the sale requirement. For example, the decree encouraged the development of an independent repair and maintenance service industry to support the used equipment market. An unanticipated consequence of the decree was the development of computer lessors that competed with IBM in financing.

131. Section 1 of the Sherman Act says, "Every contract combination in the form of trust or otherwise or conspiracy in restraint of trade or commerce among the several states or with foreign nations is declared to be illegal." Section 2 of the Sherman Act says that "Every person who shall monopolize or attempt to monopolize or combine or conspire with any other person or persons to monopolize any part of the trade or commerce among the several states or with foreign nations shall be guilty of a felony."

financial strength of IBM or the government's laissez-faire approach. Most of the server rivals were small and dead. Moreover, IBM has since begun aggressively to protect its hold over the mainframe by buying or striking deals with small competitors who raise antitrust concerns. So when an upstart, **Platform Solutions** developed software that turned standard servers into systems that mimicked IBM's expensive mainframes, Big Blue fought back. After legal action failed, IBM bought Platform in July for $150 million and then it promptly terminated the innovative product. CCIA described the IBM-Platform deal as "a clear attempt by IBM to purchase a company solely to foreclose competition in the mainframe marketplace, protecting its cash cow at the expense of consumers." HP liked Platform's concept, and in 2006 it almost bought the company for close to $200 million. Just before the deal was to close, however, it fell apart when HP's lawyers discovered letters from IBM stating that it would refuse to license its mainframe software to Platform.

In November 2007, Platform got a jolt of cash when Microsoft joined Platform's existing investors, including Intel Capital and Goldman Sachs, to put $37 million more into the company, allowing it to rehire staff and work on a fresh product. But as the legal proceedings dragged on, Platform's investors grew weary. "We were six to nine months from getting a new product to market," Gregory Handschuh, the former general counsel at Platform, recalled. "The investors just didn't have the stomach for fighting a very difficult case."

Platform was not the only potential competitor that drew IBM's fire. At the same time that it sued Platform, IBM declined to renew a patent license with **Fundamental Software**, which also made mainframe emulation software. As a result, Fundamental sits in limbo with a once-popular product it cannot sell, hoping that IBM will change its stance. Also, in 2007, **QSGI**, a company that refurbished used IBM mainframe computers and sold them to customers for significantly less than the cost of a new IBM mainframe computer—announced during an earnings call that it experienced a sharp decline in refurbished IBM mainframe sales because IBM had terminated its pre-existing policy of providing QSGI with the necessary tools to refurbish and resell IBM mainframes. QSGI informed investors that because of IBM's anti-competitive practices, QSGI had no choice but to exit the business of providing refurbished mainframe computers that competed with IBM. QSGI's CEO also told investors that its attorneys advised QSGI that IBM's conduct ran afoul of established antitrust laws. Before QSGI could file an antitrust suit, IBM entered into a "partnership" with QSGI for providing mainframe services. Under the new partnership, IBM agreed to refer its existing mainframe customers to QSGI for auditing and data erasure services, while keeping QSGI out of the mainframe market.

While Platform has disappeared, its fight against IBM lives on in a modified form. T3, the biggest packager of Platform's technology, is carrying on the battle with financial support from Microsoft. T3 Technologies, a Florida-based company that bills itself as "The Other Mainframe Provider", is among the firms filing complaints with the government. In November 2007, T3 Technologies signed onto PSI's lawsuit against IBM and added its own antitrust allegation. Despite IBM's purchase of PSI and the subsequent withdrawal of its antitrust complaint, European officials announced that they would continue to investigate IBM's actions in the mainframe marketplace. In early July 2008 after it was reported that T3 was preparing to file an antitrust complaint of their own in Europe, IBM acquired PSI who then agreed to terminate its legal proceeding against IBM. In January 2009 T3 Technologies, filed a formal antitrust complaint with the European antitrust regulators against IBM. The complaint carries the allegation that *IBM is blocking competition by offering its operating system along with its mainframe hardware and "abusing its monopoly power in the mainframe industry"*. IBM has not seen T3's alleged EU complaint. Nonetheless, IBM is confident that it is no violation of competition laws for IBM to rightfully seek to prevent another company from violating IBM's intellectual property rights. IBM has spent great time and expense developing its technology and will defend its intellectual property rights vigorously.

