Center for eBusiness @ MIT
Massachusetts Institute of Technology
Research Workshop

eBusiness Day@MIT presents:

Wireless and Mobile Commerce:
Future Markets, Current Realities

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Table of Contents

Executive Summary........................................................................................................3

I. Presentation Summaries
1.1 Where Wireless Matters: New Ventures
   New Wireless Opportunities.......................................................................................4
   Future Markets, Current Realities: The Asian Angle..............................................4
   An Acknowledged Industry Innovator.................................................................4
   Investing in Wireless Data and Next Generation Communication Technologies......5
   Early Stage Wireless Venture Opportunities.........................................................5
   Wireless Innovation – Opportunities at Crossroads.............................................6

1.2 Where Wireless Matters: Corporate Initiatives
   Axeda and Nokia: Partnering for Mobile Device Relationship Management..........6
   HP Laboratories: Tap and Go Services to a Supermarket Near You....................6
   Nortel Networks: Wireless Internet Evolution.....................................................7
   MasterCard Initiatives............................................................................................7
   FleetBoston: Wireless Decisions and Experiences...............................................7
   Telepass: Automatic Toll Payment in Italy............................................................8

II. Themes
   The Changing Climate of the Venture Capital Market...........................................9
   Wireless LANs – 802.11.........................................................................................9
   The Home of the Future – 802.15.3 for Streaming Media.....................................10
   Next Generation Cellular......................................................................................10
   11.5G – Seamless Integration...............................................................................11
   ARPU Rates............................................................................................................11
   Connected Devices................................................................................................12
   Micropayment Systems..........................................................................................12
   The Asian Market..................................................................................................13

III. Speaker Bios.......................................................................................................14
Executive Summary

The Wireless and Mobile Commerce Track consisted of presentations, case studies and panels covering current trends in wireless adoption, services, mCommerce transactions and content delivery over wireless devices. The day’s discussions were focused around addressing two fundamental questions:

1) What are the new, emerging, early-stage markets for wireless?
2) What are key innovations, lead practices and trials underway in innovative verticals?

A morning panel of seasoned investors and venture capitalists and an afternoon panel representing several key corporations, offered insights into the current state of venturing in wireless and mobile commerce internationally; next generation wireless networks; applications being trialed in the Asian market; models for proximity and mCommerce transactions; and the importance of joint ventures, partnerships and global alliances in international markets.
I. Presentation Summaries

1.1. Where Wireless Matters: New Ventures

New Wireless Opportunities
David Skok, General Partner, Matrix Partners

From a Venture Capital standpoint, the excitement of the late 90s resulted in the pendulum swinging too far in the direction of excess, with over-consumption leading to the over-funding of too many technologies and applications; now, however, the pendulum has swung back too far in the opposite direction. The biggest problem venture capitalists are facing in the current environment is that people simply aren’t buying; customers are still trying to digest what they have already bought. This period of readjustment could take as long as one to three years before regaining balance.

However, grim though the investment climate may be, venture capitalists view wireless as one of a few remaining bright spots. Wireless is still a relatively young space and there are lots of areas left for innovation. David Skok, General Partner with Matrix Partners, discussed a number of areas he and his firm see for innovation within the wireless space, including the next generation cellular networks, wireless LANs, Wireless home networks for streaming media, new applications which will drive ARPU (average rate per user per month), and machine-to-machine communication.

Future Markets, Current Realities: The Asian Angle
Greg Tarr, Managing Partner, GT Ventures

Asia is currently the most sophisticated and fastest moving market for wireless innovations. The majority of the technologies that are being developed in Silicon Valley, Boston and other US high-tech centers are being consumed first in Asia because the market is ready. Greg Tarr, Managing Partner of GT Ventures outlined the current market realities within Asia and offered recommendations for US companies interested in entering the Asian market.

