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Communications of the Association for Information Systems

Sanchari: Moving Up the Value Chain Through Telecommunication Services

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Abstract:

The year 2009 was a critical year in the development of Sanchari, a state-owned telecommunication infrastructure (TI) service provider in India. Over the past few years, Sanchari had successfully developed and delivered on-demand infrastructure services to customers in the state of Karnataka, India. Sanchari's management team wanted to move their business up the value chain to take advantage of the rapidly growing telecommunication industry in India. In the middle of 2009, Sanchari was approached by the state government of Karnataka to lead the development of a state-wide-area-network (SWAN) under the e-government initiative. This e-government project could give Sanchari an opportunity to move up the value chain. Sanchari needed to decide whether it would take the sole responsibility of this project as the government agent or form a partnership with a private company to execute it. This decision, however, would depend on whether Sanchari wanted to develop into an infrastructure or software service provider or maintain its status quo as a TI service provider in the long term. The teaching case provides a challenging decision-making situation for students and urges them to analyze the benefits and risks of moving up the telecommunication value chain.

Keywords: cloud computing, e-government project, telecommunication industry, India, teaching case, telecommunication infrastructure, telecommunication service provider, value chain

Editor's Note: A teaching note for this case can be obtained from indranil_bose@yahoo.com. Only active faculty who are currently listed in the AIS Faculty Directory are eligible to receive the teaching note.

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I. INTRODUCTION

The future of the telecom industry in India is very promising and lucrative, and we are in an enviable position to take advantage of the development opportunity. We want to build upon our success in providing telecom infrastructure services in Karnataka to expand our business and move up the value chain. We aim to become a top telecom service provider in India in ten years' time.

Aadi Aron, Director, Sanchari

Sanchari is a telecom infrastructure (TI) services provider in India. It was established in 2006 as a joint venture between the government of India and the state government of Karnataka to deliver TI service to West Town in Karnataka. Following the success of the West Town Project, Sanchari had managed several similar projects in Karnataka and became a well-known TI provider in the region. TI services allowed customers to avoid the high fixed costs of building the required infrastructure on their own and the long-term commitment of fixed-priced infrastructure outsourcing contracts. With the increase in the number of Internet applications available online, the demand for broadband services, such as streaming video and large file transfers (for example, movies), was accelerating in India. The demand for broadband services created a huge demand for telecommunications capacity, and even the residential areas were full of users running bandwidth-hungry applications. Sanchari was perfectly poised to take advantage of the TI-demand boom in India. Sanchari had been considering how to move up the telecommunication value chain.

An opportunity came in 2009 when Sanchari was approached by the state government of Karnataka to take the lead in developing a state-wide-area-network (SWAN) for the state of Karnataka under the e-government initiative. The SWAN scheme was funded by the government of Karnataka. For this project, Sanchari had to choose between the National Informatics Centre (NIC) approach and the Public Private Partnership (PPP) approach to implement it. The easiest option for Sanchari was to adopt the NIC approach and manage the project as a state-owned enterprise. Nevertheless, an appropriate PPP approach could help Sanchari move up the value chain in the long term. As a state-owned enterprise, Sanchari had the obligation to make the SWAN scheme a success in Karnataka. But it seemed that the project could not bring in synergy with Sanchari's core business in delivering TI service. Considering the different types of business models in the telecommunication industry, first of all, Sanchari had to decide on their long-term strategic direction. Then, based on this strategic direction, Sanchari had to consider how to align the SWAN project with their core business and leverage it to move up the value chain. Sanchari was considering which business model might best suit the company in the long term and whether the NIC approach or the PPP approach should be adopted in the e-government project. Sanchari had the expertise to develop SWAN, but the difficulty facing Sanchari was how to align this project with its long-term strategic vision to move up the telecommunication value chain. In order to find the best possible solution for the future of the company, Sanchari had brought in a consulting team to evaluate the situation and make recommendations on their available options.

II. THE TELECOMMUNICATION INDUSTRY

Telecommunication Business Models

The traditional business model in telecommunication was a vertically integrated model where one party owned the network infrastructure, operated the network, and delivered the services over the network. The services were limited to telephone, radio, and television, and this justified the use of a dedicated infrastructure for each service, optimized to transmit information carried by a specific physical signal and with inherently different traffic patterns. With the growing amount of available services such as video conferencing, online gaming, and e-health, more information needed to be stored and transmitted digitally. Moreover, with a range of applications available, end users were no longer limited to consuming the content and were able to participate in producing content as well. These changes made the traditional vertically integrated business model obsolete and inefficient, and the open network model, which separated the roles of the service provider, the network operator, and the communication operator, became more promising [Forzati et al., 2010]. Table 1 is a generic representation of the telecommunication business model, identifying the different players and their roles.