More recently, **Sun Microsystems**, **Hewlett-Packard** and Microsoft have made mostly unsuccessful attempts to pull mainframe customers away from IBM by creating products that handle similar tasks but run on servers. IBM has also tried to buy Sun for about $7 billion, and if the deal occurred, IBM would also gain a monopoly on the key storage systems used for mainframes.

The Justice Department has started a preliminary antitrust inquiry of IBM by seeking information about IBM's business practices from companies that compete with IBM in the market for the high end. The requests for information followed a complaint filed by CCIA.

The legal practices against IBM have resulted in higher costs for mainframes. Mainframe sales are actually surging; still about 25% of company revenue and nearly half of its profits come from the System z mainframe, according to Wall Street analysts. **IBM mainframe has benefited more from the lack of competition than from updated technology.**

Most of the legal cases are filed against IBM in the IT server market. The accusations stem from claims by IBM rivals that they have been illegally frozen out of the mainframe market because of IBM's refusal to allow its mainframe operating software to run on non-IBM computers. IBM does not have many rivals anymore that make mainframe computers, but some smaller companies are trying to develop technologies that would allow the software to run on cheaper hardware. They allege that IBM, which used to license its mainframe software to competitors and for the last half of the previous century operated under an antitrust agreement with the government, stopped doing so in recent years to **choke off competition.**

Annex XV

IBM's Evolving Mainframe Operating System

1. From 1996 to 2000, the leading operating system marketed by IBM was OS/390.

2. Initially, and for several years, IBM's OS/390, other IBM-compatible mainframe computers supplied by other computer developers such as Amdahl and Hitachi Data Systems, which combined to account for roughly 21 percent of the mainframe computer market by 1999.

3. In Jan 2001, IBM upgraded its OS/390 operating system to the z/OS, which was compatible with all existing IBM-compatible mainframe software.

4. In December 2002, IBM withdrew marketing of the superseded OS/390 version of its operating system and announced that it would discontinue service for OS/390 by September 30, 2004, leaving z/OS as the only version of the IBM-compatible mainframe operating system in production and serviced or supported by IBM.

5. In September of 2004, IBM announced that, as of March 2007, it would discontinue supporting z/OS versions that run on anything other than 64-bit hardware. Accordingly, IBM will no longer support the use of z/OS on Amdahl's and Hitachi's IBM-compatible mainframes, which are 31-bit.

<h1 style="text-align:center">Annex XVI</h1>

Forecast: IT expenditures by verticals ($ million)

Vertical	2006	2007	2008	2009	2010	2011	2012
Communications	4828	5937	6539	7104	8476	9974	11371
Financial Services	4362	5427	6268	6821	7904	8994	10139
Healthcare	659	820	939	1031	1178	1328	1484
Government	2563	3200	3703	4074	4718	5373	6010
Process Manufacturing	1056	1295	1475	1584	1828	2043	2266
Retail Trade	460	582	676	744	866	990	1135
Transportation	656	842	996	1124	1326	1543	1774
Utilities	649	833	977	1091	1288	1501	1741
Total	**20750**	**25956**	**29820**	**32797**	**38420**	**44175**	**49949**

