

F R O S T



S U L L I V A N



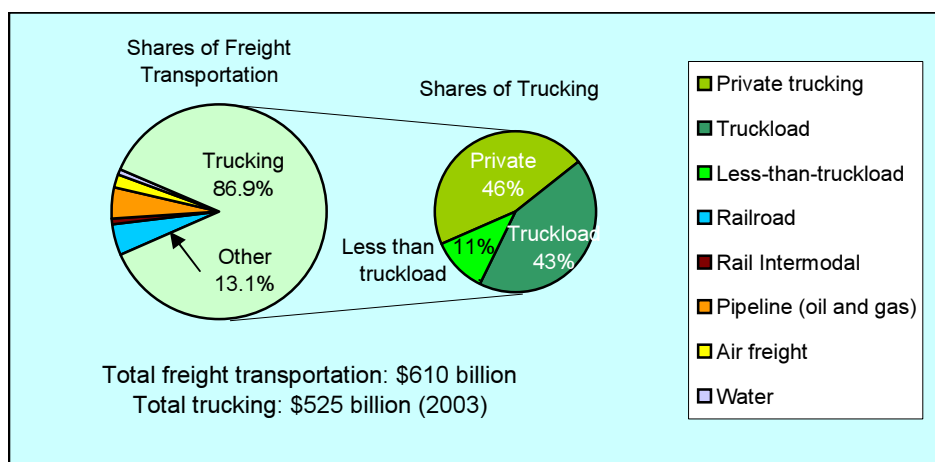
TRUCKING INDUSTRY
CHALLENGES AND
EMERGING
MULTIMODE
NETWORK
ARCHITECTURES



TRUCKING INDUSTRY: WHEELS OF THE ECONOMY

Truck transport is faster than rail transport and less expensive than air transport, giving it favorable positioning in the transportation industry. The commercial trucking industry moves over 80 percent of U.S. freight, generating revenues of \$525 billion in 2003 (the latest year for which solid data are available) -- about 4.8 percent of gross domestic product. More than 8.6 million people were employed in trucking-related jobs in 2003. For 2005, trucking industry revenues are estimated conservatively at \$570 billion. Chart I illustrates the importance of the trucking industry to freight transportation in the United States.

Chart I: Freight Transportation (United States), 2003



Source: American Trucking Association, *US Freight Transportation Forecast to 2015*

The trucking segment has been growing faster than the economy as a whole for a number of reasons:

- Other transportation modes are facing constraints
- Trucking is well-suited to current business practices such as just-in-time supply
- Economies of scale suggest a trend to larger, centralized manufacturing and warehousing operations, and more shipment of goods
- International trade is growing with the trend to globalization
- On-line shopping, which requires commercial transportation for merchandise delivery, is becoming increasingly popular

TRUCKING INDUSTRY CHALLENGES

Overcapacity in the trucking industry through the 2001-2003 recession resulted in significant capacity rationalization. As the economy improved in 2004, demand for truck capacity increased substantially, leading to shortages within the industry, with availability of drivers being the limiting factor. High fuel costs and strict regulatory environment following 9/11 have placed additional pressures on the trucking industry. The industry's major challenges are summarized as under:

- Low operating margins - sharp competition
- Centralized decision making in a mobile work environment - disenfranchised mobile workforce (drivers) controlling 80 percent of variable costs
- Driver shortage - high rate of driver churn into the construction sector
- Stricter regulatory environment and compliance regimen post 9/11 - loss of productivity and increase in operating costs
- Higher driver qualifications post 9/11 - higher cost of hiring and employing drivers
- High fuel costs
- Increase in insurance costs
- High cost of truck down time - need for effective maintenance management

Driver issues rank high on this list, and even some seemingly unrelated items such as fuel and insurance costs are in the hands of drivers to a fair extent.

The major reasons for driver dissatisfaction are quality of life issues - being away from home for extended periods, unpredictable schedules, and inability to follow an after-work routine. Driver disenfranchisement and lack of a career path further compound the problem. Although drivers are better educated and more qualified than ever before, they have little voice within their companies. Decision-making is highly centralized within trucking companies, even though the workforce is highly decentralized, with drivers controlling about 80 percent of variable cost. Variable costs are factors such as labor, fuel, and maintenance.

For these reasons, driver turnover is high - over 130 percent (annual rate) in the fourth quarter of 2005. Fleet operators estimate that recruiting and training of a new driver costs \$5,000 to \$8,500. Reducing turnover thus is a key goal, and improving driver satisfaction is key to this end. Ironically, some fleets are reluctant to invest in training because of high turnover, but lack of training may contribute to turnover.

The ability to manage affairs such as banking, health plans, retirement accounts, remote education, and to stay in touch with friends and family and have access to information and entertainment while on the road, can increase driver satisfaction by minimizing the disruptions to lifestyle caused by long periods away from home.

With rising fuel costs, reducing fuel consumption is another important goal. Idling trucks waste much fuel. Fleet operators also face capital costs, truck maintenance and downtime costs, insurance costs, and the costs of back-office functions such as record keeping and billing. The burden of regulatory compliance enters into the need for record keeping.