An Acknowledged Industry Innovator
Kari Laento, Managing Partner, CEO, SnV Partners

Finland is the International forerunner in wireless communications, boasting a mobile phone penetration of over 70%, due in part to a highly competitive market which results in mobile rates being very close to fixed-line rates. The advanced state of the Finnish wireless market gives new wireless companies a head start over international rivals, and the low mobile rates have driven major Finnish mobile operators such as Sonera to lead other European operators in the search for new sources of revenue beyond simple voice traffic.
Sonera is a global leader in mobile-based services and applications. In 2001 Sonera Venture Partners (SnVP) was established to manage the venture capital investment portfolio of Sonera Corporation, which consists of 14 direct investments and eight Venture Capital Fund investments located in Finland and abroad. SnVP focuses on global investments in high-growth early and mid-stage companies in the mobile media sector. SnVP’s strategy is to develop a strong market position by bringing the synergetic partner companies together with Sonera into an active network. A key theme in SnVP’s investment strategies is integration: between platforms, between applications and between media. As demands for mobile data, alternative mobile/wireless technologies, better usability, enterprise solutions, home applications, and ubiquitous rich-media overlap, they can be expected to result in a convergence between mobile, Internet and PC/IT technologies. Kari Laento, Managing Partner and CEO of SnV Partners, highlighted trends that he sees in the mobile market and discussed SnVP’s investment strategies in view of these trends.

Investing in Wireless Data and Next Generation Communication Technologies
Anthony Cirugiao, General Partner, Clarity Capital

For the last couple years the wireless market has been largely driven by hype, with a number of new technologies being over-funded and over-bought even though they offered little actual value. However, despite history, wireless is still an immature market with vast opportunities on the horizon for innovation. The US wireless market in particular is very young, falling far behind the activity that has been taking place in Europe for years. Anthony Cirugiao, General Partner with Clarity Capital, discussed a number of reasons that wireless technologies are particularly attractive to venture capitalists, and outlined Clarity’s strategy for investing in wireless innovations.

Early Stage Wireless Venture Opportunities
Rod Randall, General Partner, St. Paul Venture Capital

In the current market climate it is very difficult for young companies to secure first and second stage investments. The reason for this is not that there is not money available for investment, but simply that investors are no longer accepting high degrees of risk. The focus has shifted away from the aggressive funding of unproven technologies in favor of profitable service offerings and strong end-user demand. In order for companies to get funding, they need to be able to identify new opportunity areas in which they can enter the market as strong leaders. Rod Randall, General Partner, St. Paul Venture Capital, discussed some examples of these areas, such as IP networks, which will create a disruption that some of the traditional players don’t fully understand how to bridge, thus creating valuable opportunities for start-ups.
Wireless Innovation – Opportunities at Crossroads
Carlos Kirjner, Managing General Partner, McKinsey & Co.

The meltdown in the telecom market has been a disaster for the industry, but it doesn’t mean that there aren’t opportunities still out there. Although the investment bubble has burst, the Internet, broadband and wireless are all still very real areas of opportunity and innovation. The U.S. wireless industry is currently at a major crossroads: on the one hand the spectrum cap has been lifted, wireless penetration is increasing, and new applications and services are driving ARPU up; however, the market is also highly competitive, the spectrum bidding war is likely to skyrocket the cost of wireless networks, and investors are wary of repeating past mistakes in over-hyped markets. The continued demand for new services and applications suggest that investment opportunities are still out there, but the challenge will be in finding the appropriate business model.

1.2. Where Wireless Matters: Corporate Initiatives

Axeda and Nokia: Partnering for Mobile Device Relationship Management
Richard Barnwell, Vice President of Services, Axeda

Axeda and Nokia are partnering to deliver wireless Device Relationship Management (DRM) solutions. By combining its DRM software and services with Nokia’s M2M Platform, Axeda is able to offer services which enable two-way communication between remote or mobile devices (such as vending machines, utility meters, medical instruments, and refrigerator trucks) and the enterprises that build, service and use them.

DRM is a new category of software that enables the capture of information between machines. This information can then be fed into call centers or field operations for remote diagnostics and monitoring, which, in conjunction with knowledge bases and predictive markets, can enable operators to predict when machines are likely to fail. Having this information allows operators to perform remote preventative maintenance, to correct areas that are software controllable via the Internet, or to schedule future maintenance. For large manufacturers with complex equipment, these service efficiencies translate into significant cost savings. By adding the wireless component, DRM can be applied to virtually all devices, regardless of location or mobility.

HP Laboratories: Tap and Go Services to a Supermarket Near You
Wesley Chan, Cooltown Development Manager, HP Laboratories

The Cooltown project at HP Labs explores the possibilities for enabling ubiquitous computing and communication scenarios by using a platform of hardware and software modules that link web presences to people, places, and things.

