

9 Connecting the wireless networks of the world

The money from hauling data, things like video and texts instead of calls, is now 35.9 percent of total service revenue [in the US] ... The phone networks carried 341.2 billion megabits of traffic in the first half of 2011, according to the survey, up 111 percent from a year earlier ... Talk, meantime, may be falling slightly out of fashion ... The average length of a call was 1.83 minutes ... As recently as 2007, the average call was near or above three minutes. Who's got time to talk, when there's all that video to watch?¹

Mobile data service is more than a booming business; it is a global phenomenon. Teenagers text each other on their Droids as obsessively as business people check email and corporate data on their iPhone® or BlackBerry® smartphones. TV stations show video clips of everything from cute babies to the rebellion in Libya, captured and sent by people on cell phones. We take it all for granted. Yet none of these capabilities was available as little as a dozen years ago.

Just as remarkably, Aicent, a Silicon Valley startup founded in 2000 by an entrepreneur born in Taiwan, is a world leader in providing the data interconnections among the international wireless carriers that enable these functions across their networks. For example, if you are visiting China or Indonesia and access your emails on your BlackBerry, the chances are that you are using a network connection managed by Aicent.

Aicent holds interest for reasons beyond its growth and success. It provides an interesting case study of a new model for a startup business: a company that was constructed from the start to meet the challenges of operating globally even as a small enterprise.

¹ Q. Hardy, "More wireless devices than people," <http://bits.blogs.nytimes.com/2011/10/12/the-u-s-has-more-wireless-devices-than-people/?scp=16&sq=wireless+networks&st=nyt>, October 12, 2011.

Unlike Ness Technologies, the company did not address its domestic market first. Aicent was founded to provide a mission-critical service to the global wireless telecommunications industry. This placed it squarely in the largest and fastest-growing segment of the world economy: in 2010 service businesses accounted for 63.2 percent of global GDP.²

Aicent's business depends on the wide global implementation of new wireless technologies, and the rapid growth of mobile computing and messaging. But its success was based on the vision of its founder and the company's execution of its business plan. Having entered the market early, Aicent was in a good position to ride the rising tide of international data traffic. To fully appreciate its story, we need to understand how wireless networks have evolved as platforms for data services.

THE EVOLUTION OF WIRELESS DATA SERVICES

Consumer wireless (cellular) service is so ubiquitous today that one easily forgets how young it is and how quickly it has grown. It only emerged as a major industry in the 1990s, but by 2004 its global subscriber base had reached 1.7 billion. In 2011 that number was over 5 billion. Practically every inhabited part of the planet has wireless consumer service.

Cellular mobile service started with first-generation (1G) analog wireless systems, in use in the 1980s and 1990s. These were designed to provide mobile voice-only telephony, and the handsets were simply portable telephone receivers. There was practically no standardization of technology in those early years. Had the industry stayed analog and voice-only, there would have been no market for an Aicent.

Everything changed with the introduction of 2G systems in 1991. This second-generation technology switched transmission and

² Statistic from *The World Fact Book*, published by the US Central Intelligence Agency, available at www.cia.gov/library/publications/the-world-factbook/fields/2012.html.

reception from analog to digital, opening the door to data services as well as voice calls. In 1993 text messaging was the first data service to be introduced.

Digital takes over

Three new generations (2.5G, 3G, and 4G or LTE) of digital wireless networks have appeared since then, each representing a significant advance over its predecessor. As carriers deployed these improved networks, handset makers sought to exploit their capabilities, and tempted consumers with ever newer, more sophisticated handsets. Changes came incredibly fast. While analog landline telephones had stayed virtually the same for decades, mobile phones had a model lifespan measured in months.

