Mobile Data Services

Empowering the Mobile Workforce

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Executive Summary

Today, it's a business imperative: people need access to their data while on the move almost anywhere—not just within range of a corporate or public Wi-Fi hotspot. Real-time access to corporate data in the office, at home and on the road can lead to productivity gains and responsive customer service that set your business apart from the competition.

That's why so many companies are turning to wireless wide area networking (WWAN) technology to supplement their existing remote access solutions. Commonly known as mobile data, WWAN uses existing GSM and CDMA cellular networks to provide access to data anywhere that you can use a cell phone.

Unprecedented investments in next-generation wireless data networks by major wireless carriers are bringing enhanced networks on line and breaking down the traditional barriers of speed and reliability. At the same time, fierce competition between carriers is driving down the cost of WWAN, making mobile data service more practical for a broad range of mobile applications and users. While mobile data has improved in many ways in recent years, for many companies a missing piece of the WWAN puzzle has been availability of a single service offering that combines mobile data with the other necessary components of enterprise grade secure connectivity. Wi-Fi, Ethernet, single sign-on authentication, security policies, VPNs, personal firewalls and more.

In order to better understand the business benefits of WWAN and the limitations of the technology, this paper takes a look back at the evolution of WWAN and discusses how to make mobile data work for you. Based on research conducted by iPass, this paper provides some concrete performance metrics and deployment considerations to help define your company's needs and determine which services will provide a cost effective and productive mobile user environment. Lastly, it discusses how iPass has added WWAN to the same service interface that users and IT staff already trust for all their remote connectivity needs. The result: truly mobile network access, with transparent connections to corporate resources no matter what technology you use, including WWAN.

The Need for Mobile Data

Wireless networking technologies have been a major productivity boon for mobile and traveling professionals. Technologies such as Wi-Fi offer high-speed wireless access to email, large attachments and critical corporate network resources from hotels, conference centers, airports, coffee shops and even just roaming the corporate campus. That is, as long as the user remains within range of the Wi-Fi access point, which is typically 50 to 150 meters.

The problem is, on-the-go users require enterprise network access from cars, taxis, trains and locations in the field—places where convenient connections aren't always available. Even when connection points do exist, mobile users such as sales professionals, service technicians and on-site consultants often find no connection options where they need them. For many of these users, mobile data can unleash increased levels of productivity by eliminating their dependency on wired data ports or Wi-Fi access points.

Business Benefits

For the enterprise, mobile data offers these benefits:

- Increased productivity, efficiency and responsiveness by reducing the traditional barriers involved with accessing network resources
- Enhanced real-time decision-making, resulting from immediate access to business-critical data and the shared perspectives of team members
- Opportunities to automate processes and streamline operations from order entry to inventory management and supply chain integration

What Is Mobile Data?

WWAN has been described as moving from wireless broadband to true mobile broadband. Although WWAN haven't yet reached the data transport rates of Wi-Fi, mobile data throughput rates have risen dramatically, while extending coverage to virtually anywhere with a cellular phone signal.

To provide this type of coverage for accessing email, the Internet, corporate applications and enterprise resources nearly anywhere, WWAN makes use of cellular data networks. These data communications require cellular devices equipped with wireless data PCMCIA cards.

Understanding Mobile Data Technology

All mobile data services are delivered through an "air interface." Information is sent through that interface using a spectrum of radio frequencies (RF). These frequencies are distinct from those used by other RF services such as Wi-Fi, FM radio and aviation radar. The range of frequencies, or **bands**, used for WWAN are different in different areas of the world. For example, the U.S. and UK use different bands.

Within these bands, national regulatory agencies license portions of each band for use by specific cellular phone companies. These phone companies pay the licensing agencies substantial sums of money (many billions of U.S. dollars) for the privilege of offering services within these RF **sub-bands**. The regulatory agencies guarantee that part of the RF spectrum is licensed for use to at least several different companies within a given geographical area. This allocation helps ensure competition and, theoretically, better service quality and pricing for customers.

Licensed RF spectrum is clearly a very valuable resource and all cellular transmission technologies provide a means to share a licensed band of frequencies, so as to deliver reliable and private communications services for multiple customers. The frequencies allocated to a specific cellular phone company , or **mobile carrier**, are shared in some way so as to enable many mobile phone and mobile data customers to use services in a single location at the same time. In today's systems, this is accomplished in one of two ways: time-division multiplexing (TDMA) or code-division multiplexing.(CDMA)

Among the mobile data systems, GPRS and EDGE are delivered over TDMA systems while 1xRTT, EV-DO and UMTS are delivered via CDMA systems. The specifics of how these systems work is beyond the scope of this paper, however the following section summarizes the evolution of different streams of mobile data technology.