Sanchari's existing business was in fiber optics, which was wired and required cable infrastructure to run the business. They operated in Level 1 in the telecommunication business model shown in Figure 1 as a network operator or TI provider. A fiber access network is made up of passive infrastructure (e.g., right-of-way acquisition, trenching, cable duct laying, local-office premises), and active equipments (e.g., transponders, routers and switches,

Table 1: Telecommunication Business Models

Business Model	Definition
Level 1 Network operator (NO)	Passive components (e.g., fibers, cables, ducts, closures) Customer premises equipment
Level 2 Communications operator (CO)	Optical networking platform (e.g., marketing, billing) Active components (e.g., routers, switches, points-of-presence)
Level 3 Telecommunication service providers (SP)	Services (e.g., telephone, Internet, video)

control and management servers). The passive infrastructure is associated with high initial capital investment, low operational expenditure, and locally regulated business environment, while the active equipment is associated with high operational expenditure, economies of scale, and relatively limited regulations [Forzati et al., 2010].

Initially, due to the decrease in fixed line traffic volume, mainly resulting from the introduction of mobile services, the traditional service providers (i.e., legacy telecommunication operators) were forced to look for new growth engines beyond landline telephone services. Some of them joined the mobile bandwagon and slowly became “also-mobile” players. The reverse trend (i.e., big “only-mobile” players becoming “also-landline” players) was, however, not prominent except in a few cases where companies wanted to make their portfolio complete with both offerings. In fact, the traffic volume on mobile networks had been growing fast, partly because of the mutually reinforcing deployment of higher rate services and more capable devices. The policy response to rapid growth in mobile data traffic had been to increase the spectrum supply available for commercial mobile radio services, which was strongly supported by operators because it was five times cheaper to increase capacity by lighting up a new channel at an existing site than building a new site, if the cost of spectrum was not taken into account [Chapin and Lehr, 2011].

Due to the rapid emergence of mobile voice and data traffic, the telecommunication networks were beginning to become open at different levels, leading to different business models as shown in Figure 1. Generally speaking, one network operator (NO) managed the infrastructure, while one or several communication operators (CO) operated the active infrastructure on a periodical contract basis. The communication operators (CO) offered service providers (SP) equal access to the network. The end users directly purchased services from the service providers (SP). Therefore, the communication operators (CO) paid a connection fee to the network operator for network access and received payments from the service providers.

The open access business model allowed consumers the flexibility to choose between various SPs to meet their individual demands at a lower tariff. It was also suitable for offering “dynamic rental computing, and storage, network, and other office desktop capabilities to provide a range of innovative service mechanisms” by the SPs that could be useful to the consumers and create new business opportunities [Abin, 2011]. The open access business model could pave the way for mixing and matching telecommunication services from a list of SPs by the consumers where different SPs used the same infrastructure managed by an NO. However, the flexibility of the model meant that NOs and COs could be reduced to mere providers of conduits that were enjoyed by SPs to earn significant revenues from the consumers. If the NOs and COs did not wake up to this reality, it was likely that their share of revenue could become significantly limited, and they could even run out of business. As a result, there was a growing belief among NOs and COs that to survive in this intensely competitive environment, there was a need to change the business model and try to move up the telecommunication value chain by providing additional services, while maintaining a synergy with their existing core competencies.

Declining revenues combined with the need for strong growth is forcing telecom operators to consider new business models that will substantially change their role in the telecom's value chain.

Herzog [2011]

Telecommunication Industry in India

In 2007, the telecommunication industry in India was among the fastest growing in the world. The government of India regarded the development of the industry as highly important.

The telecom services have been recognised the world-over as an important tool for development for a nation and hence telecom infrastructure is treated as a crucial factor to realise the socio-economic objectives in India.

Department of Telecommunications [2011a]

The developmental history of the telecommunication industry in India reflected the changes in government policies. Until the 1990s, the telecommunication industry had been a monopolistic market under the government's

Source: Access Network Business Models [Forzati et al., 2010]

Figure 1. Evolution of Telecommunication Business Models

supervision. The Department of Telecommunications (DoT) was in charge of formulating the telecommunication development policies and granting service licenses. In July 1991, the liberalization process started when the New Economic Policy was announced. Telecommunication equipment manufacturing was de-licensed, and value added services, such as radio paging and mobile services, were gradually declared open to the private sector. In May 1994, the government of India made it clear in the National Telecommunication Policy that its intention was to liberalize the telecommunication sector and achieve some important development objectives, such as telecommunication penetration and positioning itself in the global telecommunication market. In 1997, a central telecommunication regulatory body called the Telecommunication Regulatory Authority of India (TRAI) was formed by the government of India to supervise the smooth functioning of the Indian telecommunication market. The TRAI was a subordinate of the Ministry of Communications & Information Technology (MCIT), government of India. In 1999, the New Telecommunication Policy (NTP-99) was introduced; it was considered to be the most important instrument for telecommunication reforms in India. It drew a roadmap for telecommunication reforms which opened up all the telecommunication segments for private-sector participation and emphasized the important role of the regulatory regime [Department of Telecommunications, 2011b]. In 2000, the government of India relaxed the entrance criteria for private companies and adopted a *liberalization-privatization-globalization* policy to change the way its Department of Telecommunications used to operate until then. Its operations wing was separated from the policy wing and corporatized as a new entity, named 'Bharat Sanchar Nigam Limited (BSNL)', to operate services in different parts of the country as a public sector unit. The separation of BSNL to compete with private service providers created a highly competitive business environment.

