# Company A Wireless Communication's Assessment and Recommendations

Prepared for:
Company A

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# 1 Executive Summary

This report has been prepared by Vast Solutions (Vast) at the request of Company A to help identify a wireless environment that will enable Company A to create a wireless data solution for their mobile workforce. Vast appreciates the opportunity to assist Company A in defining the future of wireless data within the Company A Company.

This report documents the wireless data systems and processes currently utilized by the Company A mobile workforce. Several factors limit the current Company A environment from providing an efficient and manageable wireless data solution for the mobile workforce requirements. They are:

- Limited wireless data coverage is the foremost limiting factor of the current system. The entire mobile workforce could greatly increase productivity and response time via a ubiquitous data network.
- Operating a private wireless data network increases the overall cost of utilizing wireless application due to the expense of operation, maintenance, upgrading and expansion of the network. This may also lock Company A into a dormant technology.
- A fragmented solution to multiple mobile work force sectors is created under the current architecture. The MDSI CAD system, Clarify and other entities are arranged in rigid architecture that does not lend itself well as a total solution platform.

This report also provides a vision toward the future, in a two to five year time frame, that combines what is realistic today with the trends of where the wireless industry is headed tomorrow. The desired environment should encompass a "unified wireless messaging" platform concept. Stated simply, this would entail multiple devices, multiple applications, and multiple wireless networks functioning seamlessly over a single platform. The systemic goal for a desired environment would attempt to meet the following attributes:

- Provide an evolution path
- Ubiquitous wireless data coverage throughout a work region
- Operation over public wireless networks
- Utilization of common and open-standard protocols which attract a large developer community
- Modular, single platform architecture with the ability to serve multiple field service worker profile types in a customizable fashion

Finally, the report makes some specific recommendations pertaining to a phased pilot program that will enable Company A to begin the migration toward their desired environment. These recommendations are:

- Proceed with a phased pilot program using the Visteon ICES device to speed pilot deployment and development.
  - Phase 1 - AVL
  - Phase 2 - CIS Dispatch and messaging for a small user group

These recommendations are reviewed more comprehensively in the report.

# 2 Current Environment

In describing the current Fantasy Land Electric & Gas operations, we will refer to three categories of workers based on the types of work they perform. Each of these workforces performs separate functions and has a different objective. They also use different systems and processes in the pursuit of these objectives. The three workforces are:

- **Gas & Electric Field Workers**
- **Other Field Workers**
- **Office Workers**

## 2.1 Gas & Electric Field Workers

Gas & Electric Field Workers' responsibilities include turning on/off gas and electricity, reading meters, blocking/unblocking gas meters, setting gas meters, and checking for gas leaks. Gas & Electric Field Workers can be responsible for responding to 3,000 - 4,000 orders in a normal day and up to 10,000 orders on a busy day. Approximately 90% of these orders are self-generated, which means that Company A receives a work order from a customer and then schedules it. Self-generated orders are planned several days in advance.

Emergency orders are generated when a customer requires same day service or there is a danger reported, such as a gas leak. These orders are dispatched to the field workers using either voice communications or simple data messaging. However, emergency orders make up only a small number of the daily message count.

### 2.1.1 Gas & Electric Field Workers' Current System

Company A's current system for providing wireless data to the Gas & Electric Field Workers is comprised of the Customer Information System (CIS), an MDSI Advantex CAD system, and the 800 MHz trunked radio system. At one point the three systems functioned together to transmit work order information to the Gas & Electric Field Workers in a limited coverage area.

#### 2.1.1.1 CIS

CIS is a proprietary customer database system used internally by Company A for customer information, billing and other customer related functions. Although the system was originally a purchased software package, it has been modified by Company A over the years to support specific business processes. The system is maintained and modified internally by Company A.

#### 2.1.1.2 MDSI CAD System

Gas & Electric Field Workers utilize MDSI's Advantex software suite. This system provides automated dispatch of work orders for the Gas & Electric Field Workers. It also allows the different dispatch centers to view the current status of work orders assigned to the Gas & Electric Field Workers. This allows the dispatch center to redistribute work as needed amongst the field workers to ensure all assigned work is completed daily. It also provides the communication layer to the Company B 800 MHz Radio Frequency (RF) network. The CAD dispatch layer generates the following data:

- Order Number
- Order Status
- Dispatch, Accept, En Route, On Site, and Completion Times
- The number of orders individual workers have completed
- The number of orders individual workers have not completed

#### 2.1.1.3 800 MHz Trunked Radio System

Wireless communications for Company A is provided by Company B Communications. Company A leases approximately 40 Company B radio sites in Fantasy Land for voice and/or data communications. Only the three Company B radio sites located in Water World, Disney Land, and Great America are data capable. The remaining 37 sites are voice analog only and the estimated cost to upgrade them to be data capable is approximately $1.85 million.

The Company B Communications Network is based on a Motorola 800 MHz trunked radio system. This radio system operates on the DataTAC network and uses packet data technology providing data rates of 19.2 KB/sec. Company B Communications receives strings of data from the CAD system or wireless modem, breaks these strings into 485 character packets, reconciles the individual headers on the packets and sends them to the appropriate wireless modem or CAD system.

#### 2.1.1.4 Current System Status

Company A recently installed a new version of their CIS. This installation caused a breakdown of the wireless data communication between the MDSI CAD system and the new CIS system. The communication between these systems is currently being repaired and is expected to be operational by August 2000. Once this happens, the CAD system will operate as it had prior to the installation of the new CIS system. Gas & Electric Field Workers will use this system as an end to end wireless solution.

When the CAD system becomes operational in August 2000, there will initially be 100 users on the network, all located in Disney Land, Water World, or Great America. Company A would like to increase the number of users on this system to 250. The expansion of this wireless data process is limited, as only three of the RF transmitter sites are currently data capable.

### 2.1.2 Gas & Electric Field Workers' Current Process

Figure 1 illustrates how Gas & Electric Field Workers use this system to service customer orders. First, the call taker receives customer calls and enters this information into the CIS system. Next, the MDSI CAD server software (‘Server SW’), acting as a rules engine, translates the CIS information into an order. The order is then routed to the appropriate field worker. The MDSI CAD software (‘Dispatch SW’) tracks order lists and status, fleet status, the number of orders individual workers have completed and have not yet completed, and other relevant information; it then dispatches orders to mobile users over the RF network. The mobile device software (‘Mobile SW) is the user interface.