The Evolution of WWAN

Following years of slow and steady evolution, mobile data development has recently accelerated. Intense competition in the wireless arena and increasing market saturation of traditional voice services have driven carriers to deploy new technologies capable of enabling innovative revenue-generating services. Carriers have embarked on major new capital investment projects, delivering an array of ground-breaking, high-speed data services.

Here's a quick recap of this evolution – for more information about each technology, refer to Appendix A:

- **First Generation** (1G) cellular technology used analog signals and evolved from 1960 to 1990.
- **Second Generation** (2G) digital cellular technology, which includes GSM, CDMAOne, and GPRS, was introduced in the early 1990s.
- **2.5G** mobile communications technologies, which includes CDMA2000 (1xRTT) and EDGE, delivered the first true high-speed digital mobile data services.
- **Third Generation** (3G) mobile communications technologies deliver much faster downlink data rates—100 to 600 kbps today and an expected 2 to 4 Mbps eventually. 3G technology comes in several flavors including CDMA2000 (EV-DO, EV-DV), UMTS and HSDPA:
- **3.5G** mobile communications technologies, which include EUDCH, HSUPA and CDMA2000 (3xEv-D*, deliver highly optimized downlink AND uplink data services utilizing 3G wideband CDMA air interfaces.
- **Fourth Generation** (4G) cellular communications systems will be characterized by high-speed data rates of 4 to 20 Mbps. These transfer rates will be suitable for streaming high-resolution movies and television. Initial deployments are anticipated between 2007 and 2010.

Limits of Mobile Data Technology

Both TDMA- and CDMA-based WWAN systems are currently limited in the following ways:

- A finite number of users (a few dozen users) may be served at any single location.
- When multiple users are present in a single location, all users share a single "bandwidth budget." That is, the throughput capacity of the mobile data system in that area is divided among the users. Hence, all users sometimes experience lower service throughput.
- Because all users are being served with a single RF resource, each mobile data technology defines a protocol whereby a device may request mobile data system resources. This

sharing protocol introduces a delay between the time a user device has data to send and the time it is allowed to send it. This delay appears as a service characteristic called "latency."

- Cellular phone users share the same RF resource as mobile data users. Unlike mobile data services, phone service requires permanent allocation of RF resources while a call is active. Because phone service generates the greatest revenue for mobile carriers, phone calls are considered higher priority service than mobile data service. Heavy phone use in a local service area will temporarily reduce the RF resources available for use by mobile data, with a resulting reduction in WWAN performance.
- The radio signals associated with the service are sent between mobile user devices and the antennas at a mobile carrier-operated radio tower (also known as a cell tower). The communications between a user's device and the tower become increasingly weak and prone to interference as the user moves farther from the tower. An area where the radio signal quality is poor is called a "fringe" service area. When a user connects with the service in a fringe area, the service will be slower and more prone to unexpected interruption, resulting in lost connections.
- Radio signals in the frequency ranges used by mobile data systems travel in straight lines from the antenna. Due to this, buildings and natural geographic features may create small fringe service areas, even close to the cell tower, by physically blocking the signal.

Making the Technology Work for You

Having recognized the potential of mobile data services to un-tether the workforce, businesses need to consider a number of issues as a part of a thoughtful and timely plan to leverage the technology. These include:

- Understanding the characteristics of the services that are actually available: their speed, reliability, consistency, latency and ubiquity
- Understanding the mobile data services market: what companies offer which services in different geographic areas, and their plans for extending their offerings
- Understanding how data services are sold: usage plans, bundling, price trends and competition
- Understanding which services work for you: which services will work with your applications and how mobile data service characteristics may affect your planning for application deployment

Understanding Mobile Communications Service Markets

While the mobile communications marketplace is quite complex, a few key facts will prove helpful in making decisions on service selection.

Expensive Business

Delivering mobile communications is an expensive business. The licenses for the radio spectrum alone require a significant outlay of capital (in the billions of U.S. dollars) by the mobile carriers. Moreover, delivering mobile communications services requires substantial investment in physical infrastructure, including antennas, transmitters, switching equipment and the network to interconnect all of the pieces. A decision to offer new services, especially new mobile data services that do not presently generate large revenues, is a profound capital decision for a mobile

carrier. It is unsurprising then that newly deployed services are usually much more expensive than those already widely deployed.

Incremental Deployment

Due to the tremendous costs, deployment of new technologies for mobile data services usually progress through the following stages:

- Limited technical trials that are known only to carrier personnel. In this stage, the carrier evaluates the viability of a technology: its ease of deployment, performance, reliability and manageability.
- "Second market" consumer trials in which the service is offered in areas that are not major markets for the carrier. This avoids widespread bad press if service issues develop during the trial.
- Major market deployment occurs once the carrier has achieved confidence in the technical and support aspects of the new service. The first markets selected are usually those that represent the greatest near-term revenue opportunity. This does not necessarily mean the largest or most sophisticated markets. Following these deployments, the carrier evaluates the development of the market and updates its revenue projections.
- Ubiquitous deployment occurs when the carrier has achieved confidence in the service's revenue model and is satisfied with its potential to recoup its investment in a reasonable time, usually about 5 to 7 years.