Annex XVII

Intel Chips from 1970 to present

S. No.	Intel-Chips	Year	Intel clock speed	No of transistors	No of Cores	Manufacturing technology	Distinguishing Features
1	Intel® 4004 Processor	1971	108 KHz	2300	1	10 μ	This is the first general purpose microprocessor that could be customized with software to perform different functions on different devices.
2	Intel @ 8086 processor	1978	5 MHz	29000	1	3 μ	This was the first 16-bit processor and delivered about 10 times the performance of its predecessors.
3	Intel® 386 processor	1985	16 MHz	275000	1	1.5 μ	The Intel386™ processor could run multiple software programs at once and featured 275,000 transistors—more than 100 times as many as the original Intel® 4004.
4	Intel486™ processor	1989	25 MHz	1200000	1	1 μ	The Intel486™ introduced the integrated floating point unit.
5	Intel® Pentium® processor	1993	66 MHz	31,000,000	1	0.8 μ	It executes 112 million commands per second.
6	Intel Pentium Processor	1995	200 MHz	5,500,000	1	0.6 μ	This makes possible advanced 3D visualization and interactive capabilities.
7	Intel® Pentium® III processor	1999	500 MHz	9500000	1	0.18 μ	This executed Internet Streaming SIMD Extensions, extended the concept of processor identification and utilized multiple low-power states to conserve power during idle times.
8	Intel® Pentium® 4 processor	2000	1.5 GHz	42000000	1	0.18 μ	This processor ushers in the advent of the nanotechnology age.
9	Intel® Pentium® M processor	2002	1.7 GHz	5500000	1	90 nm	Intel "Core"™ processor family delivers advanced mobile performance and is built for energy-efficient power savings.
10	Intel® Itanium® 2 processor	2002	1 GHz	220000000	2	0.13 μ	The architecture is based on Explicitly Parallel Instruction Computing (EPIC). It is theoretically capable of performing roughly eight times more work per clock cycle than other CISC and RISC architectures.
11	Intel® Core™2 Duo processor	2006	2.93 GHz	291000000	2	65 nm	This optimizes mobile micro architecture of the Intel® Pentium® M processor.
12	Dual-Core Intel® Itanium® 2 processor 9000 series	2006	1.66 GHz	1720000000	2	90nm	With more than 1.7 billion transistors and with two execution cores, these processors double the performance of previous Itanium processors while reducing average power consumption.
13	Quad Core Intel® Xeon® Processor (Penryn)	2007	>3 GHz	820000000	4	45 nm	The new SSE4 instructions for improved video, imaging, and 3D content performance and new power management features will extend the "Penryn" processor family leadership
14	Nehalem	15-Nov-08	2.8 GHz	731 million	4	45nm	Intel's latest-generation micro architecture.
15	Mobile – Nehalem						To be announced in late 2009 or early 2010

Source: http://gizmodo.com/photogallery/IntelChips1971to2007

Annex XVIII

FRAMEWORK FOR INVESTIGATING ABUSE OF DOMINANCE IN INDIA UNDER THE COMPETITION ACT

The Act defines: (a) Dominance and (b) Abuse of Dominance. Any act of abuse has to be seen in the context of the 'Relevant Market'. Any inquiry into a matter involving an enterprise's dominant behavior will therefore need to look at each of these concepts as applicable in a given fact situation.

The framework of inquiry on Abuse of Dominance in any given case will therefore need to comprise the following elements:

(a) Whether the enterprise is in a dominant position in the relevant market

(b) Whether the enterprise is abusing its dominant position in the relevant market

engaging in such abuse is in a 'dominant position'. For an act to be in contravention of the law, *abuse of dominant position* is imperative.