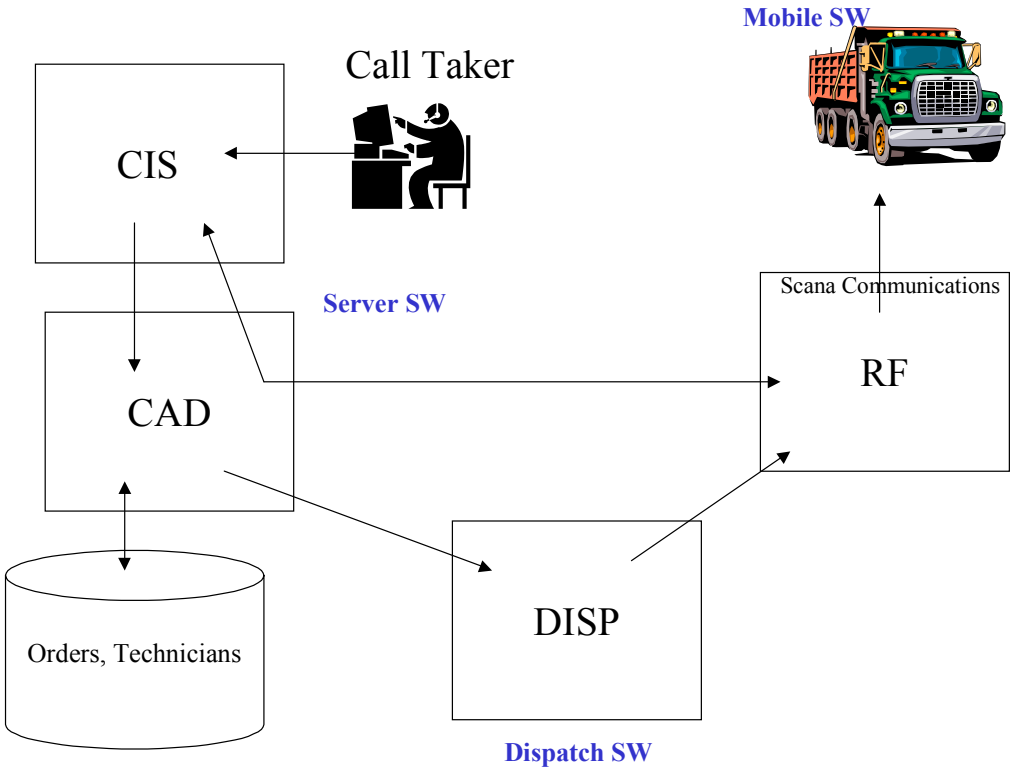


**Figure 1: Gas & Electric Field Worker Process**

#### 2.1.2.1 Wireless Data Coverage: In Coverage and Out of Coverage Workers

Based on their normal work territory, Gas & Electric Field Workers are categorized as either "in coverage" or "out of coverage" workers. If the driver's territory is considered to be within the mobile data transmitter coverage pattern, the driver is considered an "in coverage" worker. If the driver's territory roams to the fringe area or out of coverage, the driver is considered an "out of coverage" worker.

(1) For "in coverage" workers, summaries of all orders for each vehicle/worker are downloaded at the beginning of the day. The system downloads more information on the order once the driver selects "En Route" on the system.

(2) For "out of coverage" workers, all orders and information are sent to the vehicle/worker while it is in coverage at the depot. When the vehicle re-enters coverage, the mobile device will transmit any stored information.

#### 2.1.2.2 Data Requirements

There is a large amount of customer data (up to 6,000 characters) sent for each order. Data that is sent to Gas & Electric Field Workers includes:

- Name/Address

- Location of meter on the building
- Meter number
- Description of work
- Special instructions – phone number to call, dogs at the site, etc; these are coded whenever possible.
- Payment/Credit history – sometimes for 18 months (coded with 1's and 0's) – this data is sent for service disconnects only.

The CAD system currently keeps track of the following order milestones:

- Dispatch order time
- Accept order time (sent from field worker to dispatcher)
- En route time (sent from field worker to dispatcher)
- On site time (sent from field worker to dispatcher)
- Completed time (field worker sends completion information to dispatcher)

#### 2.1.2.3 Locating Workers in the Field

Gas & Electric Field Workers have an emergency button. This button allows the field worker to notify the dispatch center when the worker gets into an emergency situation. Dispatchers have no way of knowing the exact location of the field worker, but can deduce the location based on the last message received from the field worker. For example, if the last message received from the field worker prior to 'Emergency' was 'En Route', the dispatcher can deduce the field worker is located somewhere between the location of the last order serviced and that of the 'En Route' location.

#### 2.1.2.4 Coverage Area

Only within the limited coverage areas of Disney Land, Water World, and Great America does the current system adequately addresses the mobile data needs of the Gas & Electric Field Workers. While "in coverage", the CAD system allows these workers to spend more time servicing requests. Without this system, workers would have to spend time in the dispatch lab every morning collecting and sorting through hard copies of their day's orders and returning the hard copies of the previous day's orders. As a consequence, Gas & Electric Field Workers desire a wireless solution that extends coverage throughout the state of Fantasy Land.

#### 2.1.2.5 Current In-Vehicle Equipment

For Gas & Electric Field Workers, the current system includes computer/keyboard/screen with the vehicles. The computer is a Walk About™ Hammerhead™ 586 pen tablet computer that uses a Cyrix™ microprocessor. Some vehicles are equipped with Hammerheads that utilize a newer Pentium™ 233 computer. This computer uses a Windows 95 operating system and includes a computer screen with 640 x 480 monochrome resolution. The vehicles are equipped with an Aisin Seiko 800 character thermal text printer. Other in-vehicle equipment includes:

Hammerhead 586 vehicle dock

Gamber Johnson vehicle mount (pedestal)

SIIG MiniTouch keyboard

Motorola Spectra Data Radio

Motorola VRM 500 data modem or VRM 600 modem/radio combos

fuse panel

## 2.2 Other Field Workers

Other Field Workers' responsibilities range from cutting wires, installing and repairing fiber optic cables, revenue protection and maintaining the internal phone system. These are small work groups within different departments with individual and separate responsibilities. The workload in these groups varies from department to department.

### 2.2.1 Other Field Workers Current System

Each department uses their own system to perform their daily tasks. Not all of these departments are dependent upon CIS to drive their work process. One of the Other Field Worker departments currently utilizes a system comprised of the CIS and a Clarify Front Office 98 system. Effort was not expended understanding all of the possible user applications for the purposes of this report. There may be multiple applications and database systems in place to address the current requirements within individual Company A departments.

### 2.2.2 Other Field Workers Current Process

This report will focus on the process followed by the Other Field Workers who utilize the CIS and Clarify system. These workers and their managers utilize their Clarify system to dispatch, receive and update service requests.

These Other Field Workers do not currently have a wireless solution.

The process they follow can be broken down into the following steps:

(1) The IT department receives a trouble ticket and posts it to the Clarify system via CIS.

(2) A Clarify operator acknowledges the ticket and assigns it to one of two teams depending on the type of service required. Teams are based on equipment responsibility. One team is responsible for maintaining the communication equipment for the fiber optic networks while the other team maintains the internal communications equipment (phone systems, etc.).

(3) Each team has a team dispatcher who assigns the Clarify ticket to an individual field worker. The dispatcher manages the workload for each field worker. The dispatcher determines ticket responsibility based on workload, experience, and expertise.

(4) The field worker who is assigned the ticket must log in to the Clarify system (by dialing into the company network and logging in to Clarify) to receive the list of service requests he/she will work on.