The combined impact of these factors means that general availability of a specific service from an individual carrier in a specific region may be delayed for years. The areas of availability and timeframe for deployment should be weighed carefully when making decisions that rely on the timely availability of a new mobile data services in a region where the service is not already available.

Local Build Out

Additionally, carriers often incrementally build out the capacity and quality of a new service in a single market. This is essential to the nature of deployment of new technologies. When new antennas and transmitters are deployed for a new technology, the carrier often continues to build and deploy the infrastructure for one to two years after its initial availability in a market. This often means that for quite some time, a service is of better quality in certain areas of a city, perhaps downtown, than in the suburban areas of the region. Test the quality of the service yourself before making assumptions about its quality in a critical area.

Performance Metrics for Mobile Data Networks

The following table describes the performance characteristics of several network technologies in use today and those of mobile data technologies, based on research conducted by iPass. These characterizations are not attributable to any single network. These measurements summarize a small sampling carried out in five major wireless market areas in the U.S. and Europe.

Typical and observed values in *italics* reflect publicly reported results of equipment vendor and carrier technical trials. Maximum data rates reflect either the maximum data rate capability of the technology or, in the case of GPRS/EDGE, the maximum realized data rates, recognizing the limits of the mobile data cards available.

Table 1: Performance by Connection Type*

Connection Type	Downlink data rate (bits/sec)		Uplink data rate (bits/sec)		Latency (ms)
	max	typical	max	typical	observed
Corporate LAN	100 M	3–7 M	100 M	2–5 M	15–65
Dial-up	56 k	20–40 k	48 k	20–32 k	40–90
Cable broadband	4 M	0.5–3 M	256 k	150–250 k	60–90
Public Wi-Fi	11 M	0.3–1 M	11 M	0.1–1 M	65–120
GPRS	52 k	12–40 k	22 k	10–20 k	400–750
EDGE (E-GPRS)	265 k	40–120 k	110 k	30–40 k	400–700
1xRTT	307 k	50–140 k	153 k	30–60 k	350–700
UMTS	384 k	120–320 k	128 k	40–60 k	330–660
1xEV-DO rev 0	2.4 M	150–600 k	153 k	40–90 k	260–700
HSDPA	10 M	*400–1200 k*	128 k	40–60 k	*80–120*
1xEV-DO rev A	3.1 M	Unknown	1.8 M	Unknown	Unknown

**Source: iPass*

This table reveals some important basic information about mobile data services:

1. **Mobile data technologies deliver highly asymmetric data rates**. In general, the data rate to the user device is much faster than that from the device. This asymmetry is due to the observation that most applications need to deliver much more information to the user than the user generates.
2. **Delivered data rates are highly variable**. The more populated the service location, the more likely a mobile data service user is to share the available service bandwidth with other users. Data rates also go down as the user moves further from the mobile data antenna (on the cell tower) due to increased errors, retransmission, and the network's use of less efficient but more robust modulation techniques.
3. **Network latency is often very high**. This characteristic is attributable to both the effects of network sharing among local users, the characteristics of the network technology, and the configuration and tuning of the network by the network operator.

These characteristics limit the utility of mobile data services for particular applications. In the following table, we have listed a number of common remote access applications and have identified the network technologies that support the delivery of acceptable service levels for end users.

Table 2: Performance by Application*

Application	Technologies delivering minimally acceptable service	Preferred technology
Microsoft Windows* desktop	HSDPA	LAN (very low latency)
Non real-time messaging (e.g., Blackberry, mail sync)	GPRS, 1xRTT, EDGE, EV-DO, UMTS	Those with downlink data rates > 30 kbps and low cost
POP3 email	Dial-up, home broadband, public Wi-Fi, 1xRTT, EDGE, EV-DO, UMTS, HSDPA	Those with downlink data rates > 40 kbps
Microsoft Office Suite (Outlook)	Dialup, home broadband, public Wi-Fi, 1xRTT, EDGE, EV-DO, UMTS, HSDPA	Those with low latency and/or high downlink data rates
Web browsing	Dial-up, home broadband, public Wi-Fi, 1xRTT, EDGE,	Those with high downlink

Application	Technologies delivering minimally acceptable service	Preferred technology
	EV-DO, UMTS, HSDPA	data rates
VoIP	LAN, EDGE, UMTS, EV-DO, HSDPA	Those with a minimum 40 kbps bandwidth upstream and downstream
IPSec VPN	Dial-up, home broadband, public Wi-Fi, 1xRTT, EDGE, EV-DO, UMTS, HSDPA	Those with a minimum 40 kbps downlink data rate and latency < 700 ms

**Source: iPass*

To understand how common applications perform when used with mobile data networks, iPass conducted the following comparison. The comparison made use of a standard enterprise Microsoft Office infrastructure that was accessed over a Cisco IPSec VPN. To provide a better understanding of how well this application realistically performs over mobile data connections, the following script was executed several times, at several locations—and on several mobile data networks, at several public Wi-Fi hotspots and on the iPass corporate LAN. The user's Outlook profile was configured to delay the download of attachments until they were requested by the user.