Thanks to the policy change, the telecommunication industry became a major GDP (Gross Domestic Product) contributor. It directly contributed more than 1.5 percent of GDP of India in 2009 and had a multiplier effect on growth through connecting the business and people around it [CyberMedia News, 2009]. According to TRAI [2010], the growth of subscribers connected to the Indian telecommunication network achieved a compounded annual growth rate of 44.66 percent between 2005 and 2010. India became one of the fastest growing mobile markets in the world, with a compounded annual growth rate of 81 percent between 2002 and 2008 [Ghosh et al., 2009]. This growth was poised to continue for some time, and India was expected to remain the world's second largest wireless market after China in terms of mobile connections. The mobile value-added services market, including text or SMS, menu-based services, music or ring tone downloads, mobile television, videos, and other complicated mobile commerce applications, would become particularly lucrative. These value-added services accounted for 10 to 12 percent of the telecommunication operators' revenue, which was expected to grow to 20 percent by 2013 [IBEF, 2010].

The Indian mobile industry has now moved out of its hyper growth mode, but it will continue to grow at double-digit rates for next three years as operators focus on rural parts of the country. Growth will also be triggered by the adoption of value-added services, which are relevant to both rural and urban markets.

Madhusudan Gupta, Senior Research Analyst at Gartner [IBEF, 2010]

The booming Indian telecommunication market attracted a significant amount of investments with the entry of new players and the launch of new services. The Department of Industrial Policy and Promotion indicated that the telecommunication sectors (including radio paging, mobile services, and basic telephone services) attracted foreign direct investment worth US\$ 2,554 million in 2009. Besides investing directly in the industry, international players were also trying to enter the Indian Telecommunication Industry through mergers and acquisitions. The government of India followed a proactive approach to facilitate the rapid growth of the Indian telecommunication Industry. They encouraged foreign investment, allowing 100 percent FDI in the area of telecommunication equipment manufacturing and provisioning of IT-enabled services. They did not put any limit on the number of access providers in any service area.

The rapid development of the telecommunication industry was mainly concentrated in the highly populated urban areas, and rural India remained a huge untapped market. For example, in 2007, India's broadband penetration was only 0.2 percent, which meant that only about 2.5 million out of the total 1.13 billion people in India had broadband connection. To develop the broadband market, the government of India proposed "to offer all citizens of India free, high-speed broadband connectivity by 2009 through the state-owned telecommunication service providers" [Joji, 2007]. The government decided to allocate a part of the funds collected by the Universal Service Obligation Fund to establish an extensive fiber optic network throughout the country. Other measures included intensifying the competition in the long-distance sectors, making the access to cable landing stations connecting submarine telecommunication cables to data and voice networks free of charge, allowing bandwidth resale, building Web hosting facilities to reduce the usage of international bandwidth, and maximizing utilization of domestic bandwidth. These measures significantly reduced the price of broadband access in India [Bose and Joshi, 2008].

III. SANCHARI

Company Background

Sanchari, an IP-1 licensee, was a joint venture between the government of India and the state government of Karnataka. The company had strong R&D setup, and employed twenty highly skilled engineers. It had a very experienced management team, and each member of the team enjoyed more than fifteen years of experience in the field. Aron, the director of Sanchari, had worked in the telecommunication industry for over thirty years. As he had previously worked for both private companies and state-owned enterprises, he had good knowledge of the overall telecommunication industry in India and understood the differences between the private and the state-owned companies very well.

The reason for establishing Sanchari was to provide network infrastructure services to the companies and citizens of West Town, Karnataka. The provision of TI services made infrastructure sharing possible. Corporate customers were no longer required to invest a significant amount of money in building their TI. Unlike outsourcing contracts, they did not need to commit to a long-term contract either. Therefore, the TI services met the general trend of using the technologies to provide robust and converged services with a focus on data transmission. Sanchari was responsible for equipment and project execution and for technical and management expertise for development of TI in West Town. Since Sanchari was a state-owned company, it was able to provide a neutral level playing field for all commercial telecommunication operators.

The West Town project was designed to build a comprehensive underground multiple duct/fiber networks throughout the town to lend/lease/sell duct/fiber to all operators needing underground space for communication. The purpose of the project was to facilitate state-of-the-art TI to make futuristic propositions, like Fiber to the Home, and self-owned dark fiber a realistic one in order to avoid repeated digging of roads by multiple operators, and finally to get the common type of infrastructure built and maintained by an independent body to allow transparency. The network built by Sanchari was to provide basic intra data communication facilities to promote civic amenities like centralized traffic signaling, centralized and distributed surveillance system, burglar alarm system, remote-controlled energy meter reading system for electricity companies, etc., beside telecommunication services.