The instances of 'abuse' outlined in Box 1 above results in harmful impact for both consumers and other existing or potential competitors. These instances can be categorized into two broad categories: (a) Exploitative Conduct by an enterprise/ group that results in exploitation of consumers; and (b) Exclusionary conduct by an enterprise/ group, through which the enterprise/ group seeks to anti-competitively impair competition from another enterprise or growth of such other enterprise. Exploitative conduct is therefore conduct designed to exploit the power of an enterprise, whereas

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BOX 1: ABUSE OF DOMINANT POSITION: Section 4(2)

There shall be an abuse of dominant position if an enterprise or group:-

(a) directly or indirectly imposes unfair or discriminatory conditions or prices in purchase or sale of goods or services, (including through "predatory pricing");

(b) limits or restricts production of goods/services or market for such goods or services;

(c) limits or restricts technical or scientific development relating to goods or services to the prejudice of consumers;

(d) indulges in a practice that can deny market access in any manner;

(e) makes conclusion of contracts subject to the acceptance by other parties of supplementary obligations which, by their nature or according to commercial usage, have no connection with the subject of such contracts; or

(f) uses its dominant position in one relevant market to enter into or protect other relevant market.

The term 'dominant position' is defined under the Act, as explained above. The Act further lists under Section 19(4) criteria that are to be considered by the CCI while making an inquiry into whether an enterprise/ group is in a 'dominant position'. The Competition Act recognizes that *dominance* in itself is not a matter of concern. The focus of the CCI's inquiry therefore is the question whether by being in a dominant position in the relevant market the enterprise/group is engaging in abusing its position through conduct as listed in Section 4 of the Act.

Situations that would amount to an 'Abuse of dominant position' have been defined in Section 4(2) of the Competition Act. The following Box enumerates these circumstances.

The above instances of 'abuse' will need to be tested against the principles of the Competition Act only if it is established through evidence that the enterprise

exclusionary conduct is that which seeks to preserve or expand the power of the enterprise by excluding competitors from entering the relevant market.

Section 19(4) of the Act lists several factors that the CCI would need to consider in determining whether an enterprise or a group is in a dominant position. It is important to note at the outset that the Competition Act does not mandate that *all* the factors in Section 19(4) need to be applied in *all* cases. At the same time, no one factor in itself can lead to a complete analysis. The list of factors in the section provide a guide-post for analysis, and depending on the facts and circumstances of each case, the CCI would have to decide which aspects are relevant for application.

The following box encapsulates the factors listed for consideration by the CCI in an analysis of *dominant position*.

BOX 2: FACTORS FOR ASSESSMENT OF DOMINANT POSITION

S.19(4): The Commission shall, while inquiring whether an enterprise enjoys a dominant position or not under section 4, have due regard to all or any of the following factors:

(a)   Market share of the enterprise

(b)   Size and resources of the enterprise;

(c)   Size and importance of the competitors;

(d)   Economic power of the enterprise including commercial advantages over competitors;

(e)   Vertical integration of the enterprises or sale or service network of such enterprises;

(f)   Dependence of consumers on the enterprise;

(g)   Monopoly or dominant position whether acquired as a result of any statute or by virtue of being a Government company or a public sector undertaking or otherwise;

(h)   Entry barriers including barriers such as regulatory barriers, financial risk, high capital cost of entry, marketing entry barriers, technical entry barriers, economies of scale, high cost of substitutable goods or service for consumers;

(i)   Countervailing buying power;

(j)   Market structure and size of market;

(k)   Social obligations and social costs;

(l)   Relative advantage, by way of the contribution to the economic development, by the enterprise enjoying a dominant position having or likely to have an appreciable adverse effect on competition;

(m)   Any other factor which the CCI may consider relevant for the inquiry.