1. The user authenticated, and iPassConnect activated the VPN.
2. The user activated Outlook. The elapsed time from activation until the mail summary display was visible was measured **[Op]**.
3. The user composed a 2000-byte simple text email and sent it to themselves. The time from sending the email until it appeared in the mail summary display was measured **[Sd]**.
4. The user opened the mail message. The elapsed time from opening the mail message until the message was displayed was measured. **[OM]**
5. The user navigated from the mail summary to the calendar display. The elapsed time from pressing the calendar button until the current day's schedule summary was displayed was measured **[Cal]**.
6. The user returned to the mail display. The elapsed time from pressing the mail button until the mail summary was displayed was measured. **[MR]**
7. The user exited the Outlook application. The elapsed time from terminating the program until the sync completed and the display disappeared was measured **[Ex]**.

Table 3: Comparison of Application Performance by Connection Type

Connection Type	Op	Sd	OM	Cal	MR	Ex
LAN	**2**	**1**	**1**	**1**	**1**	**3**
Cable Broadband	**6**	**2**	**1**	**2**	**1**	**4**
Public Wi-Fi	**9**	**3**	**2**	**2**	**2**	**7**
GPRS	**142**	**93**	**24**	**14**	**8**	**172**
EDGE	**69**	**42**	**13**	**15**	**7**	**81**
1xRTT	**50**	**22**	**6**	**15**	**6**	**60**
EV-DO	**25**	**13**	**4**	**13**	**7**	**23**
UMTS	**26**	**13**	**5**	**11**	**6**	**12**

Web browsing performance was measured by accessing two popular Web sites: www.msn.com and www.yahoo.com. The time to completely display the page was measured. The Web browser cache was flushed prior to each page request. No VPN was active during these tests.

Table 4: Comparison of Web Browsing by Connection Type

Connection Type	www.msn.com	www.yahoo.com
LAN	**1.2**	**1.2**
Cable Broadband	**1.7**	**1.2**
Public Wi-Fi	**3**	**1.6**
GPRS	**44**	**36**
EDGE	**28**	**27**
1xRTT	**20**	**17**
EV-DO	**9.6**	**7.3**
UMTS	**8.9**	**7.0**

Configuring the User's Device for Optimal Mobile Data Connection Performance

One of the most important steps you can take to ensure a good user experience is to adjust the TCP options to minimize fragmentation and optimize TCP acknowledgement behavior for the asymmetric, high-latency environment presented by mobile data services. For Windows XP and Windows 2000 systems, the registry editor or a suitable registry modification file should be used.

Create and/or adjust the following TCP parameters to ensure optimal operation. All of these parameters are contained in the following registry key path:

HKLM\system\CurrentControlSet\Services\TcpIp\Parameters

The settings below were used for all of the performance measurements quoted in this paper.

Table 5: Optimal TCP Settings

Name	Type	Value
Tcp1323Opts	**DWORD**	**1**
TcpWindowSize	**DWORD**	**FAF0 (64240)**
GlobalMaxTcpWindowSize	**DWORD**	**FAF0 (64240)**

Deployment Considerations

Selecting Which Services to Use and How to Use Them

The most important step you can take to guarantee success with mobile data services is to apply them where they are most effective. In general, this involves guarantying the following:

1. The service is available and usable where it is needed. This is both a geographical concern and a usage venue issue.
2. The service supplies sufficient "speed" to effectively support the needs of the intended user. "Speed" is really an amalgam of several attributes of a mobile data service, including its latency, downlink speed, uplink speed and its service consistency.

As you consider adopting mobile data services or expanding your current deployments, it is important to look forward. All emerging technologies come with their own set of benefits and drawbacks. The guidelines in the following sections can help you ask the right questions when evaluating mobile data services and can guide you toward selecting the right services for your company's needs by:

- Focusing on the way your mobile employees work
- Clarifying your mobile information and application needs
- Developing best practices to make the most of the mobile data experience

Plan for a Cost-Effective and Productive Mobile User Environment

Not all users need mobile data connectivity. Considering the high cost charged by carriers for these services, there's no sense in spending money to provide mobile data to users who would make little use of it, such as employees who rarely travel out of the office. For those users who truly need mobile access, you want to provide the best user experience possible, so that these users can stay as productive as possible, no matter where they work. To help find the "right size" for your mobile data initiative, ask these questions:

- Which users need mobile data connectivity? Power users, executives, field service reps, outside sales staff, others?
- Will users be roaming or staying in one regional area? Will they be traveling between countries? While connected, will they be stationary or mobile?
- Will users benefit from connectivity over a range of dial-up, wired broadband, Wi-Fi and mobile data connections?
- Will mobile data become the main method of connectivity, even at home?
- How will you be supporting mobile data users? What about the cost of providing this support?
- Which applications will your users access remotely?
- Where do users go for support—the phone company, IT team, PC help desk?