TI, Sanchari's core business, became increasingly popular because it was able to divide legacy telecommunication service into smaller business segments along the value chain. TI providers delivered TI services on demand (as and when needed) in such a way that customers neither incurred the high fixed costs of building the required infrastructure on their own, nor needed to commit to long-term fixed-price outsourcing contracts. Instead, they received the basic infrastructure they needed and paid only for what they used. They could lease it from towers to house antennas or ducts for laying fiber optic cables [Green, 2001] for a long time and ramp it up internally by adding new antennas or new fiber strands as per the demand, either without incurring any extra leasing cost or at the cost of a nominal additional lease price. Therefore, sharing TI services helped customers improve capital efficiency and reduce the cost of maintaining passive TI, allowing telecommunication operators to focus on their core business operations.

In fact, the emerging TI services industry represented a marked departure from the existing ways of doing legacy telecommunication business. On one hand, they featured attributes that appealed to customers: short lead times in service provisioning, high reliability and survivability (a duct had an average lifetime of twenty years; a fiber had a very low error rate $\sim 10^{-9}$), customized service level agreements, a reduced learning curve in the adoption of a new service-like voice-over-IP, and easy access to new technology such as wave division multiplexing [Murthy and Gurusamy, 2001]. On the other hand, TI services had direct financial benefits for the customer. First, TI services reduced the risk faced by the corporate (high-volume) customer because the costs to the customer were proportional to the portion of TI hired by him/her for a given time period (say, a year). These two were related to the number of transactions the customer wanted to perform during the same interval, and, therefore, with the revenue stream of the customer as well. Second, financial advantage of TI services came from economies of scale. TI services were designed to run on a shared infrastructure (e.g., duct), in which fiber space could be shared among multiple customers (e.g., twenty-four pairs could be drawn through one duct and each pair could be allotted to one customer). As the number of retail (low-end) customers grew, the average duct utilization grew because of the spatial multiplexing of customer demand.

The success of the West Town Project had brought several similar TI projects for Sanchari. By 2010, Sanchari was offering ducts and dark fibers to both wholesale and retail customers on demand. The company invested heavily in WDM and dense WDM equipment, and Network Operations Centre (NOC). The management team of Sanchari wanted to explore different technology options in order to move the company forward.

The explosion in Internet use, both wired and wireless, has created a huge demand for telecommunication capacity in India. The congregation of IT firms has already fueled its core broadband demand that can be supplied over WDM technology. Shortly, broadband over last mile, may it be copper, fiber, hybrid, or wireless, will be a major thrust in bandwidth growth, once the residential areas become full of users running bandwidth-hungry applications. We are perfectly poised to take advantage of this TI demand boom in India. But, since the demand is still extremely volatile, it is very difficult for us to make strategic plans.

Aadi Aron, Director, Sanchari

The State-Wide-Area-Network (SWAN) Project

Sanchari was a state-owned enterprise, and this status was not expected to change in the following years, unless any major government policy changed. So Sanchari had no choice but to accept any request from the government. Sanchari was approached by State Government of Karnataka, to develop a SWAN for the state of Karnataka. Under this e-government initiative, each state in India was required to have a SWAN. Using either copper, optical fiber cables, or wireless as the medium of connectivity, Wide Area Network (WAN) was a TI created to transfer information and data electronically between two or more geographical locations. SWAN was considered as a key in building the core infrastructure to support the delivery of e-governance. To deliver e-governance services, the government of India aimed to fulfill the following tasks [DIT, 2010a]:

1. To develop back-end applications suitable for use by various government departments
2. To develop Common Service Centers as a service delivery platform for citizens
3. To develop SWAN as a reliable communication network to enhance connectivity between service delivery outlets and government departments
4. To develop a data center at the state level (State Data Center) for data warehousing and hosting of application software

The SWAN scheme was envisioned to develop a high bandwidth data communication network to connect the State Data Centre, Common Service Centre, Community Information Centre, and all online services provided by the state government. This could help to solve the existing situation where different administrative departments usually had their own stand-alone systems and were not connected together. By enhancing connectivity among states, the SWAN scheme also aimed to bring speed, efficiency, reliability, and accountability in the overall system of Government-to-Government (G2G) functioning. The resulting system would not only ensure the timely dissemination of government information and services and improve public service provisioning in the areas such as education, health awareness, weather information, news delivery services, and disaster management, but it would also allow the government bodies to hold virtual meetings and training courses to save travel costs and time [DIT, 2010a].