In conjunction with Stop & Shop, HP Labs has developed a proof-of-concept prototype for a Personal Shopping Assistant (PSA) that demonstrates the potential to revolutionize
the way people shop. The PSA is a wirelessly networked PDA with an attached product scanner, which enables customers to interact with electronic services that are linked to items in a supermarket, delivering personalized, product-specific information and services to shoppers. The PSA also provides a number of additional services including personalized marketing (enabling the customer to receive specific discounts based on their previous shopping history), time-based electronic coupons (such as offering significant discounts for products that are nearing their expiration dates), self-checkout, mobile point of sales, a nutrition guide, and a shopping list planner.

Nortel Networks: Wireless Internet Evolution
Mysore Prakash, Director Wireless Strategic Marketing, Nortel Networks

Declining ARPUs for voice services have driven operators to explore other opportunities for driving revenue. Nortel Networks has introduced what it believes will represent the next evolution of the Wireless industry in the form of an “Always On” strategy. Through the Always On strategy, Nortel seeks to expand from the current voice-centric marketplace towards a future where wireless permeates everyday activities. The strategy is designed to combine three key delivery areas, providing a rich array of applications and services at high speeds through a high performance core IP network. In addition to enabling the delivery of high quality audio and video, Nortel also expects to see location-based personalized end-user services become a major revenue driver.

MasterCard Initiatives
Bengt Horsma – Global E Business, MasterCard International

MasterCard is testing a new card which takes advantage of wireless technology to enable proximity payments – wireless-enabled payments that take place when the buyer is physically close to the seller’s terminal – using a more adaptable, interoperable and global protocol than is currently available. The initiative is driven by a demand in the market for fast, convenient, cashless payment systems. MasterCard found that the market can be sliced into four categories: “micro” payments, which are transactions of less than $5 and include transportation, vending and parking; “mini” payments, which are $5-$10 transactions, such as fast food, drive-thrus, parking; “minor” payments, which are small transactions over $10, such as fast food, gas and parking; and finally “major” payments, which consist of all other sectors. Micro and mini payments would likely be prepaid with stored value; minor and major payments would require validation, and the new card MasterCard is developing would utilize wireless capabilities to provide real time authenticated and secure contactless transactions.

FleetBoston: Wireless Decisions and Experiences
Jim Goodwin, Division Head, FleetBoston Financial Retail Banking

In Spring of 2000 FleetBoston rolled out a wireless banking and bill payment service that enabled customers to check account balances, credit histories, and Quick & Reilly investment account balances and details in real time using Fleet’s HomeLink Online.
banking service. The service was initially developed containing only core functionality as a means for gauging customer demand for wireless capability in the banking sector.

Upon roll-out the service saw an initial spike in usage, but demand died out shortly after. Fleet attributes this to the fact that cellular phones and handheld devices simply aren’t as user friendly as PCs for banking applications, as well as the fact that the wireless market is not yet mature enough in the US: wireless devices and service fees are still fairly expensive, wireless service areas are limited, and download times are slow. The lack of customer adoption of the wireless brokerage services came as something of a surprise, however, since there had been high expectations in 2000 that wireless brokerage services were going to be the killer application due to the highly mobile nature of the customer base and the inherent requirement for real time information. However, what the experience instead highlighted was that most mobile professionals have phones so that they can call their brokers, and the really dedicated day traders tend to stay sitting at their desks watching their screens. Fleet has subsequently cancelled its wireless brokerage services.

In hindsight, Fleet recognized that the primary challenge it faced in rolling out a successful wireless banking service was not the readiness of the market or the technology, but simply the lack of a compelling reason to take something mobile.

Telepass: Automatic Toll Payment in Italy
Giovanni Castellucci, General Manager, Autostrade

In response to the evolution of transport conditions and the new available wireless technologies, Autostrade S.p.A., along with more than 20 partnering Italian highway operators, has updated the Italian highway toll system with the introduction of the Telepass automated toll collection system. When Telepass was introduced in 1990, it was the first system in the world for automatic toll collection and stood as an early example of the potential for wireless machine-to-machine communication. The Telepass system removes the need for drivers to stop and hand over money at toll booths by equipping vehicles with a smart card which communicates with receivers at the toll point, charging the toll automatically to the user’s credit card or bank account.