Recommendations for Optimizing the User Experience

- Tailor the mobile data solution for your organization's specific user and travel profile(s). For most organizations, only a subset of users need mobile data access—often just within limited areas.
- Maximize connectivity options for users who travel a lot. With the growth of wireless options like Wi-Fi and mobile data—not to mention the huge existing wired infrastructure—you can maximize productivity by allowing users to connect with the best and most cost-effective option, wherever they may be.
- Provide only a carefully chosen set of mobile data cards for notebooks and PDAs; don't rely on IR, USB or Bluetooth-enabled connectivity via a user's phone. This has some obvious advantage in that mobile data users can simultaneously use their cell phones for voice calls. However, the greatest motivation for separate devices is in the area of support and user satisfaction. Many U.S. cellular providers have simply ceased to actively advertise the availability of mobile data connectivity using phones due to the large number of user-reported problems and the enormous customer support costs. If you provide support for your users, you should carefully consider this issue.

- Minimize compatibility and configuration support issues by supplying only a small set of carefully chosen mobile data cards. Select cards for the broadest fundamental network compatibility by using so-called "multi-band" cards that enable the cards to be used on every continent. For example, the Sony Ericsson GC-83 card enables access to GPRS and EDGE networks anywhere in the world (with a suitable service agreement).
- Evaluate actual end-user connection experiences over both wired and wireless links. By keeping track of how the mobile data solution is working, you can adjust processes and technology, and select the best service providers to improve results.
- Perform feasibility trials when you decide to deploy applications using mobile data services. Because of the latency inherent in mobile data connections, some applications may perform too slowly or unreliably, resulting in poor usability and loss of productivity for users.
- Consider support capabilities when deploying mobile data services. Make sure that your users know where to turn for support when they have connection problems, and make sure the support staff is trained in resolving specific mobile data issues.

Choose the Solution Provider that Best Meets Your Needs

Selecting service providers is an important step in deploying a mobile data solution. Here are some important issues you'll want to consider when selecting a provider to meet your technology, geographical and operational needs:

- **Selecting a mobile data provider is not the same as selecting a mobile voice service provider**. Today, the mobile data service options and the quality delivered by a single service provider vary greatly between different geographic areas. Mobile carriers tend to invest most heavily in the services and geographic areas that deliver the greatest return on their investment. Voice services remain, by far, the overwhelming source of revenue for these providers. To maintain the best voice service quality, providers often deploy new data services with minimal resources. Service remains poor or spotty until customer demand creates a financial incentive for the provider to complete the necessary investment in radio spectrum and infrastructure that enables good data service quality.

  Identify the best mobile data service provider in each area in which you need service. This can be accomplished through customer references and online research. Your savings in help desk support costs, usability of service and in general user satisfaction will almost always exceed the costs of maintaining multiple mobile data provider relationships.

- **Explore bundling options.** Should you determine that your voice carrier offers attractive data services, ask them what bundling incentives they offer. Traditionally, voice services have been sold to the "telecom" person, while mobile data services where sold to the "IT" or "remote access" person. There are strong opinions among mobile communications market pundits that this will change, as mobile data services begin to provide the transport for phone-based services, such as streaming video. "Bundled" services will likely offer the enterprise new opportunities to negotiate lower-cost mobile data services.

- **Mobile data cards aren't like wired telephones.** You can't just plug them in and expect them to work with any service provider. With some service providers, the cards you purchase will work only with that provider's network or on networks with which the provider has a roaming agreement. In such cases, when you change providers, you must also invest in new carrier-supported cards.

- **Evaluate device subsidies.** Mobile data cards are still expensive devices. The hard binding of 1xRTT and EV-DO cards to a specific carrier network is common and creates a monopolistic marketplace in which prices remain quite high. As an incentive to contract for recurring services from the carrier, a device "subsidy" may be offered—essentially a discount from the sales price with the user's agreement to purchase service for a minimum period, usually one or two years.

- **GPRS** and **EDGE** devices can be purchased in the open market at prices consistently below those demanded by carriers for unsubsidized purchases, but usually somewhat higher than the subsidized price offered by the carrier. When a subsidized device is sold, the card is usually programmed with a "subsidy lock," preventing its use on any but the selling carriers network. After the service contract terms are fulfilled, these carriers can provide a subsidy unlock code, which makes the cards usable on any GPRS or EDGE network. But you must ask for the code and receive the instructions for unlocking the card. Cards bought on the open market are not locked.