Nationwide, the SWANs would create a dedicated Closed User Group network with a minimum speed of 2 Mbps by covering at least 50000 departmental offices through 1 million route kilometers of communication links. The networks should increase the efficiency of the governance delivery mechanism and optimize the performance of the state government. The backbone thus created would provide reliable, vertical, and horizontal connectivity within the state administration and would facilitate electronic transactions between all government departments [DIT, 2010b].

To ensure a desired Quality of Service to be provided by the network operator and the bandwidth provider, a Third Party Audit mechanism would be created in the SWAN scheme, which would monitor the performance of the SWAN network in each state. The Third Party Audit agency should function for a period of five years from the date of final acceptance test of the network and primarily monitor compliance with the Service Level Agreement that the state would enter with the network operator and also with the bandwidth service provider [DIT, 2010b].

The SWAN project was backed by an investment of Rs 180 crores (approximately USD 36 million) from the government of India under the heading of e-governance for the state of Karnataka. The funding was expected to cover capital expenses incurred at all the Points of Presence of the SWAN, cost of any consultancy services required for pre-project implementation activities, operational expenditures, and cost of Third Party Audit over a five-year period [NISG, 2009].

The SWAN project built using the MPLS technology will establish a reliable, robust, secure communication between the government offices at all levels. Features such as video conferencing and mobile video van will make the state of Karnataka different from the rest of the SWAN projects in India.

M.N. Vidyashankar, Principal Secretary, e-Governance Department of Karnataka [Suraj, 2009]

There were two options available for implementation of the SWAN, the Public-Private-Partnership (PPP) model and the NIC (National Informatics Centre) model. If it chose the NIC model, Sanchari would take on the role of a National Informatics Centre as the prime implementation agency for SWAN and build, operate, and maintain the network. If Sanchari opted for the PPP model, it needed to select an appropriate firm through a suitable competitive bidding process for the operation and maintenance of the network.

NIC Option

If it chose the NIC model, Sanchari would be the key agent for development and implementation of the SWAN project. It would need to carry out requirements analysis to find out the system requirements. Then, it would have to do a feasibility study and design the network architecture, technical specifications, and bill of materials as per the design. At the same time, Sanchari also needed to determine the one-time capital expenditure and five-year operational expenditures on behalf of the state government.

These details would then be submitted to the department of IT. Once these technical and financial requirements were scrutinized and finalized by them, Sanchari would seek help from the Structural Project Management Consultants India Pvt. Ltd. (SPMC) to develop and implement the SWAN. SPMC specialized in handling large scale projects and gave advice on design, logistics, and financial management. Sanchari would need to follow all related procurement actions and formal procedures to develop the SWAN and sign a five-year Service Level Agreement for the operation and maintenance of the network with the state of Karnataka. The state government would also identify and commission a third party to monitor the network performance [NISG, 2009].

In terms of funding, the department of IT would pay Sanchari for the SWAN project. Sanchari would receive a start-up funding at the beginning of the project, and the department of IT would release the remaining funds in installments as per scheduled quarterly requirements. If Sanchari needed any professional consultancy services for the project, the state government would cover the costs of such technical services under project expenses [NISG, 2009].

PPP Option

Alternatively, Sanchari could also decide to form a public private partnership with a private network vendor to undertake the establishment, operation, and maintenance activities of the SWAN system. The private network vendor would need to be identified through an appropriate bidding process.

In this case, Sanchari would function as the nodal agency for implementation of the SWAN. Sanchari should open and operate two separate bank accounts, one for the support fund granted by the department of IT for Quarterly Guaranteed Revenue and the other for the support fund received through the Additional Central Assistance route as granted by the Planning Commission or the Ministry of Finance [NISG, 2009].

Similar to the NIC approach, Sanchari would carry out requirements analysis, design network architecture, and prepare the proposal for approval by the department of IT. The department of IT would pay for the costs of all these services. After the department of IT approved the SWAN proposal, Sanchari would prepare a Request for Proposal, Service Level Agreement, and other contractual documents, which would include technical specifications and bills of materials. These documents would then be submitted to the department of IT for scrutiny and clearance [NISG, 2009].

The state government would then formally issue the RFP after getting the approval from the department of IT. Along with the state government, Sanchari would hold a pre-bid conference with prospective bidders to clarify the project requirements. After the bidding deadline, Sanchari would help the state government evaluate all bids received and select a successful bidder. The selection of a successful bidder would also need to be approved by the department of IT. Once this was done, the state government would sign a contract with the successful bidder to establish the SWAN system under agreed terms and conditions. Sanchari would be responsible for monitoring the implementation process according to the predetermined implementation schedule until the final acceptance testing of the entire network was carried out.

While the SWAN was being implemented, the state government would issue a second RFP to private companies to bid for Third Party Administration commissioning and operationalization of the SWAN. Once the SWAN system was finally accepted by the state government, the selected vendor would operate the network for five years based on the terms and conditions of the signed contracts. During these five years, Network Performance Audit would be carried out periodically by Sanchari.