Annex XIX

A. Vendor-wise market share for Total Market in India

Vendors \ Years	2002	2003	2004	2005	2006	2007	2008	2009 Q1
Acer	3.39	4.47	2.38	1.53	1.37	0.72	1.37	0.25
Apple Computer	0.00	0.04	0.01	0.02	0.02	0.01	0.01	0.01
Dell Inc	2.57	3.08	4.10	6.09	6.93	8.39	8.08	7.78
Fujitsu/Fujitsu Siemens	0.00	0.00	0.00	0.00	0.00	0.02	0.25	0.19
Groupe Bull	0.00	0.00	0.00	0.05	0.06	0.01	0.00	0.00
HCL Insol	4.60	4.98	8.15	7.89	5.61	3.78	6.13	6.56
HP	31.86	31.97	30.05	33.93	33.67	38.04	39.24	35.48
IBM	24.45	29.93	27.97	31.43	34.17	33.16	31.46	31.16
Lenovo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Other Vendors	5.04	3.75	3.00	1.87	1.40	0.62	0.76	1.17
SGI	0.62	0.18	0.25	0.04	0.00	0.01	0.07	0.31
Stratus Computers	0.02	0.19	0.21	0.19	0.16	0.75	0.01	0.00
Sun Microsystems	23.98	18.78	20.71	14.61	14.77	13.27	11.80	15.38
Unisys	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Verrari Systems	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Wipro	2.71	1.81	1.81	1.71	1.44	0.99	0.67	1.50
Zenith Computers	0.77	0.82	1.37	0.63	0.38	0.22	0.13	0.16
Total	100	100	100	100	100	100	100	100

B. Vendor-wise market share for Entry Level Segment

Vendors \ Years	2002	2003	2004	2005	2006	2007	2008	2009 Q1
Acer	6.74	7.47	3.90	2.45	2.20	1.21	2.25	0.49
Apple Computer	0.00	0.06	0.00	0.03	0.04	0.01	0.01	0.01
Dell Inc	5.11	5.15	6.74	9.78	11.13	14.16	13.25	15.12
Fujitsu/Fujitsu Siemens	0.00	0.00	0.00	0.00	0.00	0.04	0.29	0.09
Groupe Bull	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
HCL Insol	9.13	8.32	13.38	12.67	9.01	6.38	10.05	12.74
HP	33.03	34.99	29.29	31.24	30.94	40.93	35.63	31.81
IBM	21.06	26.46	24.98	24.63	30.68	25.27	26.12	19.37
Lenovo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
Other Vendors	10.01	6.27	4.92	3.01	2.25	1.04	1.24	2.28
SGI	0.08	0.00	0.13	0.02	0.00	0.00	0.06	0.18
Stratus Computers	0.03	0.02	0.03	0.00	0.00	0.05	0.02	0.00
Sun Microsystems	7.91	6.87	11.42	12.33	10.82	8.85	9.74	14.59
Unisys	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Verrari Systems	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Wipro	5.38	3.02	2.96	2.74	2.31	1.68	1.11	2.92
Zenith Computers	1.53	1.37	2.25	1.02	0.60	0.37	0.22	0.31
Total	100	100	100	100	100	100	100	100

C. Vendor-wise market share for Mid-range Segment

Vendors \ Years	2002	2003	2004	2005	2006	2007	2008	2009 Q1
Fujitsu/Fujitsu Siemens	0	0	0	0	0	0	0	1.01
Groupe Bull	0	0	0	0.04	0.40	0.08	0	0
Hewlett-Packard	25.29	26.23	33.21	32.84	28.16	28.83	37.25	52.61
IBM	38.77	34.37	38.04	48.26	35.02	37.83	20.45	31.49
SGI	0.52	0.38	1.04	0.15	0	0.07	0.10	0.29
Stratus Computers	0	0.21	0	0	0	0.30	0	0
Sun Microsystems	35.43	38.81	27.71	18.71	36.42	32.89	42.20	14.59
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

D. Vendor-wise market share for High-end Segment

Vendors \ Years	2002	2003	2004	2005	2006	2007	2008	2009 Q1
Fujitsu/Fujitsu Siemens	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00
Hewlett-Packard	35.47	28.89	29.79	44.47	45.39	36.58	46.91	33.79
IBM	18.25	35.93	28.71	36.47	43.48	48.39	44.90	48.81
SGI	1.73	0.54	0.00	0.00	0.00	0.00	0.07	0.50
Stratus Computers	0.00	0.73	0.85	1.08	0.72	2.57	0.00	0.00
Sun Microsystems	44.56	33.91	40.65	17.97	10.40	12.45	7.87	16.90
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Annex XX