- **No single carrier can provide true around-the-world coverage.** If you need service worldwide, you will need service from multiple providers.

Questions to Consider: Before making the choice, you'll want to answer the following questions:

- In what regions do you need mobile data service? Do you already have a relationship with a wireless operator that provides the coverage you need?
- Do you have a preferred primary service operator and card manufacturer that meets all of your requirements for coverage, form factor and throughput?
- If you don't already have a preferred operator, what are your primary criteria for selecting one—speed, pricing, footprint, support, etc.?
- What wireless standards are used in the areas where your mobile employees will be traveling—GSM, GRPS, EDGE, UMTS, 1xRTT, EV-DO, etc.? What throughput levels do you need? Would you like support for multiple connectivity standards?
- Which mobile data cards will work with your users' mobile devices?
- Will you be networking other types of mobile devices? If so, what are their hardware requirements?

Recommendations for Choosing a Mobile Data Service Provider and Hardware

- Evaluate hardware compatibility. Make sure that your preferred service provider offers mobile data cards that are compatible with your current mobile devices, as well as any new devices you are planning to deploy in the future.
- Consider the provider's useful network coverage area and the portability of your equipment investment. Some mobile data service providers implement "subsidy lock" programming of the data cards they sell. Before purchasing hardware, select a service provider with the proven capability to deliver quality mobile data service in each region you target. Be prepared to use service from multiple providers. A $200 mobile data card with a $70/month mobile data service contract is expensive. It is exorbitantly expensive if you can't use it reliably or effectively.
- Consider roaming coverage and costs. Some carriers have roaming agreements for data services. This may be convenient for your users, but as with voice roaming, it can often be substantially more expensive than regular service costs.

- Consider cards with multiple wireless capabilities. With all the wireless standards available in different regions around the world, it makes sense to consider mobile data cards that support multiple wireless capabilities. Newer cards on the market support GPRS/UMTS, GPRS/EDGE/UMTS and 1xRTT/EV-DO. These multi-standard cards let your users access your network via the fastest locally available mobile data service.

Simplify Provisioning and Minimize Costs

Mobile data service can be quite expensive. In the U.S., most operators are charging $80 per person per month for mobile data service on top of the cost of purchasing a data card. For many companies in the U.S., this is twice the typical remote access budget per user ($30–$40 per month). You also need to consider the expense of provisioning equipment to end users, and training them how to use it. One obvious way to minimize costs is only to provide the service to those who truly need it. Wise choices and good management practices can help further control costs while maximizing the benefit of your mobile data solution.

Questions to Consider: What budget does mobile data service fall under—IT, the remote access team or the overall voice/telecom budget?

- Will the person responsible for voice communications be the same person negotiating for data connectivity? Will they be negotiating with the same carrier for both voice and data?
- How will the service be enabled? Who will distribute mobile data cards to end users? Where and how will user training occur?
- Once provisioned, how will cards be tracked? How will they be managed in different countries?

Recommendations for Efficient and Cost-effective Provisioning

- Typically, once a mobile data card is turned on, the operator is charging whether or not the card is actually being used. Billing is not usage-based, as it is with other modes of wireless and wired connectivity. To get the most bang for your buck, create a provisioning and training plan that gets mobile data cards out on the street as quickly as possible.
- To prevent excessive connection charges, implement an idle time-out feature, which automatically closes inactive connections after a specified time period.
- If possible, use a single operator for both voice and data. You may be able to negotiate a lower rate, and you'll only have one provider to deal with for billing and service.

Provide Security at the Device, Connection and Network Levels

True mobility can potentially open your enterprise network up to new vulnerabilities. As with a wired network, protecting your company's vital assets requires end-to-end security measures. The difference is that, unlike a wired network, the endpoints can be virtually anywhere. You need to determine how your mobile data solution provides security along each segment of each possible connection—if at all:

- Does the carrier protect transmissions within the mobile data network itself? How about when users roam between wireless networks?
- Is data protected over the Internet portion of the transmission chain? Will users be required to establish a VPN?
- Does your chosen mobile data service offering integrate with your existing corporate security solutions, and allow you to update and enforce your own security policies?

- Does the mobile data solution provide a means to ensure that mobile data PC cards can only be used by authorized users?