The Telepass system is currently the largest automated toll collection system in the world, with 2.8 million customers, and Autostrade expects to achieve a customer base of 5.5 million users within the next three years. Autostrade also plans to expand the Telepass system into a multi-services platform, offering additional services such as payment on and off of highways, parking systems, and GPS and GSM features, and is anticipating expansion into foreign markets, beginning with Austria.
II. Themes

The Change in Climate of the Venture Capital Market

Despite the recent contraction in the investment market, there is still a significant amount of money awaiting investment opportunities. However, conditions have changed considerably. Whereas the last half of the 90’s was a sellers market in which investment opportunities ran on hype and were significantly over-valued and under-investigated, the burst in the bubble has had the effect of shifting the terms to investors.

With the change in conditions, naturally comes a change in investor attitudes. The downturn in the economy has resulted in less competition. As a result investors are less willing to take risks. Venture capital firms are no longer interested in dramatically new business models, and are increasingly avoiding early stage investments. The focus now is on incumbents, retained earnings, profitable service offerings, strong end-user demand, and purchasing proven technologies from substantially credentialed companies. Even among those investors that are still exploring opportunities for early stage ventures, the focus has shifted towards technology-based disruption opportunities that fit within the existing value chain and offer explosive growth opportunities with the promise of entering new markets as leaders.

Wireless LANs – 802.11

The WLAN 802.11 technology has been enormously successful over the past 18 months. Most data-access is going to occur in places like airports, train stations and other similarly high-density spots where it’s not possible to provide adequate coverage via a cellular network. It also happens to be significantly cheaper to produce wireless services via 802.11 capacity than via cellular network. This is expected to result in a convergence between cellular and 802.11 networks, which will open up new opportunities for service providers involving the development of a mixed network and PC cards that are capable of automatically switching to 802.11 to enable cheaper service in these areas.

An additional opportunity is found in one of the weak spots with 802.11, which is security. Currently the only solution to securing 802.11 networks is to put the base station outside of the firewall, requiring users to dial in if they leave the area. However, in situations with thousands of users on a large campus, no VPN software will scale well enough to handle such high throughput. Therefore there is a great need and opportunity for companies that are able to develop a solution to this problem.

There are also investment opportunities related to 802.11 for chip companies. Base station chip companies will be key in handling the many different standards that arise from the 802.11 technology, such as 802.11b (the current mainstream technology adopted by wireless device manufacturers), 802.11a (faster than 802.11b, but not compatible with 802.11b devices), and 802.11g (developed to boost data transmission while still maintaining interoperability with the earlier specifications). Because each standard is
slightly different, it will be important for somebody to find a way to minimize the conflicts between them.

The Home of the Future – 802.15.3 for Streaming Media

Currently music, videos and photos are all moving towards digital media, and this is creating a dramatic change in terms of low cost media storage. The TiVo personal video recorder is an example of the direction in which home entertainment and media is going to go. One of the drawbacks to the TiVo system, however, is that recordings can only be watched on the TV they were recorded on, which can be inconvenient in homes that have more than one TV. The next step will be the development of a central home server which will house all of the home media. Photos, music and video will all be located on one central wireless device and then streamed to flat panel displays located throughout the house.

The 802.11 technology will not work for this, however, because 802.11 is a “collision oriented” network and is unable to handle streaming media which requires a guaranteed bandwidth. So it will be enabled by a new technology – 802.15.3 – which has a low battery consumption similar to the bluetooth technology, but with enough throughput to support multiple high-speed video streams taking place simultaneously.

Next Generation Cellular

One of the big changes that cellular is going through right now is the move from 1st and 2nd generation technologies to 2.5 generation (2.5G) and 3rd generation (3G) networks, which promise greater bandwidth and multimedia functionality on wireless devices. The 2G network technology is differentiated from 1G primarily as a move from analog to digital. Among the common 2G networks are CDMA, GSM, and TDMA. But 2G is too slow for most data services, with most wireless Web access moving at speeds of 10 to 19 kilobits per second. 3G networks promise speeds of 284 kbps up to 2 megabits per second. At 3G speeds, mobile phones or handheld devices could handle high speed multimedia. However, 3G is still in its early stages in Europe and Japan, and the high cost and current lack of customer interest suggest that it will be some time before it reaches the US market. In the interim 2.5G technologies are being introduced which deliver speeds of between 56 kbps and 144 kbps, enabling adequate provision of most 3G services.