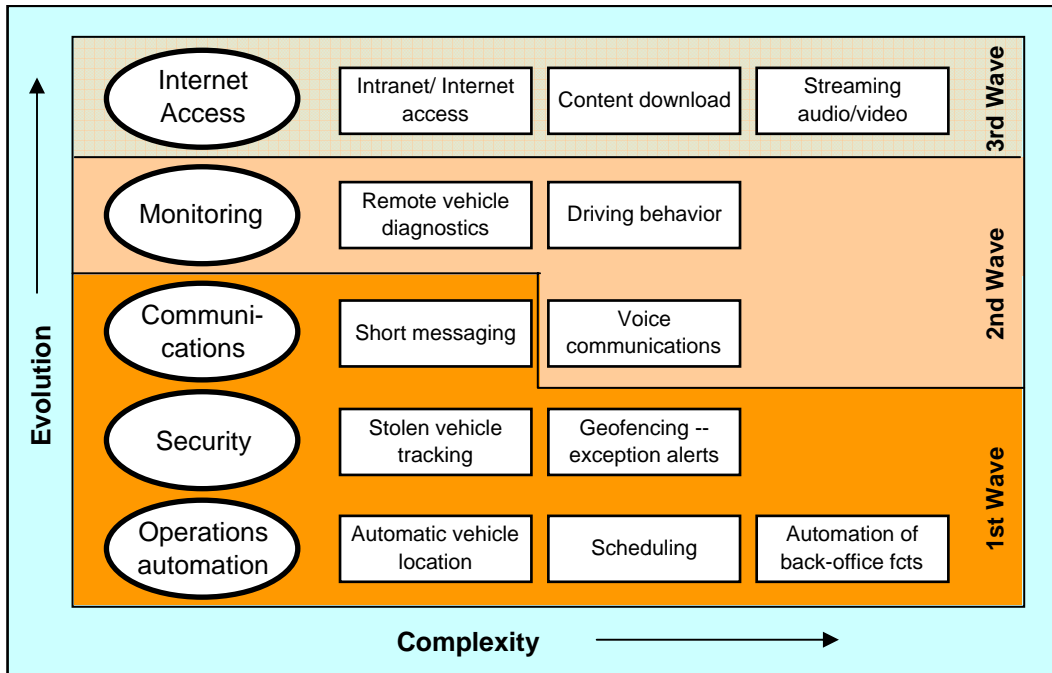
Sharp competition translates into low margins (under 4 percent net margin for class 1 & 2 carriers). In a tough pricing environment, efficient operation is critical as there is no room for unnecessary costs. Fleets must maximize efficiency in all aspects of their operations to remain competitive and profitable.

COMMERCIAL VEHICLE TELEMATICS - IMPROVING OPERATIONAL EFFICIENCIES

Commercial vehicle telematics (CVT) combines onboard computing, location technology (based on the global positioning system or GPS), and communications technology to offer a host of applications. The first wave of telematics applications targeting the "low hanging fruit" was aimed at improving fleet operations through better asset and resource management. As early adopters and forward-thinking carriers began seeing diminishing incremental gains from the first wave of applications, a second wave of applications, which included remote vehicle diagnostics, remote driving behavior monitoring, and voice communication became available.

The first two waves of applications were operations-centric. Now, in a third wave of applications, telematics customers are looking for solutions to address more complex problems concerning the human aspects of their operations, drivers being central to such a solution. The human aspect has become important in recent years in light of the high degree of driver churn and the consequent expectation of an acute long-term driver shortage. Chart 2 illustrates the evolution of telematics applications over time.

Chart 2: Commercial Vehicle Telematics Applications (North America)



Source: Frost & Sullivan

For commercial applications, telematics typically provides communications between dispatchers and drivers, the ability of dispatchers to locate vehicles for scheduling and security purposes, and the ability of fleet managers to extract information from trucks to manage maintenance and to monitor driving behavior. Information is sent from the truck to a central server from where the dispatcher can retrieve it as needed. Dispatchers can also receive exception alerts that notify them, for example, if a truck leaves a pre-defined geographic area.

Because the trucking industry is diverse, the CVT market also is diverse. It can be segmented as follows:

- Trucks in long-haul use - truckload and less-than-truckload carriers in regional and nationwide use
- Vehicles in local use - cable, telephone, plumbing, taxi, etc. fleets
- Trailers - in long-haul use
- Equipment - for construction, mining, and agricultural use (off-road vehicles)