(5) After the field worker completes the work, he/she logs in to Clarify and updates the service request with completion time and any comments; the field worker can also utilize a cellular phone to call the team dispatcher, who can enter the information into Clarify from the office.

## 2.3 Office Workers

Office Workers are mobile executives, sales personnel, traders, materials handlers, and other workers who are not normally associated with servicing work orders. These workers may or may not rely on CIS to perform their daily responsibilities. There may be wireless applications developed in the future to enhance the productivity of these workers.

### 2.3.1 Office Workers Current System

The current system for the 4000 Office Workers is comprised of CIS and any other internal system required. These workers have PC's and laptops that they use for e-mail and any other LAN based process. Effort was not expended understanding all of the possible user applications for the purposes of this report. There may be multiple applications and database systems in place to address the current requirements within individual Company A departments.

### 2.3.2 Office Workers Current Process

Office Workers do not currently have a wireless solution or process. Process studies will accompany any future wireless productivity enhancement developments.

## 2.4 Limitations with the Current Environment

There are several main factors that limit the current environment from providing an efficient and manageable solution for the mobile workforce requirements. They are:

- the lack of comprehensive wireless data coverage
- the use of private wireless network solutions
- a fragmented solution to various mobile work force sectors that relies upon expensive middleware

### 2.4.1 Extremely Limited Wireless Data Coverage

The limited wireless data coverage available is the foremost limiting factor of the current system. The entire mobile work force could greatly increase productivity and response time via a ubiquitous data network. A gain in productivity would come from sources such as:

- Reduction of multiple handling of data – forms could be filled out, edited, and submitted over the air without the need for operator assistance or entry into the system upon return to the office.
- Essential data in real time - field workers would be able to look up and extract essential data without the need to connect with a warm body back at the home office. This eliminates wasted time and effort in occupying an additional individual's time acquiring and relaying the information.
- Reduction in the need to return to home office – many of the functions which now require a return trip to the home office could be eliminated or reduced with mobile data connectivity.

### 2.4.2 Private Wireless Network Solution

The current use of the Company B/DataTAC network limits the viability of Company A's wireless network in several ways.

- Very limited off-the-self applications offering

- Expense of operation, maintenance, upgrading, and expansion of network
- Locked into a dormant technology
- Lack of robust security

### 2.4.3 Fragmented Solution to Multiple Mobile Work Force Sectors

Under the current architecture, the MDSI CAD system, Clarify, and other entities are arranged in a rigid architecture that does not lend itself well as a total solution platform. A more global approach with adaptable modules that fit the needs of various work force sectors and leverages Intranet/Internet access would be beneficial. The current environment minimally addresses the wireless data needs of Company A's mobile workforce and only in a very limited region of coverage. Looking forward, it is desired to provide workers with a mobile data solution which allows connectivity throughout their work regions and provides flexibility in choosing bearer network technologies that best fit their requirements and cost constraints now and in the future.

This flexibility would also allow Company A to expand the usage of wireless solutions within the current user departments and to other departments that could take advantage of wireless applications. In addition, when new versions of an application are installed, there would be a lower possibility of the application not being compatible with the network since standard interfaces would be used.

# 3 Desired Environment

The purpose of this section is to provide vision toward the future, in a two to five year time frame, that combines what is realistic today with the technology trends of where the wireless industry is headed tomorrow. First, we will discuss a list of desired system attributes. Second, we will describe a desired environment in terms of systemic goals, migration path, applications supported, and functions required. Last, we will propose a desired environment platform that is realizable within the considered time frame.

Because the wireless and IP worlds are constantly changing, evolving, and merging, the overall mission is to move toward an environment that easily adapts to the next technical plateau. The choice of mobile devices and off-the-shelf applications are continually growing as well, and a viable plan should strive to enable these devices and applications over multiple bearer networks using a single, flexible platform. Stated simply, these include multiple devices, multiple applications, and multiple wireless networks functioning seamlessly over a single platform. This unified wireless messaging platform concept is shown below in Figure 2. In addition, the systemic goal for a desired environment would attempt to meet the following attributes:

- Provide an evolution path
- Ubiquitous wireless data coverage throughout the work region
- Operation over a public wireless networks
- Utilization of common and open-standard protocols which attract a large developer community
- Modular architecture with the ability to serve multiple field service worker profile types in a customizable fashion on a single platform

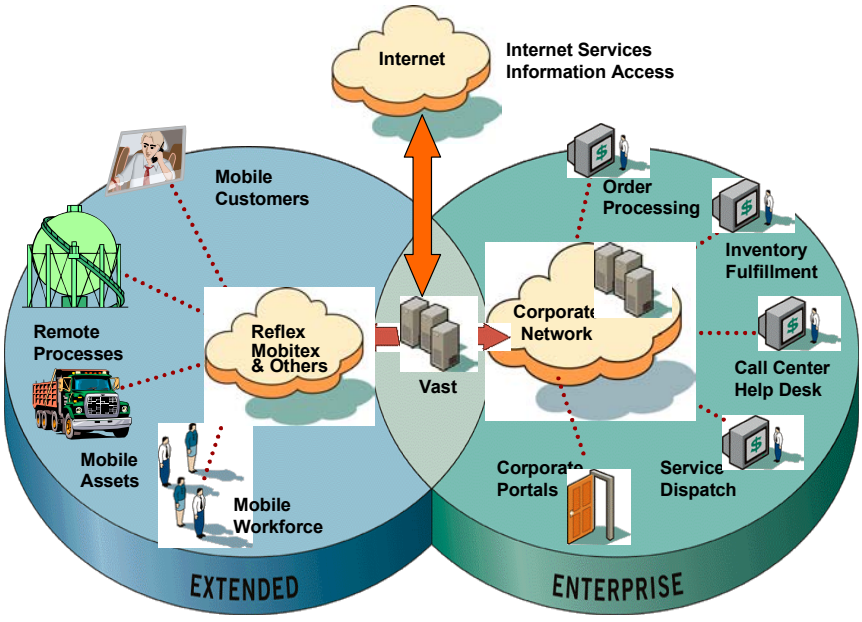


**Figure 2: Multiple devices, networks, and applications**

It should be noted that before committing to a particular solution, a thorough cost/benefit analysis and needs assessment should be undertaken. The scope of this section is to provide vision looking forward and not to propose a detailed solution.

## 3.1 Description of Desired Environment

### 3.1.1 Systemic Goals

Over the last several years, the choice and availability of wireless solutions has broadened considerably and is constantly changing. The desired environment needs to allow for the matching of differing technologies to differing applications in an optimal manner and provide the means for evolution and migration to future technologies.

The ideal Company A mobile system architecture would be capable of integrating multiple wireless bearer networks and technologies into a total modular solution that matches the needs of individual work force sectors and/or applications with the appropriate/optimal technology.

Looking again at the desired environment attributes, it becomes clear that the platform should be capable of transparently connecting applications to the appropriate bearer networks in a seamless and modular way.

*Provide an evolution path* – Providing an evolution path is arguably the single most important feature of the desired environment. It provides insurance against getting locked into a technology that does not progress or becomes unsupported. The remaining attributes of using open standard protocols and an adaptable architecture are the key elements in providing a system migration path.