Recommendations and Solutions for End-to-end Mobile Data Security

- Enforce the use of SIM PIN codes. This feature requires the user to enter a valid PIN code when inserting a mobile data PC Card into a notebook PC. This ensures that a lost or stolen card cannot be used by an unauthorized person to access your network. Make sure your mobile data carrier offers this feature, and that your employees know how to use it—and how to protect their PINs.
- Protect mobile data security through enterprise-level authentication. In addition to authenticating the user and PC Card with a SIM PIN code, you'll want to further authenticate users prior to granting access to corporate network resources.
- Secure data transport to prevent unauthorized interception of data. Mobile data solutions use the public Internet for transmitting data between the provider and your network. Use a VPN or SSL-based application to prevent data from being intercepted in human-readable form. iPass recommends using a properly configured VPN even if you have a "private access" arrangement with your mobile data carrier.
- Protect network endpoints through proactive anti-virus and security management. One of the greatest threats to enterprise productivity and security is the viruses, worms and other malware that mobile devices pick up while on the road. These systems can then attach and infect the entire network, destroying vital data and wasting IT resources to diagnose and inoculate against the offending code. It's almost impossible to ensure that mobile systems remain in compliance with your security policies. So you need to find an automated way to assess endpoint security status and quickly bring systems into compliance—without denying users easy access to their files and applications.

Mobile Data as an Extension of the iPass Service

As you have seen, enabling your workforce with mobile data access isn't a task to be taken lightly. There are a number of considerations to be made: service speed, reliability, coverage, consistency, latency, ubiquity, compatibility and pricing—just to name a few. iPass can help simplify all this.

iPass is a global leader in remote access services over dial-up, Wi-Fi and broadband connections. Mobile data connectivity is another natural extension to the iPass Corporate Access™ service. iPass is aggressively working with mobile data technology partners to enable Enterprise Ready mobile data access that rivals our other connectivity options.

Simplify the End-user Experience

The iPassConnect™ universal client provides users with a single interface and a consistent experience for all their connectivity needs—dial-up, Wi-Fi, broadband and now mobile data. Connectivity via a single interface can increase employee productivity and satisfaction, while minimizing your number of help desk calls.

Secure Your Mobile Data Access

iPass allows the use of digital certificates and SSL tunnels for all communications across the iPass network, from the provider to the enterprise. iPass also allows integration with enterprise security systems, providing single sign-on for these systems.

For example, through iPassConnect, you can force users to establish a VPN connection before they can transmit data. The auto teardown feature provides additional security by automatically disconnecting the mobile data connection if the VPN tunnel is terminated for any reason. iPass Enterprise Ready testing helps ensure that you can painlessly integrate your mobile data solution with leading VPN and security software.

In addition, the Endpoint Policy Management™ service from iPass automatically assesses compliance as soon as mobile endpoints connect to the Internet, installing IT-prioritized operating system patches and anti-virus updates before these devices connect to the enterprise network.

Reduce Total Cost of Ownership

iPass works with mobile data operators around the world to provide a single source for provisioning, connectivity, billing and customer service. Customers will have just one point of contact—iPass—for all their needs, greatly simplifying and lowering the overall cost of mobile data service.

iPass can also help lower costs—while improving the end-user experience—with the iPass intelligent Online Quality (iOQ®) reporting system. This optional service lets you monitor the experiences of end users connecting to the iPass global virtual network. It delivers detailed reports on actual end-user experiences to facilitate troubleshooting, improve customer service and proactively address user connectivity issues.

Keep Your Options Open

iPass software supports a wide range of mobile data access cards and technologies—including GPRS, EDGE, UMTS, 1xRTT and EV-DO. And iPass is adding support for the remaining major standards that are used around the world. iPass allows you to choose service providers, equipment and standards today, with confidence that you'll still have the support you need if you decide to go in a different direction tomorrow.

Learn More

Supporting mobile data access is more complicated than some vendors might let on. As with any emerging technology, there will be bumps in the road. iPass is moving forward and working through issues as they arise, with the goal of helping customers navigate trouble spots easily.

To learn more about Mobile Data or other iPass connectivity or security services, visit www.iPass.com or contact an iPass account manager today.

Appendix A

Evolution of WWAN

First Generation (1G) cellular technology used analog signals and evolved from 1960 to 1990.

Second Generation (2G) digital cellular technology, which includes GSM, CDMAOne, and GPRS, was introduced in the early 1990s.:

- GSM (Global System for Mobile) is a living, evolving standard that refers to both a technology platform and a powerful family of related technologies (GSM, GPRS, EDGE and 3GSM). This complete digital communications system includes a TDMA air interface, voice, data and auxiliary services, signaling and mobility. The GSM technology provides real-world data throughput rates of up to 14 kbps. Major GSM providers include Cingular and T-Mobile in the U.S., and Vodafone in Europe, Asia and Australia.
- IS-95 CDMAOne (Code Division Multiple Access) is an evolved system developed primarily in the U.S. by Qualcomm and North American carriers delivering digital voice and low-speed data services generally equivalent to GSM.
- GPRS (General Packet Radio Service) is considered 2G technology and delivers maximum data rates up to 52 kbps using PPP optimizations such as IP header compression. Major GPRS providers include Cingular and T-Mobile in the U.S.; Vodafone in Australia and New Zealand; and Vodafone, Orange and T-Mobile in Europe.