Early digital handsets provided only telephony and short message service (SMS, the foundation of today's Twitter network). They soon added more data services, such as full Internet access, first announced by NTT DoCoMo in Japan in 1998. Eventually they evolved into today's smartphones. Smartphones have become platforms for entertainment, personalization, and rich media communications. Voice communication is just one of their many functions. Subscribers can use their smartphones to listen to music, connect to the Internet, get GPS-based travel directions, access email, exchange short messages, and send and receive pictures and short videos recorded with cameras incorporated into their handsets.

These devices also serve as gateways to an ever-growing number of personalized applications offered by the networks, such as online payments and social network interaction. Data and video applications dominate the list of features on handsets from companies such as Apple and Research in Motion (RIM), maker of the BlackBerry phone, and those equipped with Google's Android operating system.

Building out the network

Digital wireless networks grew rapidly, thanks in large part to the orderly development of standards by international industry organizations. Carriers seeking to upgrade their networks selected their

digital technology from a limited menu of accepted standards. Most carriers, including those in developing countries in Asia and elsewhere, adopted GSM (Global System for Mobile Communications) technology, which had originated in Europe. A smaller group, including a few Asian carriers and Verizon and Sprint in the US, adopted CDMA (Code Division Multiple Access) technology, developed by another California startup, Qualcomm.

Regardless of which system a carrier chose, it was built on digitally “packetized” data technology (discussed in [Chapter 5](#)). For GSM operators, the need to offer data services meant adopting the GPRS (General Packet Radio Service) standard. CDMA operators had their own standards, which were not compatible with GPRS. In either case, subscribers could access the Internet from handsets at data rates higher than 100 kbps (kilobits per second).

Carriers deployed data-service-enabling networks in most of the world between 1999 and 2009. As these networks proliferated, smartphone sales grew rapidly, particularly after 2004 when many networks were already in place. Sales increased from 35 million handsets in 2004 to over 500 million units in 2011. Recently they have roughly doubled every year.

Mobile computing arrives

Mobile computing, and the use of data service networks, took a big leap forward with the introduction of wirelessly connected tablet computers in 2010. In 2011, Cisco Systems projected that 15 billion devices would be wirelessly connected globally by 2015. It predicted that mobile data network traffic would nearly double every year.

A good way to appreciate the remarkable growth of mobile computing is to compare it to that of PC-based personal computing. A metric for the two industrial sectors is their comparative sales of hardware and software, shown in [Figure 9.1](#).³ In 2000 these revenues were \$348 billion for PC computing and only \$500 million

³ T. McCourt and M. McKee, “The mobile computing revolution,” Morgan Keegan, January 28, 2011, p. 4.

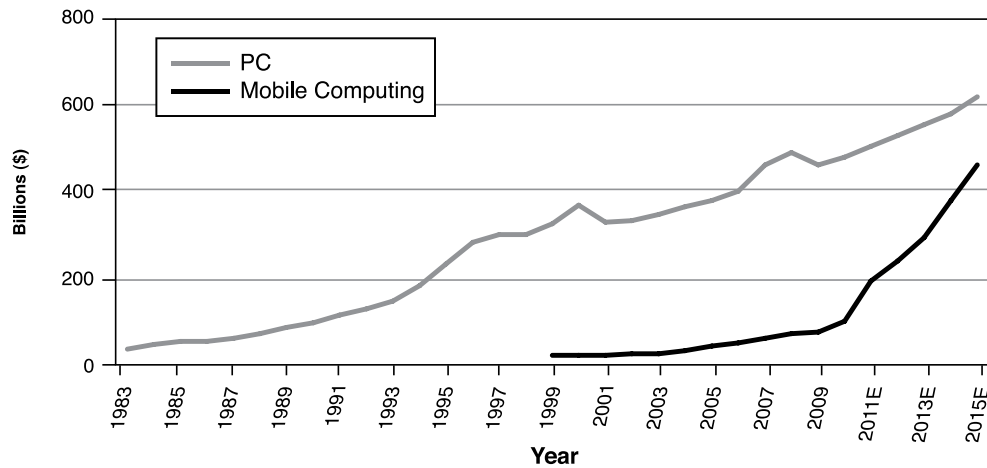


FIGURE 9.1 A comparison of combined hardware and software revenues in the personal computing and mobile computing industries (ref. 3).

for mobile computing. By 2005 mobile computing had reached \$20 billion. By 2011, however, PC hardware and software sales had risen to only \$485 billion, a 40 percent increase, while mobile computing hardware and software revenues had leaped more than eightfold to \$171 billion. This growth was primarily due to mobile network construction and increased sales of smarter handsets.