*Ubiquitous wireless data coverage* - This feature is best addressed by individually assessing the separate application's coverage needs which may require differing bearer technology solutions. For example, the in-vehicle fleet management application might be better served by a CDPD bearer and a corporate campus email application better served by a ReFlex bearer, or vice versa. The point is that it is important to have a flexible architecture capable of matching the coverage, cost, and performance needs of the differing applications with the most appropriate bearer technology.

*Public wireless networks* – The concept of utilizing public networks stems from the increased availability of these networks and the benefits they hold. Just a few years ago, this was not the case and the majority of two-way wireless data solutions were private networks. Today there are several choices and the future promises enhanced data rates, increased coverage and reduced prices. In addition, public networks hold benefits such as increased system availability, multiple carrier choices, increased service choices, continual network improvement and evolution.

*Open standard protocols to attract large developer community* – Open standard protocols, such as the Wireless Application Protocol (WAP), attract a larger population of application software developers and result in a growing body of applications that can be utilized.

*Adaptable architecture* – An architecture that can adapt via conversion modules to various bearer networks is a key element in accomplishing the desired environment. WAP, for example, is a layered set of protocols similar to the OSI Reference Model. This layered design allows the WAP architecture to provide scaleable and extensible application development as well as a layer that adapts to any bearer network. The significance of this is that only the adapter module of the architecture changes according to the differing bearer network; nothing else changes in the WAP

server. In addition, WAP provides a development environment for "write once" applications that can be transported across multiple device and network types.

### 3.1.2 Develop Platform along a Migration Path to an Open "WAP Plus" Environment

As previously mentioned, Company A will need to provide an application development platform allowing a migration path bridging network and device evolution, as well as providing backward compatibility. Fundamental to that end is the goal to adopt an open-standard such as WAP.

Currently, WAP is in its infancy and provides only limited capabilities. Despite its initial limitations, WAP has been adopted by nearly all cell phone manufacturers for inclusion in their product lines. Developers, on a global basis, have embraced WAP and are producing value-added software. In the beginning, user acceptance will depend highly upon usability and the value of initial offerings. As networks, devices, and applications evolve and expand, the end-user's expectations will continue to grow. WAP, in turn, will steadily gain adoption as networks, devices, and applications evolve. In addition, the WAP protocols will evolve to accommodate new needs and provide extended capabilities. In essence, WAP will provide a migration path for application developers bridging network and device evolution.

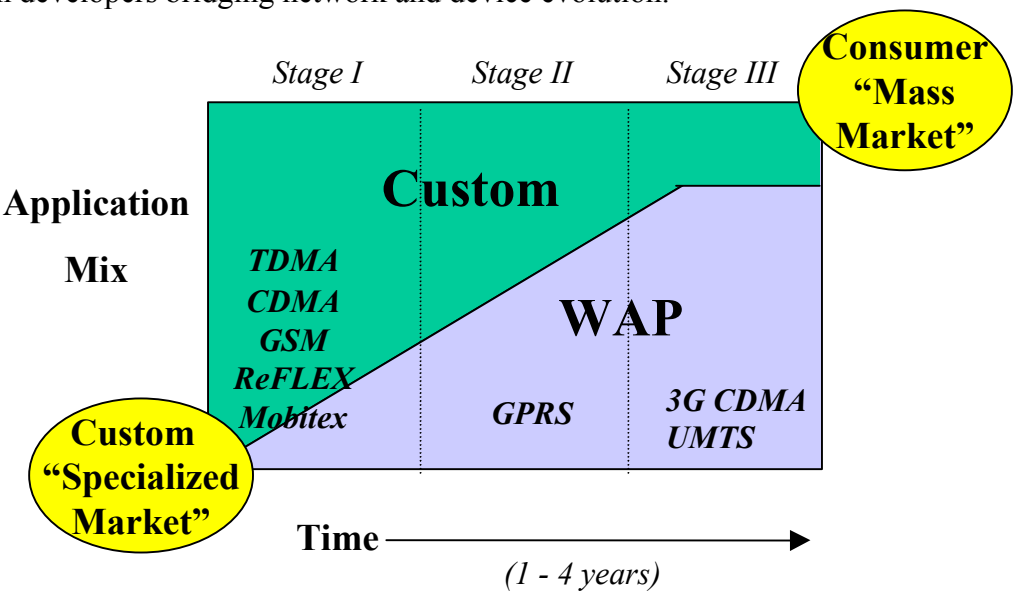


**Figure 3. Custom to Standard Software Mixture Migration**

Figure 3 illustrates how the mix of application software should migrate through several stages, which are represented as follows:

- Near Term (Stage I) - increasing custom applications with limited WAP applications
- Mid Term (Stage II) - more even distribution between custom and WAP standard applications
- Long Term (Stage III) - increasing WAP standard applications

The trend is to move from custom applications to open-standard, WAP applications that will become more widely available in time. Note that there will always be a certain portion of custom applications being developed for niche and legacy products. The migration trend begins heavily

weighted toward custom applications, with the final phase evidenced by widespread adoption in the consumer market.

As Figure 3 implies, network evolution is in progress and over the next few years GPRS, followed by 3G-CDMA and Universal Mobile Telephone Service (UMTS), will make their entries. These next generation networks will draw increased application development and existing WAP applications will be transported to these new networks and devices. Although next generation networks will be coming on-line over the next several years, the other networks and devices will continue to exist and need to be supported. Even after GPRS and eventually UMTS appear, the older bearer networks will not disappear and will continue to provide very cost-effective solutions to corporate applications. Therefore, a migration path with backward compatibility will be needed.

### 3.1.3 Company A Applications

Let's consider five broad application categories: Gas & Electric Field Workers with In-Vehicle PCs, Other Field Workers, Office Workers, Automatic Vehicle Location (AVL), and Asset Management and Tracking.

#### 3.1.3.1 Gas & Electric Field Workers with In-Vehicle PCs

Company A's CAD system is expected to be back in place by August 2000. In areas where two-way data is available, Gas & Electric Workers will continue to use this system to satisfy their order dispatching needs. However, these field workers are able to use this system only where there is data coverage, which is only in the Disney Land, Water World, and Great America vicinities. Therefore, the most important attribute of the desired environment for Gas & Electric Field Workers is to extend the data coverage to as much of the state as possible.

In addition, the desired environment would be flexible enough to provide for two-way messaging, alert pushes, direct interaction with the CIS database through a web page, Intranet/Internet access, the ability to track and manage fleet location and scheduling, and the ability to track corporate assets.

Using a public network rather than a private network would provide Company A flexibility in choosing a provider or providers based upon coverage, costs and service. Multiple carriers may be contracted for competitive and redundancy purposes. In addition, a wireless service provider can be contracted to provide the portal to wireless systems, completely eliminating the need for Company A to negotiate and manage wireless vendors. In this scenario, Company A data would be passed to the service provider and the provider would pass the data to the proper destination efficiently and effectively. This option gives Company A more power to control and easily manage their wireless solutions compared to continuing to use the private network solution.