IV. CLOUD COMPUTING INFRASTRUCTURE

The general trend in IT at this time was to move towards cloud computing, which might have important implications for Sanchari. Cloud computing incorporated the benefits of virtualization, on-demand deployment, Internet service delivery, and open source software. Though cloud computing was using established approaches, concepts, and best practices, cloud computing had completely changed how the industry invented, developed, deployed, updated, maintained, and paid for applications and the infrastructure on which they ran [Sun Microsystems, 2009]. The key feature of cloud computing was its on-demand, self-service, and pay-by-use nature. Cloud computing offered customers choice and environments that were open and standardized, and this allowed customers to have the choice of server, storage, and networking technologies [Sun Microsystems, 2009].

Cloud computing infrastructure was an inclusive concept, including SaaS (Software as a Service), PaaS (Platform as a Service), and IaaS (Infrastructure as a Service). SaaS allowed customers to use a software application hosted in a remote service via the Internet. SaaS had two major categories: line-of-business services which were sold and made available to companies and enterprises on a subscription basis, and customer-oriented services which were offered to the general public either on a subscription basis or offered for free but were supported by advertising [Topbits, 2010]. SaaS could bring the benefits of improved efficiency, lower risks, and a generous return on investment to customers, but the initial decision to relinquish control of their business critical applications to a vendor was a difficult one. From the vendor's perspective, there were a lot of challenges, including building and maintaining a complete network infrastructure for delivering the application, providing enhanced security to assure application availability via the network, and providing customers with the latest version of the application software [Zucco, 2009].

PaaS allowed business customers to build Web applications and services accessible via the Internet without purchasing the associated hardware required to host the applications. All the necessary tools for application design, development, deployment, and testing were made available on the Internet by the vendor. Customers could benefit from these tools that facilitated scalability, team collaboration, and application integration. Compared with service-oriented architecture which allowed businesses to integrate pre-existing applications and technologies, PaaS was more flexible and allowed businesses to create applications within the cloud [Modavi, 2010]. For the time being, open PaaS was still available in theory and the competition among the vendors existed only for closed PaaS platforms. With the increasing popularity of open PaaS, the competition was expected to intensify between PaaS service providers and open source PaaS providers [Modavi, 2010].

IaaS allowed customers to use equipment, such as storage, hardware, servers, and networking components, which was provided by the vendor to support operations. Customers did not need to purchase software, servers, data center space, or network kit and were billed on a utility computing basis and on the amount of resource they consumed. Thus, IaaS gave corporate customers the financial latitude to not only conserve capital but also to better align operating expenses with revenue streams. Moreover, IaaS gave the company the opportunity to choose a right-sized, right geography, and right cost-based IT infrastructure and time-to-market by procuring and adding IT infrastructure with some flexibility [NTT, 2010]. The unique characteristics of IaaS brought some specific network challenges to IaaS service providers. They had to continually eliminate wasteful activities and expenses by choosing the appropriate network equipment to reduce the costs of space, power, and cooling. At the same time, operating in such a rapidly changing IT environment with elastic applications and evolving virtual machines, they had to provide the highest levels of network control and automation in real time. Moreover, they were operating under high pressure, as they were responsible for delivering services that businesses depended on for success and even survival. This also meant that they had to use equipment that provided network reliability, availability, and performance at the highest levels. Security was also a critical issue for IaaS providers, as they needed to handle traffic spikes for some customers without impacting the rest [Neovise, 2010].

In India, the use of IT in the domestic market was still lagging behind its position as a leading global IT services provider. Cloud computing was still considered to be in its nascent stage in India, and several IT decision makers did not understand the cloud computing terminologies such as IaaS, PaaS and SaaS [Janakiram, 2010]. Therefore, India had a great market potential for cloud computing, and most of the existing cloud computing providers were start-ups [Narayan, 2010].

V. BUSINESS OPTIONS

Over the years, Sanchari had gained technical and managerial expertise in developing and delivering TI services. It was capable of handling the SWAN project. However, whether it would adopt the NIC model or the PPP model was not a straight forward decision for the senior management of Sanchari. If it wanted to maintain the status quo, then the NIC model would suit the company best. If it wanted to expand business, then the PPP model would be a good chance to test the water. Since this decision might have a long-lasting impact on the future business development of Sanchari, the senior management had to seriously consider the three business options available: First, it could choose to follow the PPP model and learn from the private sector to become an independent IaaS provider; second, it could opt for the PPP model and use the expertise gathered from the SWAN project to move fully towards a mobile applications and contents provider; third, it could just follow the NIC model and further develop its expertise in providing TI services. Next, the different models will be explained first; then the pros and cons of each option will be discussed.