Percentage share of different OS installed across verticals

	2006	2007	2008		2006	2007	2008
Agriculture, Mining, and Construction				**Process Manufacturing**			
Linux	7.2	8.6	10.2	Linux	7.2	9.2	10.9
Other	0.6	0.1	0.0	Other	0.1	0.0	0.0
UNIX	8.7	6.0	6.7	UNIX	6.5	5.8	6.4
Windows	83.5	85.2	83.1	Windows	86.2	84.9	82.7
Total	**100**	**100**	**100**	**Total**	100	100	100
Communications				**Retail Trade**			
Linux	21.5	23.0	20.8	Linux	7.1	7.7	10.2
Other	0.3	0.1	0.1	Other	0.2	0.0	0.0
UNIX	10.8	10.2	13.8	UNIX	4.0	3.3	6.3
Windows	67.5	66.7	65.3	Windows	88.8	88.9	83.5
Total	**100**	**100**	**100**	**Total**	100	100	100
Discrete Manufacturing				**Services**			
Linux	9.0	12.3	14.7	Linux	16.2	18.9	22.2
Other	0.2	0.0	0.0	Other	0.2	0.2	0.1
UNIX	5.3	4.3	6.9	UNIX	6.4	7.2	11.4
Windows	85.6	83.4	78.4	Windows	77.2	73.8	66.2
Total	**100**	**100**	**100**	**Total**	100	100	100
Education				**Transportation**			
Linux	18.3	25.3	43.5	Linux	12.3	12.2	14.4
UNIX	7.6	7.3	4.9	Other	0.0	0.0	0.0
Windows	74.1	67.4	51.5	UNIX	3.4	2.3	6.4
Total	**100**	**100**	**100**	Windows	84.3	85.5	79.2
Financial Services				**Total**	100	100	100
Linux	9.2	12.8	12.9	**Utilities**			
Other	0.4	0.3	0.5	Linux	7.1	20.6	36.1
UNIX	8.9	9.2	10.6	Other	0.1	0.0	0.1
Windows	81.4	77.7	76.0	UNIX	10.3	7.5	11.6
Total	**100**	**100**	**100**	Windows	82.5	72.0	52.3
Government				**Total**	100	100	100
Linux	12.4	16.5	21.8	**Wholesale trade**			
Other	0.2	0.0	0.0	Linux	15.2	22.6	32.5
UNIX	10.3	6.7	4.6	Other	0.1	0.1	0.0
Windows	77.0	76.8	73.6	UNIX	7.2	9.4	9.1
Total	**100**	**100**	**100**	Windows	77.6	67.9	58.3
Healthcare				**Total**	100	100	100
Linux	9.1	11.1	12.7				
UNIX	13.5	14.3	14.8				
Windows	77.4	74.6	72.5				
Total	**100**	**100**	**100**				