Data traffic dilemma

As carriers deployed digital networks around the world, they found an increasingly troublesome problem. Global wireless data offered a major opportunity for revenue growth, but the data had to travel easily across all networks. Unfortunately, interconnection among the networks was not transparent, because carrier traffic standards and operating conditions were not uniform around the world.

This situation threatened to undermine the popularity of data services. For example, what if a carrier's customer was outside its coverage zone, or "roaming," in the parlance of the industry? The customer would have to connect through another carrier. Voice calls in this situation were expensive, so the carrier wanted to provide lower-cost data services such as SMS and multimedia message service (MMS). Messaging was the first area of interest for carriers

because the earliest popular data services consisted of SMS and MMS messages.

However, because of the disparity in traffic standards, network interconnection required extensive investments in connectivity, followed by rigorous testing, involving the wireless carriers interested in partnering. This was a big change for the industry. Previously, when establishing voice interconnections, carriers had typically negotiated much simpler direct bilateral agreements with each other.

Market opportunities for intermediaries

To address the interoperability problem, in 2000 the GSM Association established standards for GPRS Data Exchange, or GRX. Carriers connected by a GRX-compliant hub could interchange data, thus replacing the complicated, and dedicated, one-to-one technical relationships previously needed to accommodate subscribers who wanted to use GPRS services outside of their home network.

It worked like this. Each carrier would connect its switches, provided with suitable new software, to a GRX computer hub. From there its roaming data traffic would be connected to other carriers with similar termination capabilities. Such a hub and spoke arrangement freed wireless carriers from the cost and difficulties of managing individual connections. CDMA operators also established an interconnection service called CRX.

However, these technology-specific interconnections were not a complete solution. In addition to both technologies needing hubs, carriers that used CDMA technology could not connect their data traffic to those that used GSM technology, and vice versa, without another intervening gateway for standards translation.

Clearly this situation created opportunities for companies that could build and operate interconnection hubs for the international wireless industry. The more carriers that appeared and networks that were built, the greater were the opportunities that arose. This was the business for which Aicent was built. It was designed to serve

as a trusted intermediary, providing interconnection for the carriers and eliminating the need for them to establish and maintain bilateral relationships for handling each other's data traffic.

PRECURSOR TO AN IDEA

Lynn Liu, the founder of Aicent, is a serial entrepreneur. Born in Taiwan and educated at National Taiwan University, she came to the US to earn an M.S. in Computer Science at the State University of New York. At the completion of her studies she moved to Silicon Valley where, in 1994, she co-founded GRIC Communications with her husband, Dr. Hong Chen.

The idea behind GRIC was to provide people with low-cost access to the Internet while they were traveling. In the 1990s, when broadband connections were rare, there was a boom in companies called ISPs (Internet Service Providers) who offered dial-up access to the Internet over telephone lines. People would contract for an Internet connection with an ISP that had phone numbers in their local calling area. Since getting Internet access was a local call, they could stay on line as long as they wanted without piling up long-distance phone charges.

Everything changed when these subscribers were on the road. Their regular number became long distance, and they would have to hope their ISP had local numbers in the places they were visiting. Without either a local connection or a toll-free dial-up number, access through an ISP to the Internet became a costly long-distance call, billed by the minute. GRIC offered a number of services, but the most interesting one enabled travelers to access the Internet from anywhere through a local phone call to a local carrier, as long as the carrier participated in the GRIC network. GRIC negotiated the agreements among carriers to permit travelers to access the Internet through a local phone call, thus saving them the expense of timed long-distance calls.