What 2.5G and 3G have in common is their underlying method of moving data. Both utilize packet-switched networks which enable information to be sent across the network in the form of packets of bits. Because the bits are commingled, they are able to share the same pipeline rather than requiring a dedicated channel for each connection as in a circuit-switched network. This results in an increase in capacity, since packets of data from multiple voice and data calls can travel together instead of having to wait for a dedicated channel to be freed up. This efficiency enables carriers to increase their voice
capacity by up to eight times and to provide always-on data connections that don’t dominate the networks.

One such technology is 1xEVDO, which offers 3G speeds on the 2.5G platform by splitting data up from voice. This works well because the technical requirements for “voice” and “data” are substantially different – a voice call, for example, requires a minimum bandwidth throughout the entirety of the conversation, whereas data has less consistent bandwidth requirements. By separating the data component from the voice, data throughput is able to be increased dramatically. The 1xEVDO service is currently being trialed in Korea.

11.5G – Seamless Integration

11.5G is the term used to refer to the whole spectrum of competing platforms: 2G, 2.5G, 3G, as well as 4G, which includes short range wireless technologies, such as 802.11a/b, HiperLAN2 and Bluetooth, plus alternative metro and wide area wireless technologies. The simultaneous discontinuities that come with each new generation of architecture create a challenge for operators as they must balance management of the technology evolution and investment cycles with transition to new industry structures and with migration into new business models.

As markets become flooded with parallel roll-outs of competing and complementing technologies, an opportunity arises for the re-packing of content in a format that becomes seamless for customers regardless of which protocol they are using. The business solution therefore is in integration of the different generations of protocols so that they work together seamlessly from the end-user’s perspective, along with an architecture which provides good content and services and good service management.

ARPU Rates – New Applications and Services

One of the most crucial problems currently facing the wireless operator is declining ARPU rates, which have been falling significantly for the last five years. This is compounded by the fact that subscriber rates are dropping as well. Because these two factors are fundamental drivers of operator revenue, it has become critical that operators focus on ways to get the ARPU rate back up again. One such strategy is the introduction of more sophisticated services. For example, one of the key attractions of Nextel is the “push to talk” feature, and this one feature alone has enabled Nextel to achieve a much higher ARPU rate than many of their competitors.

Japan and Korea currently represent the two most dynamic wireless markets in the world. Within these two markets there are a number of similarities: entertainment (gaming), e-mail, and access to basic information are all very popular. Consequently, the introduction of color handsets has led to a significant rise in ARPs.

SMS (Short Messaging Service, also known as “instant messaging”) is another feature that has seen a great deal of success in Europe, particularly in the teenage market.
Similarly, a new service currently being trialed in Japan and Korea is a Multimedia Messaging Service (MMS), which enables users (who in this case are primarily kids) to send photos and videos to their friends through their video-enabled phones. Kids have been a huge driving force behind phones, and the MMS service along with the next generation of multimedia-enabled handsets are expected to see a great deal of success.

Another area of development is in GPS applications. An aspect of future GPS applications is likely to be a backend database system capable of aggregating the positional information from a number of phones into a geographically sensitive database, allowing users to make queries in the process. An example of such an application would be “geographical buddy lists.” This is another application that will likely be popular with kids, enabling them to see which of their friends are currently in a nearby neighborhood so that they can go by and visit them. Additionally, this is an application that gives great backend capabilities to allow content to be paid for by the producer (like a 1-800 website).

From the billing perspective, a new area of development is the design of more sophisticated billing systems, such as “BOBO” (bill on behalf of others), whereby operators are able to bill customers on behalf of the content providers. This capability is one of NTT DoCoMo’s particular strengths.

Connected Devices

The Web is moving into a new generation of user relationships: the first generation was humans using a browser; the second, which is just beginning now, is the use of “web services” to enable machine-to-machine communication (e.g., an order processing system within a company will be able to send an order electronically using an XML web service). The third generation will involve devices (such as trucks, vending machines, containers, plants and machinery, refrigerators, security devices, etc.) connecting to the Internet. This will present a huge number of opportunities for new networks – particularly wireless networks – and new devices, as well as new software to run the devices and new management software to control and run the networks.