#### 3.1.3.2 Other Field Workers

Field Workers other than gas and electric workers currently receive trouble tickets within the Clarify Front Office application. They do this by logging into the company network and into Clarify. The desired solution for these workers includes the ability to wirelessly receive, update, and close trouble tickets, use Intranet-based IP systems to host information such as forms, logs, manuals, applications, and to wirelessly access these systems. In addition, two-way messaging, AVL information, and Internet look-up capability are also desired.

The desired goal would be to eliminate either the MDSI or Clarify system since these systems perform like functions. It would also be possible to eliminate both systems and have the customer management data stored within the CIS system with the data packets going directly to the required field worker via the public wireless network.

#### 3.1.3.3 Office Workers

Office Workers currently do not have Intranet-based IP systems. However, it is important to develop such systems in the future. These systems would host forms, logs, manuals, applications, etc. Once these systems are developed, the desired environment would include the ability to wirelessly access and update this information. Also desired are two-way messaging and Internet look-up capability.

The optimal solution would provide the flexibility to use different wireless receiving/sending devices that match the needs of the Company A employee. Use of public networks and a wireless service provider or an internal WAP solution would give Company A the ability to choose multiple devices, as supported by the service provider, without the complexities of supporting those devices within their applications.

#### 3.1.3.4 AVL

The ability to manage, dispatch, and schedule field service workers is an inherent part of the desired environment. For the in-vehicle PC this is easily accomplished by passing GPS information to the corporate server with a location management/optimization engine. For vehicles without a GPS receiver, another method of vehicle location calculation would be used; however, the position information would be passed to the server for processing in a similar manner as the GPS solution.

#### 3.1.3.5 Asset Management and Tracking

The ability to manage and track other valuable corporate assets would be a similar application as AVL and could quite easily be implemented as a part of the AVL application. The difference would reside in the physical solution and might well involve a different type of wireless bearer network than the AVL solution.

### 3.1.4 Functions Supported

Based upon the five general applications mentioned above, the desired environment should support the functions listed below at a minimum.

- Intranet connectivity to content and databases
- Internet connectivity (e.g., weather and navigation)
- Customization of and access to information via corporate web page
- Two-way messaging
- Clarify/MDSI CAD integration into an easily maintainable corporate server database application
- Ability to interface with multiple wireless solution devices

### 3.1.5 Operational Characteristics

The operational characteristics of the applications and functions described previously should, in general, follow the push and pull model of connectivity to the Intranet and Internet. Field workers will wirelessly access the corporate web page, which will serve as a window to all needed data, forms, materials lists, corporate contact lists, logistics, and navigation services. In addition, the home server will contain asset management, dispatching and decision engines and will update, maintain, and store all incoming information from the field. For instance, a field worker will log onto the network via wireless device, provide authentication, and be able to submit or retrieve work orders, material lists, part descriptions and drawings, and so on.

The desired environment could take two basic platform shapes.

1. A third party portal and application service provider (ASP), such as the Vast Viaduct, which integrates multiple bearer networks and applications to the Company A corporate database via virtual private network (VPN) or frame relay.
2. A Company A corporate enterprise WAP server with adapters to various wireless bearers.

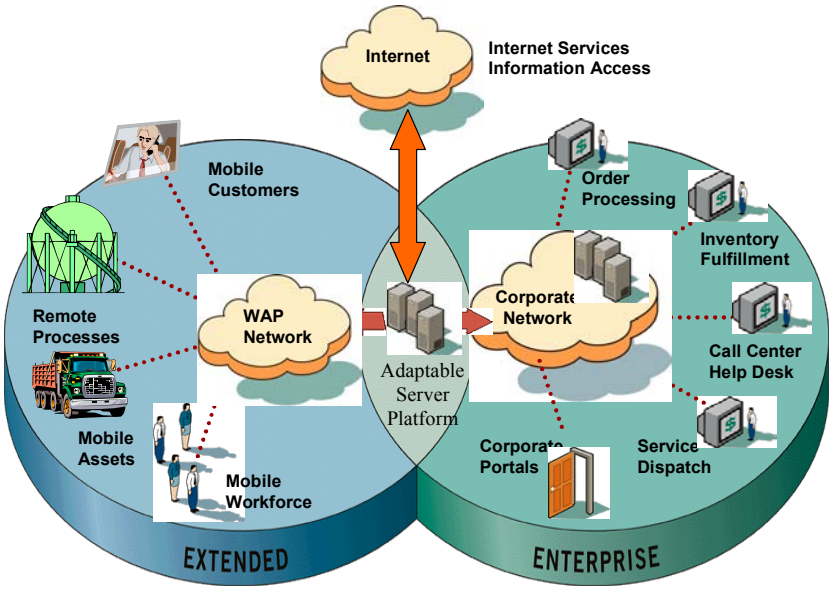


**Figure 4. Multiple Devices in a WAP Environment**

Attaining the desired environment is mainly a function of providing a flexible platform, which allows easy adaptation to the most appropriate devices, applications, and wireless networks. Because the market will ultimately determine the uptake, pricing and coverage of the various new technologies, the key is to position a wireless solution, which can readily utilize those upcoming technologies in the most optimal and cost effective manner.

# 4 Market Analysis

## 4.1 Introduction

The Desired Environment for Company A as defined in this report will bring many benefits. However, its implementation requires the knowledge of technologies that are relatively new and not commonly understood by the corporate world.

As with any new technology, the adoption rate of these technologies will be influenced by many factors and those projects exclusively utilizing leading edge technologies, will assume some risk to their success. This greater risk must be balanced against the opportunity for competitive advantage the new solutions will provide to the corporation.

This section will review the market situation for the technologies underlying the Desired Environment and, in doing so, attempt to suggest:

- What factors will influence the feasibility of the Desired Environment
- When this might occur
- The transitions that the technology will make

The Desired Environment described previously is attractive because it allows for flexibility in and commonality with the wired Intranet environment. It holds the potential to reduce, over time, the amount of specialized programming that must be done for the wireless environment. It also relies on the marketplace to invest in and expand the publicly available wireless data networks thereby eliminating much of Company A's capital that would be required to fund a wireless data solution.

The Desired Environment is dependent upon the following technologies being deployed with availability and robustness sufficient to warrant their production use:

- Broadband Network Technology
  - To ensure sufficient bandwidth is available
  - Could be GPRS or CDPD depending on coverage and availability
- The Wireless Application Protocol
  - To ensure that the standards and support middleware required to extend the Intranet out to the wireless user is in place
- A Migration Path
  - To provide the ability to implement with today's technology that will easily migrate into tomorrow's solutions

There are several U.S. market trends should be considered by Company A as to when the Desired Environment, outlined in the previous section, should be adopted. These are:

- The general rate of market uptake for wireless solutions.
- Factors influencing the adoption of WAP in the U.S.

- The rate at which new generation network technology will be deployed.