Dr. Hong Chen was chief executive officer of the company, but Lynn Liu was its chief operating officer and head of international

market development. Believing that the Asian market offered the greatest growth opportunities, she concentrated on building relationships with regional carriers in Asia. She earned the trust of senior executives of the major carriers in China as well as those in Singapore and Hong Kong. These relationships would prove extremely valuable for Aicent.

Riding the Internet and telecommunications bubble, GRIC had its IPO on NASDAQ in 1999. Despite its modest revenues it reached a market valuation in excess of one billion dollars. Shortly after its IPO, when its value burst along with the market, GRIC was acquired by a competitor. This left Liu free to start Aicent in 2000. She was joined by David Zhang, the former head of technology at GRIC and a telecommunications expert.

The initial funding for Aicent came from Asian venture capital funds. That money lasted long enough for the company to reach significant revenues and attract another investor, Warburg Pincus, which invested in the company in 2005.

AICENT GETS STARTED

Lynn Liu had realized there was an opportunity to build a company to solve the data interconnection problems of the wireless carriers. The GSM industry association had defined standards for its GRX interconnection service. But who was going to manage the interchange hubs it required? She positioned Aicent as a neutral third-party enabler of data traffic interoperability for carriers around the globe, concentrating at first on Asia, where GSM was dominant and she had personal contacts.

Liu planned to establish digital traffic management hubs in strategic locations such as Beijing, Hong Kong, and London, and contract with carriers to route appropriate international traffic through these hubs. Aicent's revenues would come from two sources: fees for message transmission; and payments from carriers for the use of the interconnection links, based on the amount of traffic carried on their behalf. Instead of building her own facilities, she rented the

“pipes” that interconnected the data trunks of the various carriers. This kept Aicent’s initial costs low, and allowed the company to scale its infrastructure as traffic volumes increased.

It was a bold idea. There were three key conditions for its success:

- the economic build-out of a rented global network to attract the interest of carriers in linking their traffic to the Aicent hubs;
- trust on the part of the carriers that Aicent was capable of delivering a reliable service at an attractive price; and
- enough data traffic to fill the hubs and garner enough revenues to keep Aicent in business.

Without all three of these factors working in the company’s favor, there was no business.

Building the network

For Aicent to succeed, it had to quickly establish a dominant position by offering the most routes for data interconnection and the highest reliability. This meant that a special network meeting the most rigorous requirements had to be in place before carriers would commit their traffic. When asked about her strategy in the early years, Lynn Liu says “a business like this needs to have the greatest number of connected carriers – the whole value is in the network. Whoever has the best and widest network has the most attractive one and gets the growth – the winner takes all.”

Right from the start, the Aicent technical team, managed by David Zhang, proved itself capable of building and managing the required international access networks. This was owing in part to experience acquired at GRIC, but they also implemented a great deal of novel digital technology to ensure security and reliability.

There were operational challenges too. When dealing with carriers, failure of a link is not an option – 100 percent uptime is essential. That the Aicent team was able to meet this standard of performance was a major reason for the company’s eventual success. Compatibility and adaptability were another requirement. Aicent’s

service had to be compliant with the many existing industry standards; but the wireless industry does not stand still. The company also needed the ability to implement new standards quickly.

Gaining the trust of big carriers

Demanding as these requirements were, building the network was the easy part. It just cost time and money. Overcoming the trust barrier was a much more difficult proposition. What carrier would trust a startup with such a critical service? This is where Liu's previous experience at GRIC came into play.