NIC Option

The NIC option would be the easiest approach for Sanchari. Sanchari would maintain its state-owned status and continue to specialize in delivering TI projects for the public sector. Sanchari had gained plenty of project management experience through its involvement in projects such as the West Town project. In the future, Sanchari could use its expertise to get involved in more e-government projects. Sanchari had earned a good reputation in the Karnataka region, and it could consider taking up similar e-government projects in other states of India. Once Sanchari was able to build its reputation for providing TI services and delivering e-government projects, there might be opportunities for Sanchari to transfer its expertise overseas as a government consultant.

If this approach seemed feasible to Sanchari, it should opt for the NIC model in the SWAN project. In that case, Sanchari would take the full responsibility to design, develop, and manage the system for the state government of Karnataka. Similar to its participation in other government projects like the West Town project, the success of the SWAN project could help Sanchari build up its reputation as an e-government agent.

This approach, however, had its limitations. Sanchari's business scope was limited to delivering TI to the public sector. Though government projects were not expected to dry up in the near future, Sanchari would still be in a passive position and would have to wait for new projects if and when they became available. Moreover, in the long term, there was no visible opportunity for Sanchari to move up the value chain. Compared to service providers and network operations providers, infrastructure providers had the lowest profit margin. Above all, India's telecommunication industry was booming, Sanchari would not be able to benefit from this fast growth if it just maintained its status quo.

IaaS Option

As an Infrastructure-as-a-Service (IaaS) provider, Sanchari would deliver IT infrastructure to clients as a service. Sanchari would not only provide TI, but also computer infrastructure, such as servers, software, data centre space, and networking equipment to its clients. Similar to TI services, Sanchari would charge its clients according to their actual usage of services.

As cloud computing became increasingly popular, the potential of the IaaS market would be huge. Cloud infrastructure gave the clients the flexibility to scale up or scale down its computing infrastructure almost instantly depending on their business needs. The clients would also save money by saving the initial investment in the hardware and making payments based on their actual usage. Moreover, India's IaaS market was at a nascent stage in 2010, and the outlook for IaaS was promising. Virtualization, regarded as the first step toward a cloud strategy, started to be implemented in many Indian data centers. Meanwhile, related markets such as SaaS saw significant development, and this was expected to contribute to wider acceptance of the IaaS concept [Ernst and Young, 2010].

If Sanchari opted for this option, it could quickly move on to the IaaS market with its expertise in delivering TI services and its TI market dominance in the Karnataka region. Before making such an important decision, Sanchari could use its participation in the SWAN project as an opportunity to move toward becoming an IaaS provider. Compared with the NIC model, the PPP model might be more suitable, as Sanchari would have a chance to investigate and learn how a private telecommunication company functioned and competed in the market. Also, the

private business partner might help Sanchari understand and learn the technical and managerial skills of becoming an IaaS provider. To have more freedom to decide on its future development, Sanchari might even consider changing its state-owned status and operate as a private company in the future.

When considering this option, Sanchari should also decide whether it should stick to its expertise in the wired world or it should shift its focus to the wireless arena, as the number of wireline subscribers in India was decreasing and the market value of broadband subscription was growing slowly. Sanchari had developed its strength in delivering optical-fiber-based telecommunication systems over the years, which provided a good foundation for Sanchari to develop a wired TI. If it continued building up a wired TI, Sanchari would have three options. On the lower end, Fiber-to-the-Cabinet, which capitalized on the existing copper wire, required the smallest capital expenditures, but its services were very limited and did not support analog television programming. In the mid-range with higher capital expenditure, Hybrid-Fiber-Coaxial had the capability for analog television programming, but its bandwidth for high-speed Internet services was still limited. At the higher end, the Fiber-to-the-Home systems, which required a significant investment of capital to build new infrastructure, offered both analog television services and high speed connectivity.

As the wireless arena was beginning to reshape the telecommunication industry, Sanchari might also consider changing into an IaaS provider using wireless technologies. One option for Sanchari would be to develop the infrastructure required for 2G, 3G, and 4G mobile networks, including towers capable of holding multiple antenna systems and space for base station or mobile switching centers. In 2010, India had around 600 million mobile users and was about to introduce 3G services. An alternative for Sanchari would be to develop the infrastructure for Worldwide Interoperability for Microwave Access (WiMAX), which provided wireless access as well as expanded the coverage of wired networks. WiMAX was a metropolitan access technique, well-known for long-distance transmissions and high data capacities, and was suitable for network access for remote or suburban areas. Another option Sanchari could consider was to develop the infrastructure for municipal wireless networks, such as the municipal broadband networks and community Wi-Fi which was considered as basic infrastructure for the twenty-first century. The usages included Internet access, location based advertising, online applications and services (such as VoIP, IPTV, online backup, social and business networking), and third-party access (such as emergency services, utility services, CCTV monitoring, etc.).