Micropayment Systems

Originally conceived of as a means for web content sites to generate revenue through incremental charges, micropayment systems have found a new niche in the wireless market. Micropayment systems operate as third party intermediaries that reduce the cost of individual transactions by consolidating small charges into lump sums. By enabling real time authentication and removing the high cost associated with small transactions, vendors are able to offer customers cashless payment systems for transactions of all sizes. Wireless carriers are also seeing benefits from micropayment systems in the form of enhanced ARPs as a result of the additional services they are able to offer.

In addition to mobile payment systems accessed through phones and handheld devices, there are also a number of point-of-sale vendors looking to test new products in the form
of keychains and company ID cards containing embedded chips or plastic radio-frequency identification devices. The path to consumer acceptance for such devices has already been paved by the success of wireless automatic toll payment, which utilize back-end micropayment systems.

The Asian Market

A common mistake made by investors and start-ups looking to enter the Asian market is a tendency to group the entire region into a single category. When trying to market a US start-up in Asia, it is necessary to thoroughly understand the region and to recognize that the dynamics of each market are distinct. For example, in Japan 20% of the ARPU is based on data, compared to Korea, which is currently only seeing 9% for data, followed by China at a mere 4%. This can be explained as a function of the handsets that are available within each market, and China, for example, lacks the buying power of Japan and Korea.

Put very simply, there are four fundamental steps that any start-up considering entering the Asian markets should take:

1. Start-ups should begin by conducting some preliminary research to develop a robust understanding of the marketplace before beginning to market their product.

2. The next step is to focus on developing relationships with channel partners and creating an effective channel strategy. Because Asia is a very fragmented market with a number of specialized system integrators, it can be very difficult for newcomers to break into the market without a partner. Additionally, it is important to ensure that the product is appropriately customized for the local market and adheres to the various different specifications – having a channel partner can help with product localization.

3. The third step is to target the launch customers. Each of the markets moves at a different speed, and it is important to understand the dynamics of the market place and the customer base being targeted.

4. The last step is to put in place a good local management team that can use their local relationships and knowledge of the Chinese, Japanese and Korean markets to drive channel sales.
III. Speaker Bios

Richard Barnwell
Richard Barnwell is VP of Services at Axeda an Enterprise software and services company whose Device Relationship Management (DRM) products allow organizations to capture real time information from devices over the Internet. Prior to Axeda Barnwell was Chief Technology Officer at ZEFER an Internet consulting company acquired by NEC. At ZEFER Barnwell led the technical delivery of Internet projects with companies such as Fidelity, Portugal Telecom, Gillette, Ford, Greenlight/Amazon, First Data Corporation and many others. Barnwell led the creation of ZEFER's Wireless and Mobility Practice and many of its activities in major technical initiatives such as Sun's SunTone and iForce programs. Prior to joining ZEFER, Barnwell was Director of Technology for Infinium Software a leading developer of ERP software systems. Prior to his contributions at Infinium, Barnwell served as a business unit manager for Dun & Bradstreet Software (McCormack & Dodge) which was a pioneer of packaged ERP software. Barnwell has spoken at numerous industry conferences on topics such as wireless and mobility, integration of internet and transaction processing technology, and large scale component based software development. He received his master's in information systems from Brighton University and earned a bachelors degree in business from De Montford University in England. Barnwell is a member of the ACM and IEEE. Barnwell serves on the Advisory board of a number of early stage technology companies including iConverse, Pango Networks and Aptium.

Wesley Chan
Wesley Chan is a pervasive and mobile computing researcher at HP Labs, creating and studying new applications and use models of Auto-ID technologies and their role in bringing personalized and context-aware services to the supermarket near you (and a wide variety of other places). Wesley focuses especially on uses for RFID, bluetooth, and IRDA-based beacon technologies. Prior to HP Labs, he was a researcher at the MIT Media Laboratory, where he founded Project Voyager--an endeavor to build proof-of-concept location-based and context-aware applications. Wesley has also worked as a project manager on the Windows 2000 operating system and as a technical designer on the .NET platform at Microsoft Corp. In what little spare time he has, he enjoys hacking digital cameras and snapping photographs of anything imaginable. Wesley received both his Bachelors and Masters degrees in computer science from MIT.

Anthony Cirurgiao
As the Managing Partner of Clarity Capital, Anthony has been focused on the wireless industry since 1995. Prior to founding Clarity, Anthony was an investment professional with a Boston-based venture fund, aimed towards wireless opportunities that benefited wireless service providers. Anthony
worked at McKinsey & Company, focusing on high-technology services, and was a
founding member of two high-tech companies launched out of MIT and Harvard.
Anthony holds a B.Sc. degree in Molecular and Cellular Biology and an MBA
from MIT's Sloan School of Management.