## 4.2 General Market Uptake for Wireless Solutions

The Yankee Group estimates that there are 45 million mobile workers in the U.S. today. This is number expected to double over the next five years. In 2005, it is expected that wireless devices (including WAP enabled phones) will outnumber laptops and hand-held computers by 4:1 with business usage representing the largest percentage of this number (Source: Gartner).

Wireless email is already driving growing subscribership utilizing current wireless data technologies (e.g., Mobitex, ReFLEX). This trend is expected to grow significantly, as wireless data becomes more feasible in the context of the cellular networks. In Europe, where GSM networks have been deployed, the Short Message Service (SMS) is used to send and receive over 400 million messages daily in a market smaller than the U.S.

The demand by business users to access corporate databases while on the move and to improve efficiency by interacting directly with the corporate systems seems to be sufficient to continue to drive widespread use as the technology improves. In many ways, we believe that business use of wireless will grow significantly. The major factors keeping industries from utilizing wireless to its full potentials are:

- The challenges of deploying applications (which will be addressed by WAP in the long term and can be simplified today by using a wireless service provider)
- Initial costs associated with implementing wireless solutions
- Traffic loads required when sending data and voice (which will be addressed by the convergence of voice and data)
- The limitations of current wireless device capabilities
- The multitude of wireless devices with a lack of protocol standards

## 4.3 Factors Influencing the Adoption of WAP in the U.S.

The benefits of the Wireless Application Protocol (WAP) were reviewed in detail in the previous section. WAP is an industry-driven standard that promises to make the task of writing applications programs to be run on multiple wireless devices across multiple networks much easier. WAP has been designed to extend the programming paradigms common to the Internet (e.g., HTML, URL's, Browser interface, etc.) a wireless environment. As such, an affinity between the Internet/Intranet applications of a corporation and their wireless solutions can be attained.

The adoption rate of WAP will be dependent on a number of factors. There is some controversy as to whether WAP will become the single standard for all wireless applications. In general, Vast believes WAP will be a major factor in wireless applications no later than late 2001.

The driving factors for the rate of adoption for WAP will be:

1) **Advancing Wireless Network Bandwidth**

   WAP is based on a browser model not unlike that used by the Internet. In general, this model will be best served by network bandwidth of higher rates than are available today. This need is exacerbated by the tendency of most Internet/Intranet applications to be graphics and

multimedia rich. Early on these larger files will be stripped out of the wireless application, making the results disappointing to the user. The greatest uptake is expected when advancements in the networks facilitate faster rates and the capacity to transmit larger files.

2) **Availability of WAP Capable Devices**

WAP will be deployed most aggressively in cellular phones. Here, even in WAP's primitive early stages and with the phone's limitations on human interface (the 12 key data entry pad), the microbrowser model will allow early access to email and information from the Internet. This form of access is a feature that most phone users will find to be a useful add-on to their voice service.

By the end of this year it is estimated that over 100 million WAP enabled phones will exist worldwide. Motorola will be shipping all WAP-enable phones by the end of 2000 and Nokia will reach that stage later in 2001. Nokia has estimated that over half of its phones shipped worldwide will be WAP-enable by the end of 2000.

Today, most wireless devices do not come with standard WAP microbrowser capability, however this is changing rapidly. As an example, Palm OS has recently made a WAP browser optional. Vast expects this trend to continue until all wireless devices will be capable of executing a WAP interface.

3) **Maturation of the WAP Infrastructure in the U.S.**

Deploying WAP will be dependent upon the carriers support for this standard. All are working towards this goal, and their success will be a factor in the uptake of WAP. For example, today AT&T is selling WAP capable phones but will not be supporting WAP-based services on their network until later this summer.

Another factor will be the roll-out of enterprise WAP servers that allow corporations to establish a secure data path from their IT facility through the carrier and to the end user. Several vendors, including Nokia and Motorola, are currently in the early stages of bringing such enterprise WAP servers to market. The market leader in WAP solutions, phone.com, continues to concentrate on the carrier market for the implementation of its WAP solutions.

4) **Resolution of Security Concerns**

Today, WAP does not set a standard for over the air security. In general, the encryption approaches utilized in the wired world are too CPU intensive to be supported across a wide range of hand-held mobile devices. An alternative must emerge and be adopted on a broad basis in order for corporations to be comfortable with moving sensitive data over wireless networks. The leading contender for this is elliptic curve technology, which reports to offer encryption nearly as strong as the DES algorithms with far less computing. Elliptic curve encryption is becoming available on hand-held units such as Palm OS and from a variety of other vendors.

WAP does not currently provide for authentication of the user. The limited resources of hand-held or a mobile device often prevent the use of standard digital certificate technology. Therefore, if more than a simple login/password authentication is required today, the user is on their own. Technologies such as the SecureID card are being developed to resolve this concern.

### 4.4 The rate at which new generation network technology will be deployed

A number of network related issues will influence the adoption of wireless solutions overall and the time to get to the Desired Environment outlined in this report. In general, these issues are:

1) Bandwidth

   Today's wireless data networks support transmissions in the range of 1.2 Kbps to 19.2 Kbps. Bandwidth is expected to continue to increase, with the pending GPRS networks being capable of up to 170 Kbps. Even with the growth of bandwidth, history has shown network capacities to always be a concern when considering remote applications. Network planning and monitoring will always be a requirement when implementing any wireless solution.

2) Latency

   Wireless applications are designed on the premise of possible transmission delays, or latency. When data is transmitted, it is bundled into "packets" for transmission to the wireless device. The packets may arrive in several seconds or possibly minutes depending on the network "load". These delays are a primary factor against the rapid deployment of interactive wireless solutions.

3) Diversity

   Today there is a large number of networks to choose from that are theoretically WAP capable (e.g., ReFLEX, Mobitex, CDPD, CDMA, GMS, GPRS, etc.). In general, diversity will work against broad based adoption of wireless since a corporation would be required to choose one protocol, which could limit the coverage area, or develop their application to span all protocols, elongating development time and costs.

Even though many corporations have a need for wireless applications, they are hesitant to deploy them due to reasons previously stated. Service providers, such as Vast Solutions, have recently come to the market to help bridge these concerns to provide a common interface to the wireless world. By using a wireless service provider, Company A would be capable of implementing cost-effective wireless solutions without having to build the infrastructure to support wireless devices or protocols. Company A would be able to reduce the time required to implement wireless solutions and thereby realize a faster return on investment by having a more productive workforce which is more flexible and responsive to client demands.

# 5 Pilot Options

As discussed in the desired environment section, Company A should evolve toward a more ubiquitous broadband wireless data coverage - GPRS or CDPD - combined with an open standard (WAP) server platform which provides ready access to Company A intranet web pages. This environment, for reasons previously stated, may still be 24 to 48 months into the future, which leads to the question of what to do today.