When simple messaging was the only data traffic, the large carriers, including China Mobile, entered into bilateral agreements with each other for GRX data services. But as new messaging services were introduced, many of the carriers, including China Mobile, sought to avoid investing more time and effort in establishing bilateral contracts, performing engineering tests, and running trials with multiple operators. They shifted to a neutral third-party hub strategy. Outsourcing such services to a trusted outside company made strategic sense, but they had to find the right neutral party. The fact that Liu had already worked with senior executives at the carriers was hugely helpful. She was known and trusted, an important business advantage in Asia, so when she presented Aicent as a vendor a major barrier to achieving credibility was removed. While that level of trust provided an opening for Aicent to build its business, it was still a slow process in the early years. The company had to establish a reputation for quality and reliability. That wouldn't happen overnight.

Liu was successful in securing China Mobile, already the largest wireless company in the world at the time, as an anchor customer. This was a key milestone in the company's development. Aicent created the transport network for China Mobile's data roaming infrastructure. This relationship was critical in helping Aicent to acquire other Asian carriers as clients. By 2005, Aicent had commercial GRX contracts with thirty-four carriers in the Asia-Pacific

region, representing a 59 percent market share in a part of the world with 732 million wireless subscribers. By 2010 Aicent had the largest customer base for data roaming services in Asia. It was one of the first to offer these services.

For better support to its Asia-Pacific customers, it has a research and development and customer support center in Beijing, China. Aicent has nearly two-thirds of its employee base in Beijing, where the average engineer costs Aicent around one-third of what it would cost to hire staff in Silicon Valley, the company's headquarter site. This gives the company an important competitive edge over larger competitors who entered the market such as Belgacom, which is based in Europe, or Syniverse, which operates out of the United States. Aicent has another advantage, too. Unlike some of its competitors, it is an independent vendor. Many carriers are reluctant to rely on another carrier to provide their data facilities.

AICENT RIDES THE WAVE OF DATA SERVICES GROWTH

Building a network and earning the trust of big customers were both necessities for Aicent, but logging enough traffic to generate significant revenues was just as important. Here the company was fortunate, though not at first. Carrier data services took a few years to ramp up in volume. While the market was developing, Aicent's revenues remained low, and the company was not profitable but it wisely used its resources to build a customer base. While the business thesis appeared sound, predicting revenue growth is not a science. It took real courage on the part of company management and the investors to continue to support the business while revenues grew slowly.

The turn in revenue growth finally happened in the mid-2000s, jumping between 30 and 45 percent every year. This was because there were finally enough 2G data service-enabled networks in operation to create significant interconnection traffic needs. In fact, [Figure 9.1](#), which charts the hardware and software sales of products that enabled mobile computing (i.e. network deployment), shows

that the inflection point at which growth ramped up came in 2003. Carrier network deployment preceded data traffic growth, of course. But when the traffic needs emerged, Aicent was there to handle it, because it had the key infrastructure in place and the staff to handle customer needs.

Since about 2005 the growth in mobile data traffic (and its associated carrier revenues) has been huge. Worldwide mobile data revenue grew from \$65 billion in 2004 to \$310 billion in 2011. Much of this growth has been due to the popularity of mobile video. About 50 percent of the data being transmitted to mobile devices in 2011 is video. It is amazing to realize that in 2010, global mobile carriers were handling data traffic three times bigger than what the whole Internet handled in 2000. Roaming has also become a very profitable revenue source for wireless carriers, increasing from 12.2 percent of their revenues in 2004 to 21.5 percent in 2009. While voice traffic is still the main revenue source on the new networks, in 2011 data accounted for about 20 percent of the world's mobile carrier revenues, with more growth on the horizon.

Expanding beyond Asia

As handsets proliferated, data services diversified, networks increased their geographic dispersion, and international travel boomed, the need of carriers and their customers to interconnect mobile services across networks, across handsets, and across types of data became more pressing. Aicent was well positioned to grab a bigger share of this exploding market. It had benefited in the early years from the fact that the interconnection market opportunity was too small to be attractive to big companies. By the time the majors began to appreciate the strategic value of such a business, they were in catching-up mode. Aicent already had the network assets to exploit the opportunity and the reputation to sign up new customers.