Jim Goodwin
Jim Goodwin heads FleetBoston Financial's retail e-commerce efforts,
including Interactive Banking, Web Content, Marketing and Business
Development. In this role, he has overall responsibility for the experience
provided to the firm's 2,000,000+ Online customers. Jim held e-commerce
management roles at BankBoston and lead the firm's Fancial Engineering
efforts. He joined the Bank in 1992 to head Currency Derivative trading.
Prior to his time at Fleet, he traded Currency and Interest Rate Options for
several firms in New York. He holds a BA in Mathematics from Williams
College.

Kari Laento
Mr. Laento has over 25 years of industrial experience in general management,
strategic partnerships, intellectual capital management and corporate venture
capital operations. He is CEO and Managing Partner of SnV Partners (spin off
from Sonera Corp.). Prior that he was since 1997 Senior VP of Corporate
Strategic Sourcing and Intellectual Asset Management of Sonera Corp., he
served also as Chairman of Sonera's VC Investment Board and from summer 2000
on Senior VP of Corporate VC Operations, based in Los Angeles. His career
before Sonera was 18 years with Neste Corp., a global oil- and petrochemical
company, most recently Corp. VP of Technology Asset Management and Venture
Capital Operations. 1994 - 1996 he served as CFO and Member of Board of
Gasum Corp. (JV between Neste and Russian Gazprom). 1989 - 1994 he was
President and CEO of Neste Alfa Corp (base oil and Lubricants division).
1981 -1988 he served as Executive VP of Finnoil Corp. Prior to that he has
worked as Legal Counsel for KansallisPankki and as District Attorney of City
Vantaa. He is member of ICM-Gathering, leading Round Table in the field of
Intellectual Asset Management. He has Master's degree in Law from the
University of Helsinki and executive programs both Finnish Management
Institute and Darden Business School, Univ. of Virginia. Mr. Laento holds
positions as chairman and member of board in several privately and publicly
held companies. He is also member of Advisory Boards of several VC-Funds.
He has been 1991-1999 President and Member of the Board Finnish Basketball
Federation and Member of the Board of Finnish Olympic Committee and Finnish
American Chamber of Commerce, Pacific Rim. He is co-author of books:
"Strategic Partnership-New Way of Creating Value" and "Profiting from Your
Intellectual Assets."

Carlos Kirjner
Carlos Kirjner is a partner at McKinsey and Company's Stamford office.
Since joining McKinsey, Carlos has served senior management of a wide range of telecommunications service providers and manufacturers in strategy, operations, technology, and regulatory questions. Carlos is a leader of McKinsey's telecommunications practice in the Americas, and is an expert in broadband access and mobile services. Before joining McKinsey Carlos worked as an engineer for Siemens. He received a PhD degree in Electrical Engineering and Computer Sciences from the University of California at Berkeley, where he won the Sakrison Memorial Prize for outstanding and innovative research. He also holds an MSc degree with distinction in Electrical Engineering from the Imperial College of Science and Technology of the University of London. He has published in leading journals on operations research, systems and communications, and applied mathematics.

**Mysore Prakash**

Dr. Mysore Prakash is Director of Wireless Strategic Marketing at Nortel Networks. In this role, Dr. Prakash manages a department that provides Strategic Planning, Market Analysis, and Competitive Analysis functions for global wireless markets. In his previous role, Dr Prakash was Senior Product Manager for Nortel GSM Networks. His previous responsibilities at Nortel included: Network Planning, Network Design, and Product Line Management for Switching and Network Management products. He has a Ph.D., in Electrical Engineering from SUNY Buffalo. Before joining Nortel, he worked at AT&T Bell Laboratories in Holmdel, New Jersey in the area of Data Networking.