The critical business issues for the success of Company A today are:

1) Automated Vehicle Location (AVL)
2) Remote access to and management of CIS information
3) Ability to easily implement and support a wireless solution

## 5.1 Recommendation

Considering these critical success factors, Vast considered two options:

1) The applications can be created using separate devices and systems.
   a) AVL - Provided through a separate dedicated application using a cost-effective in-vehicle mounted device that provides periodic GPS updates back to a server based application, which plots coordinates on a map application.
   b) Dispatch – Provided by developing an ability to extract from and push information to the CIS database. This will allow the dispatch file for each field worker to be pushed to them to set their route. In addition, it will provide for the ability to update the field worker based upon events, which will happen during the course of the day. The field worker client could reside on a ruggedized PC or even a handheld device such as a Pagewriter, RIM or Palm based upon the degree of functionality required. The server side interface would be common regardless of the device.
2) Use of an in-vehicle PC (see Appendix A for description) to combine the capability of AVL as well as provide a client environment capable of supporting a dispatch application. In addition, the PC would provide the added conveniences of text to speech and voice recognition for interaction while driving to minimize windshield time between jobs.

Since Company A requires an accelerated solution, Vast recommends the use of an in-vehicle PC for the initial pilot project.

The ultimate solution provided to Company A would have to optimize several variables, such as coverage and cost per vehicle; however the fastest way to demonstrate the proof of concept is with an in vehicle PC, such as the Visteon ICES product. This will minimize time to deployment for the AVL component as well as airtime due to using off the shelf components. It also gives a common platform to provide CIS dispatch and input updates such that both functions can be accomplished with a single device.

This option allows Company A to prove feasibility and perfect the business concepts in the fastest means possible. Also, any server side application developed to manage AVL data or to access CIS data is fully reusable regardless of the ultimate choice for devices. Initial coverage using Mobitex should not be an issue in the greater Water World or Disney Land areas. Later versions could use different RF technology.

The next steps for Company A would be:

1) Acquire approval for the expense to proceed with a pilot project
2) Proceed with a phased pilot using the Visteon in-vehicle PC
   a) Phase I – AVL
   b) Phase II – CIS dispatch

      NOTE: Server side AVL application and CIS connection are fully reusable.
3) Review and select deployment options of device and network against functionality and cost.
   a) Current best network choice would be Reflex 25. However, applications should be able to migrate to a broadband wireless data coverage when available.
   b) Device choices need to be weighted by Company A using functionality versus price.
   c) Multiple solutions/devices can be supported through a Vast Viaduct type technology.

## 5.2 Device Alternatives

In parallel with providing a Visteon in-vehicle PC, Vast is in the process of developing a lower cost unit which would provide AVL only functionality. It should be available in three to four months and could be evaluated at a later stage of the pilot if requested by Company A.

There are also a variety of handheld devices that may be well suited to providing the desired dispatch functionality. Due the relatively low cost of such devices, Company A may opt to utilize these devices for some categories of their mobile workers depending on the degree of functionality required. Again, the server side interface would be common regardless of device.

## 5.3 Network Alternatives

Company A has many options for wireless providers. Vast has performed a study on coverage (see Appendix B) of the different providers and has concluded the best options are: PageNet R25, Bell South Mobitex and Weblink Wireless. The broadest coverage (excluding an expensive satellite-based system) is the Reflex 25 network provided by PageNet. This system is ideal for machine interactions such as AVL and given the direct connect to CIS and the way that Company A interacts with their enterprise system, it matches these needs as well. Due to Vast's relationship with PageNet, it is possible to address additional coverage in selected areas to support Company A's complete business needs.

## 5.4 Benefits

Company A will realize many benefits from moving forward with the pilot project:

1) Proof of concept before making a major investment in new technologies
2) Rapid execution of pilot by using a flexible solution with the in-vehicle PC

3) Determine actual benefits to be gained from an implementation of final solution

Vast determines Company A will benefit in multiple ways as they implement the overall solution. This includes:

1) The solution will easily migrate to broadband when fully available
2) Optional elimination of some products, such as Clarify and MDSI
3) Customizable solutions able to provide cost effective solutions for some employees and/or high end solutions for other employees
4) A fast return on investment as work efficiencies improve, processes are reduced and client satisfaction increases.

Vast recommends Company A immediately proceed with the pilot project in order to better appreciate all possible benefits from implementing a flexible wireless solution within their corporate structure. It is understood Company A may require some assistance with the implementation of the pilot project and Vast Solutions is willing to join with Company A in helping to make the pilot a success. Although current technologies may not fully support all requirements of Company A, Vast strongly believes many of Company A's needs will be fulfilled as a full implementation is rolled out. Since Vast's recommendation would provide a high degree of flexibility, as technologies change Company A will be well positioned to modify the implementation to take advantage of the latest technologies.

## APPENDIX A: Device Analysis

### In Vehicle PC Dash Mounted Unit

**Advantages** – Many in-vehicle PC's are fully integrated devices; the GPS receiver, the communication module, and the processor are all housed in one enclosure. This presents a small form factor and can reduce development and installation time. These devices also use "Dead Reckoning" technology in addition to GPS in determining vehicle location. This is an especially important advantage when vehicles will operate in areas where GPS signals could be impaired by natural terrain or a high density of man-made structures.

**Disadvantages** – Many in-vehicle devices have relatively small screens that may not be able to render a detailed map or other technical image. Some of these devices utilize touch screens, making any input other than a canned response extremely tedious for the user. Price could also be a factor with the in vehicle dash mounted units as they are forecasted to cost between $6,000 and $10,000.

Since Vast is recommending the use of a Visteon in-dash PC for the pilot project, a synopsis of this device is included:

Visteon, a wholly owned subsidiary of Ford Motor Company, has been in the vehicle electronics business over 90 years. With this experience comes substantial knowledge of vehicles, their systems, and vehicle related environmental issues. In the next 24 to 36 months Visteon expects every vehicle rolling off the Ford Motor Company assembly line to be PC equipped as part of a standard entertainment system package. Ford plans to spin off Visteon to Ford shareholders late this year to enable Visteon to pursue vehicle manufacturers other than Ford and its subsidiaries.


The Visteon ICES unit utilizes the Microsoft Widows CE operating system, which at this time has the full commitment of Microsoft in its plan to dominate mobile computing. The Visteon ICES unit also contains a CD reader that will support storage and frequent updates to the mapping and a turn by turn driving directions application. The production release version will also support text-to-voice, which can be a significant feature where operator distraction is a concern.

Standard Laptop

There has been substantial technological advancement and price improvement with laptops in the last few years. A new low-cost machine is as powerful as the best desktop machines were just 24 months ago. Probably the most significant improvement has been screen technology that now allows a higher angle of incidence while maintaining readability of the screen.

**Advantages** – The low costs of the core units. Of the manufacturers evaluated we have seen a cost per unit spread of $1,000 to $1,400 per device. These machines are have 400 MHz processors, 32 MB of RAM, and 4 Gigabytes of hard drive space, or better. Some organizations believe a low-cost, "throw away" machine is a better investment than a rugged machine that cost thousands of dollars more. These machines all utilize the WIN 9X operating system, which lends

itself to high availability of off the shelf applications for the mobile workforce. All of these machines also posses a 12.1 inch SVGA monitor which is more than adequate for displaying maps, or other technical data that requires high resolution. These machines are USB port equipped to support connections to other devices.