Aicent, by contrast, was focused on expansion. It began contracting with operators in Europe, starting with one of the major carriers, British Telecommunications (BT). In 2004 BT decided to

divest itself of its GRX interconnection service, which had yielded only modest revenues. Accordingly, it invited bids from a number of companies interested in acquiring it. However, BT was not anxious to hand over its hubs to an international telecommunications competitor. Making a deal with Aicent solved this problem, because it was a neutral party. The company also committed itself to leasing BT assets as needed to serve its customers. In effect, Aicent and BT became business partners to the benefit of both. And Aicent gained access to European carriers, complementing its Asian footprint.

In 2005 Aicent acquired an operating base in North America, getting AT&T as a customer. AT&T is the new name of SBC, a spin-off of the original AT&T, which bought its former parent that year and adopted its name. AT&T also owns a majority share of Cingular Wireless, which had acquired the original AT&T's wireless division a year earlier.

By 2011 the company was interconnecting 180 mobile service operators with more than 2.5 billion subscribers, including nine of the ten largest in the world. Its footprint is particularly strong in Asia. It services all of the carriers in mainland China, Hong Kong, Macau, Taiwan, South Korea, Singapore, Philippines, Malaysia, Indonesia, and Thailand. RIM became an important customer, using Aicent's services to connect BlackBerry customers in Asia with its central data center in Canada. On any given day, Aicent's network facilitates over 100 million roaming transactions generated in 114 countries.

New services are constantly being added to its portfolio. For example, the rapid growth of WiFi services around the globe has given rise to the need for roaming agreements, and the company is providing a service that addresses that need.

Aicent's ability to quickly address emerging needs is a tribute to its excellent technology team in Beijing, with support from marketing and customer service teams around the globe. Continuous monitoring of the international network for quality assurance purposes is conducted from the Beijing location.

MANAGING A GLOBAL BUSINESS

It took five years, from 2000 to 2005, for the company to generate the revenue growth it had hoped for. Once that was achieved, it ramped to profitable revenues in excess of \$50 million. As is the case with all startups, this lag between investment and revenues is a critical period. How well a company is prepared to make good on its promise depends completely on following a wise investment strategy during this early period – which always lasts longer than any entrepreneur or investor expects.

In Aicent's case its growth was funded with a relatively modest investment. This would not have been possible without the decision to build the company's technical resources in China, where operating costs were much below those in California. The experience of the co-founder of the company provided the basis around which the outstanding technical team in network design and management could be built. At the same time, however, the company's headquarters were maintained in Silicon Valley. This was done in the belief that it would be easier to attract international marketing and senior management talent, as well as future funding, in this location. Lynn Liu acquired a second home in Beijing and was able to manage the company effectively from either side of the Pacific. As she spent a great deal of time with Asian customers and the majority of the company's employees were in Asia, this proved to be a good strategy.

None of this success would have been possible without outstanding financial and operational management. Kallen Chan, the chief financial officer of the company, provided the glue to knit together the operations of the company around the globe from his office in the Silicon Valley company headquarters. Born and raised in Hong Kong, Chan came to the US to attend Santa Clara University, where he earned an MBA. Prior to joining Aicent in 2005, he had held senior financial management positions in several companies in California. He joined the company just when its revenues were starting to grow and profitability was in sight. Along with that growth

came a host of financial commitments. How well the needs and commitments were matched determined the fate of the company. It passed this test with flying colors.

The successful operation of a business like Aicent's presents unique challenges. First, the customers are mostly big companies, and many millions of dollars of their revenues depend on Aicent's service. While the fees paid for the service delivered are actually quite small compared to their overall revenues, the carriers are nevertheless very difficult customers because of how critical the service is to their users. Vendors such as Aicent are held to extremely high standards of performance. Second, carriers are also notoriously cost sensitive. Contracts may be renegotiated annually with many of them. Hence, negotiating contract pricing is a major responsibility of the central financial organization.