**Rod Randall**

Rod Randall joined St. Paul Venture Capital as a general partner in November 2000. Based in Boston, Rod specializes in communications equipment and software for service providers, and currently supports investments in Avian Communications, Kenetec, SnowShore Networks, and Teltier Technologies. Mr. Randall was formerly chief marketing officer for Service Provider Networks (SPN) at Lucent Technologies Inc. Prior to being named chief marketing officer for Lucent, he was the senior vice president, Global Marketing for InterNetworking Systems, which consisted of Lucent's former data networking systems group and Ascend Communications. Mr. Randall came to Lucent through the acquisition of Ascend Communications, Inc. As part of Ascend, Mr. Randall was vice president of marketing for their Carrier Signaling and Management Unit with responsibilities for marketing and product management for the Ascend Intelligent Network and SS7 Solutions, including the converged SS7/IP Solutions at the core of the Next Generation Public Network. Mr. Randall was also focused on comprehensive Intelligent Network solutions for PSTN, Wireless, and PCS networks. Prior to this, he was vice president of Worldwide Marketing, and Business Development functions for Stratus Computer, and was the General Manager of Stratus' Telecom Infrastructure Software Business. Stratus merged with Ascend in October of 1998. Mr. Randall brings more than 15 years of industry experience to his post. He was previously vice
president of Strategic Market Development for Madge Networks NV, where he led the company's expansion into the wide area and video networking markets in Europe while based in Paris, France. In addition, he oversaw the establishment of the company's strategic partnerships, including those with Intel, Microsoft and MCI, among others. In 1987, Mr. Randall co-founded Teleos Communications, Inc., a wide-area network access equipment provider acquired by Madge Networks in 1996. During that time he played a leading role in expanding Teleos from a start-up company to a multi-national enterprise. He held a variety of senior executive roles at Teleos, where he most recently served as executive vice president and chief technology officer. Mr. Randall started his career as a member of technical staff and supervisor at AT&T Bell Laboratories. He has an MS degree in electrical engineering and computer science from the University of California, Berkeley, and a BSEE with highest honors from Georgia Tech.

David R. Skok
David Skok joined Matrix Partners as a General Partner in our Waltham office in May 2001. He has a wealth of experience running companies. Skok started his first company at age 22. Now 45, Skok has founded a total of four separate companies and performed one turn around. Three of these companies went public. He joined Matrix from SilverStream Software, where he continues as chairman, acting more in a board capacity than in a day-to-day role. Skok founded SilverStream in June 1996. Today SilverStream is a public company with approximately 800 employees and offices in more than 20 countries around the world.

Prior to the formation of SilverStream, Skok was the President and CEO of Watermark Software, a company he founded in January 1993 whose products fast became market share leaders in the document imaging marketplace. Watermark was sold in August 1995 to FileNet Corporation. Skok holds a B.Sc Honours Degree in Computer Science from the University of Sussex, England.

Greg Tarr
Greg Tarr founded GT Ventures - a Venture Consultant/Angel Investor based in Asia (www.gtventuresvc.com). He works with the Top Boston & Valley based VC's and their portfolio companies on Business Development/Strategic/Financial projects. In addition, he is a consultant responsible for sourcing deal flow to CDP Capital (US$10b Managed) Canada's Largest Private Equity Group. Greg also founded M-Werks where he sourced, analyzed, valued, worked on exits and Business Development with VC's and Asian Wireless/Broadband infrastructure firms. He initiated strategic alliances with Verizon, Nokia, Nortel, Qualcomm & Sun. His geographic expertise is US, Korea, Japan, Taiwan and China. Investments include: Intrinsic from Shanghai which supplies technology to China Mobile (valuation has doubled after attracting Fidelity & Asia Info as investors), Unitech Networks - a Regional Asian System Integrator who designed software for Hong Kong Airport's 802.11 system, was the first Channel partner to bring Ascend,
Alteon & Unisphere to Asia and Infobank - Korea's Leading Wireless Financial Trading platform. Greg worked in Investment Banking/Equity Research at Deutsche Bank Securities - DMG Tech Group (now CSFB Tech Group) where Reuters ranked him #4 sell side Asian Technology analyst after his first year as an analyst, he was a Management Trainee in Toyota Motor Corp operations and interned for MTV during startup mode. He is an Advisor to the Wireless Research Consortium/Center for eBusiness at MIT's Sloan School of Management and lectures at MBA schools: MIT, Korea Institute of Science & Technology & NUS - Singapore. Greg is quoted by: CNBC, CNN, Wall Street Journal, Fortune and has worked/lived in Asia 5 years (Korea, Hong Kong, Singapore), Europe (Sweden), US (NY,LA). He holds an MBA from Pepperdine Business School (Los Angeles), a BA from U Colorado - Boulder and attended Bronx High School of Science (New York City).