**Disadvantages –** In a mobile industrial environment the failure rate of a standard laptop could invalidate the financial gains of the low cost core unit through excessive "shop" time and the resulting loss of productivity for the operator and vehicle. Standard laptop screens were designed for tungsten and florescent illuminated indoor environments and may not be bright enough for all outdoor work situations. Loss of devices due to theft or user mishap is also common.

### Rugged Laptop

Rugged portables have been around almost as long as standard laptops. Typically the hard drives are smaller, the speed is lower, and the screens are smaller than standard commercial laptops. However, mobile industrial applications are designed with these limitations taken into consideration.

**Advantages** – The rugged units we have evaluated are built to take the abuse that is inherent in a mobile industrial application. These units are tolerant to extreme temperatures, up to and including full immersion in water. Most units are available with a wireless option. All brands have a touch screen option and are designed to be easily viewable in bright sunlight.

**Disadvantages –** Cost could be the limiting factor depending on the brand selected. The range of prices for these units is from $2,500 to $5,500.

One popular rugged laptop is the Hammerhead™ 586 computer made by Walk About™. The Hammerhead is a pen tablet computer that uses a Cyrix™ microprocessor and Windows 95 operating system. This computer includes a computer screen with 640 x 480 monochrome resolution. Company A is currently using the Hammerhead and would realize some return on investment by being able to reuse these devices for some applications.

### Vehicle Server

Vehicle servers are designed to be trunk or cab mounted with monitors mounted in a forward cab position. Most monitor mounting solutions are designed to be airbag compliant, thus allowing the airbag to deploy without striking and making a projectile of the monitor. Some of the vehicle servers use solid-state data storage instead of a shock mounted hard drive. All of the solutions evaluated use a keyboard and touch screen for operator interface.

**Advantages** - As with rugged laptops, this technology has been around for some time but has been primarily deployed in law enforcement applications. Due to competition in the marketplace, the price point of this type of solution has come down substantially. As a result of the price improvements, the vehicle server configuration is gathering greater acceptance in other rough duty environments. Additionally, because most of the systems consist of separate

components, some organizations are selecting the server and monitor from different manufacturers to better meet the needs of the application or budget.

**Disadvantages –** Cost could be the limiting factor depending on the brands or models selected. The range of prices for these units is from $2,900 to $4,500.

### Handheld Devices

The use of handheld or palmtop devices could be made possible using several wireless networks but this is limited to wireless modem availability. The most appropriate device type (e.g., PDA, palmtop PC, 2-way pager, etc.) for the job would first have to be determine and then the optimal network for the chosen device type would have to be selected.

The price range for handheld devices varies from $350 to $2000. The major concern with choosing a handheld device for a wireless solution is the amount of information (data) that is required. Handheld devices can easily manage small amounts of data where large amounts of data can start to eliminate smaller handheld devices as an option.

## Appendix B: Network Considerations

The choice of which network to select for a given application will depend upon several factors such as network coverage, data transmission characteristics (e.g., data rate, security, cost, etc.), and applicable device availability. In the end, the network choice will be decided by weighing several tradeoffs. In addition, multiple applications may be optimally served using differing network and device choices. Therefore, the overall wireless connectivity solution may be a hybrid of several networks and devices. It is recommended to enact a forward-looking plan that utilizes public networks and allows for easy transition to future devices and networks.

### Wireless Network Coverage Comparison

The table below can be used as a subjective network coverage comparison for Fantasy Land. The following networks were compared: PageNet R25, Skytel R50, Pagemart Weblink Wireless, BellSouth Mobitex, BellSouth Mobility GSM, Powertel GSM, Ardis Network, and Ardis Satellite.

The following three criteria were used:

1) Coverage of major cities/areas – the following 6 cities/areas were used:
    a) Anderson/Greensville/Spartanburg
    b) Water World/Sumter
    c) Florence
    d) Orangeburg/Holy Hill
    e) Disney Land
    f) Savannah/Hilton Head/Beaufort
2) Coverage of major highways
3) Network pricing

A rating system from 1-5 was used where 1 = poor/very expensive, and 5 = excellent/very inexpensive.

| | Coverage of major cities/areas | Highway Coverage | Price | Overall Coverage/Comments |
|---|---|---|---|---|
| PageNet R25 | 5 | 4 | 3 | Without going to satellite, one of the best overall |
| Skytel R50 | 3 | 1 | 3 | Fairly good major city coverage but much less expansive than R25 and no highway coverage |
| Pagemart Weblink Wireless | 5 | 4 | 3 | Similar to R25 (highway coverage maybe even better); without going to satellite, one of the best overall but map resolution is a question mark |
| BellSouth Mobitex | 5 | 3 | 4 | Similar to R25 – major cities coverage may be a little better, highway coverage a little worse; without going to satellite, one of the best overall |
| BellSouth GSM | 3 | 5 | 3 | Coverage fairly limited in Water World; Overall, seems excellent for the highways; map accuracy a question mark (done by hand) |
| Powertel GSM | 1 | 1 | 3 | Hardly any coverage in S. Carolina – Augusta coverage extends slightly into S. Carolina, and Savannah coverage extends to Hilton Head/Beaufort |
| Ardis Network | 3 | 1 | 3 | No coverage in Orangeburg, no highway coverage |
| Ardis Satellite | 5 | 5 | 1 | Provided line of site, coverage is everywhere; pricing is extremely high, however |

Overall coverage rating based on major city/highway coverage and pricing:

1) R25/Mobitex/Weblink Wireless
2) Ardis Satellite
3) BellSouth GSM (best for the highways)
4) R50/ Ardis Network
5) Powertel GSM

## Network Advantages and Disadvantages

### Mobitex

**Advantages**

- Store and forward capabilities – stores messages until device returns to coverage and can acknowledge receipt.
- Packet switched data design provides for a high level of security
- Single carrier network with nationwide roaming
- Robust transmission, claims 99.5% probability of message receipt within coverage area
- Low latency – 4 to 10 seconds typically

**Disadvantages**

- Protocol used is highly proprietary
- Not capable of data throughput greater than 8 kbps

### ReFlex 25 & 50

**Advantages**

- Store and forward capabilities – stores messages until device returns to coverage and can acknowledge receipt
- Message error detection and retransmission
- Broadcast capabilities for efficient use of spectrum
- Nationwide roaming
- In-building penetration better than cellular technologies

**Disadvantages**

- Longer latency than other data networks
- Simulcast of forward channel from multiple transmitters produces delay spreading of signal

### GSM

**Advantages**

- Reliable circuit switched data (CSD) up to 14.4 kbps
- Multiple device offerings by a variety of manufacturers
- High level of security

**Disadvantages**

- CSD incurs charges for the time the circuit is connected and not the amount of data that is transferred

## ARDIS

**Advantages**

- High security level
- Good in-building penetration
- Robust transmission, claims 90% probability of message receipt within coverage area

**Disadvantages**

- Longer latency than other data networks