SaaS Option

Software as a Service (SaaS) was the most lucrative option for Sanchari. Sanchari could become a telecommunication applications provider to deliver value-added services to clients. A research on telecommunication companies conducted by an independent telecommunication research firm found that the move to delivering value-added services would bring customer loyalty, improve margins, and encourage longer-term contracts [Ovum, 2010]. The emerging cloud computing paradigm also created many previously unthinkable solutions, such as giving consumers access to data and applications stored in cyberspace through any Internet device. This was an upcoming business that Sanchari could consider in the long run. Another option was to provide enterprise software solutions to SMEs which were previously affordable only to very large enterprises, such as Enterprise Resource Planning applications. Cloud computing opened up this new market segment. Sanchari had engaged in providing TI services, so that it had the basic capabilities that were needed to expand its business scope and prepare to deliver such Internet-based software services to SMEs.

Alternatively, Sanchari could use its existing infrastructure and expand its business to focus on providing applications for home cloud computing. Consumers had already stored a large amount of personal data in different devices, such as computers, mobile phones, and digital media players, which made synchronization very difficult and time consuming. The idea of a home storage cloud was suggested as a way to link up personal files and external cloud services. People could back up their files online, while the application provider would be responsible for keeping the home cloud and the Web-based cloud in synchronization and delivering the content to any device at the consumer's request [Roque, 2008]. This was surely an attractive proposition for Sanchari.

To individuals, the concept of 'My Computer' will give way to the concept of a personal mesh of devices—a means by which all of your devices are brought together, managed through the web, as a seamless whole. After identifying a device as being 'yours,' its configuration and personalization settings, its applications and their own settings, and the data it carries will be seamlessly available and synchronized across our mesh of devices. Whether for media, control or access, scenarios ranging from productivity to media and entertainment will be unified and enhanced by the concept of a device mesh.

Ray Ozzie, Microsoft Chief Software Architect [Taft, 2008]

Cloud computing infrastructure is a new industry approach that has the potential to change the way the consumer electronics industry operates and provides services to its customers.

Bruce Anderson, General manager for IBM's Electronics Industry [Hiddenwires, 2010]

Another option for Sanchari would be to specialize in one area of cloud computing, for example, security issues. Privacy was of critical importance for cloud computing in terms of legal compliance and maintenance of user trust. Many cloud providers did not offer appropriate and sufficient encryption and needed to pay more attention to network security such as firewalls to protect critical data-at-rest [Jamwal et al., 2011]. Sanchari had the experience of dealing with security issues when providing TI services. It could leverage this expertise and further acquire new knowledge to build up its expertise to ensure the security aspects of cloud computing.

To become a SaaS provider, Sanchari could choose the PPP model in the SWAN project which provided an opportunity for Sanchari to investigate the SaaS market. By working with a private partner, Sanchari could also decide whether it should change its status to a private company. Since cloud computing was still emerging in India, it provided a very good opportunity for Sanchari to explore and develop its new business.

Despite the huge potential, Sanchari should be aware of the risks involved in providing these application-oriented businesses: first of all, the financial profile of the investments required was different for end-user business than that for infrastructure business. Sanchari had always been operating as a not-for-profit organization, and many business decisions would be very different once it became a profit-driven SaaS provider. Second, the lifecycle for software applications was much shorter than it was for TI. This required Sanchari to acquire new technical skills through staff training and recruitment. Finally, barriers to entry for this market were low. Therefore, compared with the NIC model and the IaaS model, this option posed the highest risk to Sanchari.

V. MOVING FORWARD

There is a significant growth opportunity for wholesale carriers with the necessary network resources and skills to deliver managed services to network operators and other intermediaries. The market is only just starting to take shape but we expect carriers to quickly move beyond commodity bandwidth to providing value added services.

Bruce Anderson, General Manager for IBM's Electronics Industry [Hiddenwires, 2010]

The year 2009 was a critical year for Sanchari, a state-owned TI provider in India. Over the past few years, Sanchari had developed into a successful TI provider who developed and delivered on-demand infrastructure services to customers in Karnataka, India. In the middle of 2009, Sanchari was approached by the government of Karnataka to lead the development of the SWAN under the e-governance initiative. Sanchari had to decide on the extent to which it should get involved in this project. Sanchari had to choose either to act as an NIC, or go through a PPP model, to outsource the entire network establishment and operational services, to a competent network vendor identified through an appropriate bidding process. To Sanchari's management team, their dilemma was how to use the SWAN project as a business opportunity to develop their core business. With its core business dedicated to delivering TI services, Sanchari was in a good position to take advantage of the rapidly increasing demand for bandwidth growth in India. As the SWAN project could not bring in synergy with their core business, the management team of Sanchari had to decide how to align this project with their core business and leverage it to move up the telecommunication value chain. For the future development, the management team of Sanchari had three options: They could maintain status quo of Sanchari and continue to deliver TI services as a not-for-profit enterprise, or they could take a risky path and try to transform Sanchari into an IaaS provider or even make Sanchari move further up the value chain to become a SaaS provider. What should they do and how should they do it?

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