2.5G mobile communications technologies delivered the first true high-speed digital mobile data services:

- **CDMA2000** (Code Division Multiple Access) is the evolved version of the CDMAOne system introduced in 1995. It has defined several digital data service variants, including 1xRTT, which is considered 2.5G, and others, which are considered 3G (see more below):
  - ***1xRTT*** *(1x Radio Transmission Technology)* offers typical downlink speeds from 40 to 90 kbps and uplink speeds of 40 to 60 kbps. Major providers using this technology include Verizon Wireless and Sprint in the U.S., KDDI and NTTDoCoMo in Japan, and Telstra in Australia.
- **EDGE** (Enhanced Data rates for GSM Evolution, also called E-GPRS) is an evolved GPRS service that is approximately three times faster than 2G GPRS. EDGE delivers actual downlink rates of 40 to 110 kbps and uplink rates of 50 to 80 kbps. Major EDGE carriers include Cingular and T-Mobile in the U.S., and Orange in the UK.

Third Generation (3G) mobile communications technologies deliver much faster downlink data rates—100 to 600 kbps today and an expected 2 to 4 Mbps eventually. 3G technology comes in several flavors:

- **CDMA2000** (Code Division Multiple Access) is the evolved version of the CDMAOne system introduced in 1995. It has defined several digital data service variants:
  - ***1xEV-DO*** *(Single RF Carrier Evolution–Data Only)* delivers actual downlink data rates range from 150 to 600 kbps currently. The technology includes the ability to deliver downlink data rates up to 2.4 Mbps. Verizon, KDDI, Telstra and Telecom New Zealand are examples of major regional carriers with deployed EV-DO services. A newly released version of this technology (EV-DO Release A) will enable downlink speeds up to 3.1 Mbps. This upgrade will enable the real data rates needed for bandwidth-intensive applications like streaming video.

- ***1xEV-DV*** *(Single RF Carrier Evolution–Data & Voice)* delivers a fully IP-based network for voice and data services. However, the success of its predecessor, EV-DO, may eliminate the need for the deployment of this technology. Qualcomm, the basic technology vendor for this technology, has announced it is ceasing its development activities related to EV-DV, pending emergent carrier interest in the technology.

- **UMTS** (Universal Mobile Telecommunications System) utilizes a wideband CDMA radio interface to deliver actual downlink data rates of 64 to 340 kbps and a typical uplink data rate of 32 to 64 kbps. Major carriers Cingular, Vodafone and T-Mobile (Europe) are deploying this technology.
- **HSDPA** (High-Speed Downlink Packet Access) is an additional 3G technology that is being evaluated by various carriers in mature mobile markets. Existing versions of this technology will deliver reliable low-latency (< 120 ms) downlink data rates of 300 kbps to 1 Mbps and a 128 kbps uplink. Cingular has completed a successful technical (non-consumer) trial in the Atlanta area and predicts initial availability sometime in 2006. Additionally, Vodafone and Japanese carriers are evaluating the technology. Later versions will eventually enable peak downlink data rates of up to 10 Mbps. These services will enable reliable delivery of low- to medium-resolution video.

3.5G mobile communications technologies deliver highly optimized downlink AND uplink data services utilizing 3G wideband CDMA air interfaces:

- **EUDCH** or **HSUPA** (Enhanced Uplink Data Channel, also known as High Speed Uplink Packet Access) optimizes the uplink performance of UMTS/HSDPA networks and will enable low-latency broadband access similar to home cable but with more symmetric uplink bandwidth (> 600 kbps). This technology is still in development and a first public specification has not yet been approved. The first EUDCH-enabled wireless services, which will include HSDPA, will likely appear in 2006 to 2007.
- **CDMA2000 3xEV-D*** (Multiple RF Carrier Evolution–Data) is an additional 3.5G technology. It promises downlink data rates up to 8 Mbps and simultaneously uses several RF channels to deliver improved speed and reliability.

Fourth Generation (4G) cellular communications systems will be characterized by high-speed data rates of 4 to 20 Mbps. These transfer rates will be suitable for streaming high-resolution movies and television. Initial deployments are anticipated between 2007 and 2010.

About iPass

iPass Inc. (NASDAQ: IPAS) delivers simple, secure and manageable enterprise mobility services, maximizing the productivity of workers as they move between office, home and remote locations. iPass security services—based on unique Policy Orchestration capabilities—close the gaps in protecting computers, network assets, user identities and data whenever users connect over the Internet. iPass connectivity services utilize the iPass global virtual network, a unified network of hundreds of dial-up, wireless and broadband providers in over 150 countries. iPass services are the choice of hundreds of Global 2000 corporations including Ford Motor Company, Mellon Financial and H. J. Heinz Co. Founded in 1996, iPass is headquartered in Redwood Shores, Calif., with offices throughout North America, Europe and Asia Pacific.