Annex XXI

Percentage share of Processors sold in each vertical

	2006	2007	2008		2006	2007	2008
Agriculture, Mining, and Construction				**Process Manufacturing**			
IA64	1	0	1	IA64	0	1	1
Other	0	0	0	Other	0	0	0
RISC	6	5	4	RISC	6	5	3
x86	93	95	95	x86	94	94	95
Total	**100**	**100**	**100**	**Total**	**100**	**100**	**100**
Communications				**Retail Trade**			
IA64	1	2	1	IA64	0	0	1
RISC	8	7	8	Other	0	0	0
x86	91	91	91	RISC	3	3	3
Total	**100**	**100**	**100**	x86	96	97	96
				Total	**100**	**100**	**100**
Discrete Manufacturing				**Services**			
IA64	0	0	1	IA64	0	1	2
Other	0	0	0	Other	0	0	0
RISC	4	4	4	RISC	5	5	4
x86	96	96	95	x86	94	94	94
Total	**100**	**100**	**100**	**Total**	**100**	**100**	**100**
Education				**Transportation**			
IA64	0	0	0	IA64	0	0	0
RISC	5	4	1	Other	0	0	0
x86	95	96	98	RISC	3	2	1
Total	**100**	**100**	**100**	x86	97	98	98
				Total	**100**	**100**	**100**
Financial Services				**Utilities**			
IA64	1	1	1	IA64	0	0	0
Other	0	0	0	Other	0	0	0
RISC	6	6	5	RISC	2	1	2
x86	93	93	94	x86	98	99	98
Total	**100**	**100**	**100**	**Total**	**100**	**100**	**100**
Government				**Wholesale trade**			
IA64	1	1	1	IA64	1	2	1
RISC	8	5	3	Other	0	0	0
x86	91	94	97	RISC	3	5	4
Total	**100**	**100**	**100**	x86	96	93	95
Healthcare				**Total**	**100**	**100**	**100**
IA64	2	5	5				
RISC	12	9	4				
x86	87	86	91				
Total	**100**	**100**	**100**				

Annex XXII

Distribution of OS installed across verticals by top three Vendors (2006-2008)

Vendor	Vertical	Linux	Other	UNIX	Windows
Hewlett-Packard	Agriculture, Mining, and Construction	0.3	0.0	0.1	0.6
	Communications	19.8	26.9	25.4	13.9
	Discrete Manufacturing	4.6	0.0	1.1	9.2
	Education	2.5	0.0	0.9	5.0
	Financial Services	13.5	66.8	31.1	18.4
	Government	10.8	0.0	2.2	9.2
	Healthcare	2.5	0.0	11.0	3.0
	Process Manufacturing	2.7	0.0	4.2	4.8
	Retail Trade	1.6	0.0	0.7	4.9
	Services	21.2	5.9	12.5	16.3
	Transportation	3.3	0.0	0.7	3.6
	Utilities	1.9	0.0	0.4	2.7
	Wholesale Trade	15.3	0.5	9.6	8.4
Hewlett-Packard Total		**100.0**	**100.0**	**100.0**	**100.0**
IBM	Agriculture, Mining, and Construction	0.1	0.1	0.8	0.5
	Communications	19.8	10.2	18.4	12.8
	Discrete Manufacturing	7.5	2.0	3.9	8.0
	Education	8.3	0.0	0.3	2.8
	Financial Services	16.1	54.5	26.1	23.6
	Government	5.0	2.8	14.6	10.4
	Healthcare	0.0	0.0	1.7	0.5
	Process Manufacturing	1.9	0.9	4.6	4.3
	Retail Trade	1.6	1.5	1.6	5.2
	Services	21.7	24.7	16.9	16.6
	Transportation	0.1	0.2	1.4	3.3
	Utilities	1.4	0.9	1.3	2.6
	Wholesale Trade	16.5	2.2	8.4	9.2
IBM Total		**100.0**	**100.0**	**100.0**	**100.0**
Sun Microsystems	Agriculture, Mining, and Construction	0.0	0.0	0.5	0.0
	Communications	53.8	0.0	19.2	46.2
	Discrete Manufacturing	2.2	0.0	6.7	0.0
	Education	4.2	0.0	5.7	0.0
	Financial Services	12.2	0.0	20.7	32.9
	Government	5.1	0.0	11.2	0.0
	Healthcare	0.3	0.0	2.1	0.0
	Process Manufacturing	0.7	0.0	3.9	1.4
	Retail Trade	1.1	0.0	2.9	0.0
	Services	17.7	0.0	16.1	18.6
	Transportation	0.4	0.0	0.4	0.0
	Utilities	0.1	0.0	1.7	0.0
	Wholesale Trade	2.3	0.0	8.9	0.8
Sun Microsystems Total		**100.0**	**0.0**	**100.0**	**100.0**

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