Third, and equally critical to Aicent's success, is negotiating the best prices for the transport capacity leased from regional carriers in dozens of countries. Aicent rents data transport facilities for its service. Monitoring capacity to determine its actual need and setting prices for its use are central to ensuring a profitable operation.

Finally, the importance of careful long-term planning cannot be understated. The company must lease facilities ahead of customer demand to make sure it has the capacity to meet future needs. This financial commitment carries a degree of risk. So does investment in new technology, equipment, and software, also necessary to meet customers' needs. Getting too far ahead of the demand entails the funding of idle capacity. Being too short-sighted, however, risks not being able to meet customer needs. The job of the financial organization is to work with the operating units to strike the right balance.

LOOKING BACK

Aicent presents us with an interesting case of a company built from the ground up for global operation. It is based on Lynn Liu's recognition of an attractive market opportunity in what established companies thought of as a fringe service. It is strictly service-based,

and leases facilities to provide that service. Yet major wireless carriers are totally dependent on it to make data traffic, an increasingly important part of their business, work smoothly. Some of the more striking features of its growth and success deserve a second look.

The advantage and risk of being a first mover. Aicent is not built on proprietary technology, but on providing the most effective service to carriers. This requires an outstanding technology implementation team. Nevertheless, as an innovator in the market, it assumed risk and gained advantages by getting ahead of the large demand wave for its services. Having perceived a growing need for international interconnection services, Aicent correctly assumed that, in order to end up in a leading position, it would have to develop the broadest reach and greatest ability to interconnect data traffic of any company in the field, and would need to offer excellent service well before its competitors. There is not room in the market for many providers of such a service. Aicent had to be in the market early, with a convincing offering, if it wanted to be profitable.

This strategy entailed considerable financial risk. Initially the data traffic being handled by the carriers in the markets served by Aicent did not justify the capacity it was putting in place. This risk was mitigated by placing as much of the technology and network management organization as possible in China, where costs were much lower than in the US. Further, Aicent managed to lease transport capacity under favorable terms. Nevertheless, putting such a network in place well before it was financially justified was a bold step. It did wind up paying off as the company grew in response to the increase in data traffic, but that took several years. During that interim period it had the resources to survive owing to its low operating costs.

The strategic steps taken by Aicent demonstrate the business rationale of a successful startup. The company took risks, but it had investors and management prepared to assume these risks. Everyone knew there were no easy short cuts to success.

The importance of business relationships. Lynn Liu leveraged her prior relationships in the fast-growing Asian telecommunications

markets to get her first customers. It is hard to imagine how such a startup, providing a critical service, could have succeeded otherwise. Her contacts were instrumental in winning the initial sponsorship of China's biggest wireless carrier. Other carriers in the region, all of whom were growing rapidly, were open to dealing with a young company because of this prior experience. And of course that impressive start in Asia then made possible the company's expansion into Europe and the US.

An international company from the start. Aicent presents a new model for international business: one that is organized to be local where necessary and multinational where possible. Aicent started in Silicon Valley, but the majority of its staff was in Asia right from the start. Ultimately the staff became multinational. The company operated in many countries where its local representatives had to deal with country-specific issues. Sales teams for each country were recruited locally because of their familiarity with the local carriers. A staff that is familiar with a country and its business environment is best able to deal with local customers.

On the financial side, however, the company was definitely not local. It wisely avoided the common error of decentralizing financial control, which can lead to serious disconnects in pricing, contract profitability, and employee compensation. Aicent maintained strong financial control from its headquarters in Silicon Valley.

There is no doubt that entrepreneurs play a necessary part in building the novel industries required for accelerated economic growth. The big question is, must governments become the patrons of these new industries, and if so, in what ways and to what extent?

In the next chapter we address this issue.