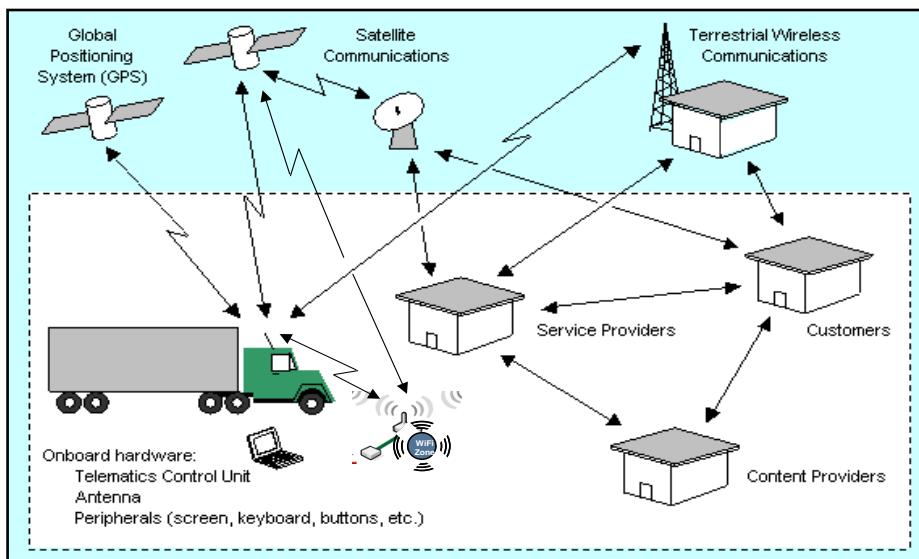
Numerous companies are active in commercial vehicle telematics. The market is likely to remain fairly fragmented because of the many segments that can be addressed by highly specialized companies. Currently, the major providers of telematics systems and services for long-haul trucking are:

- Qualcomm Inc.
- Aether Systems Inc.
- PeopleNet Communications Corp.

Frost & Sullivan Whitepaper

CVT systems typically have an onboard hardware aspect, a location aspect, a communications aspect, and a services aspect. The global positioning system (GPS) provides location information, and communications may be provided by cellular or satellite links. Some systems have both cellular and satellite communications capability, using cellular links when available for lower cost and satellite links for ubiquitous coverage. Chart 3 illustrates the telematics network.

Chart 3: The Commercial Vehicle Telematics Network



Source: Frost & Sullivan

PROSPECTS FOR COMMERCIAL VEHICLE TELEMATICS

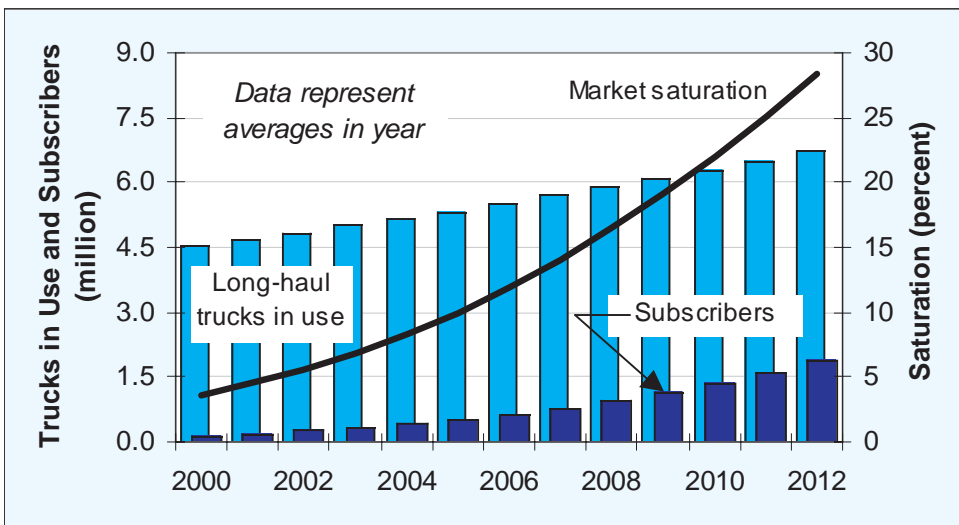
The CVT market has been growing on the basis of the demonstrable positive returns on investment that CVT systems provide to fleet operators. This technology provides a range of benefits to fleet operators and other stakeholders. Depending on the particular system and the nature of the fleet's work, benefits may include:

- Greater worker productivity through monitoring and better scheduling
- Lower driver turnover through greater job satisfaction
- Lower fuel costs through less idling and better driving habits
- Less truck downtime through better maintenance
- Lower truck maintenance costs through remote vehicle diagnostics
- Automation of back-office functions
- Better regulatory compliance
- Greater security through tracking of trucks
- Safer operation through monitoring of driving behavior

- Lower insurance costs through safer operation
- Reduced liability exposure through safer operation

Because there are so many different kinds of commercial fleets, there also are many different telematics solutions. Some providers specialize in providing service for long-haul fleets, for specific kinds of local fleets, for trailers, or for equipment. Many fleets find that the expected return on investment is positive, resulting in a growing market. However, much market potential remains untapped - in 2005, only an estimated 10 percent of the long-haul truck fleet was equipped. Chart 4 presents the size of the long-haul fleet versus the number of telematics subscribers over the 2000-2012 period. Market saturation also is shown.

Chart 4: Long-Haul Truck Fleet and Subscriber Base (North America), 2000-2012



Source: Frost & Sullivan

Even though growth of about 20 percent per year is forecast for the subscriber base, Frost & Sullivan anticipates that only 28 percent of the fleet will be equipped in 2012. Clearly, much market potential remains to be tapped.

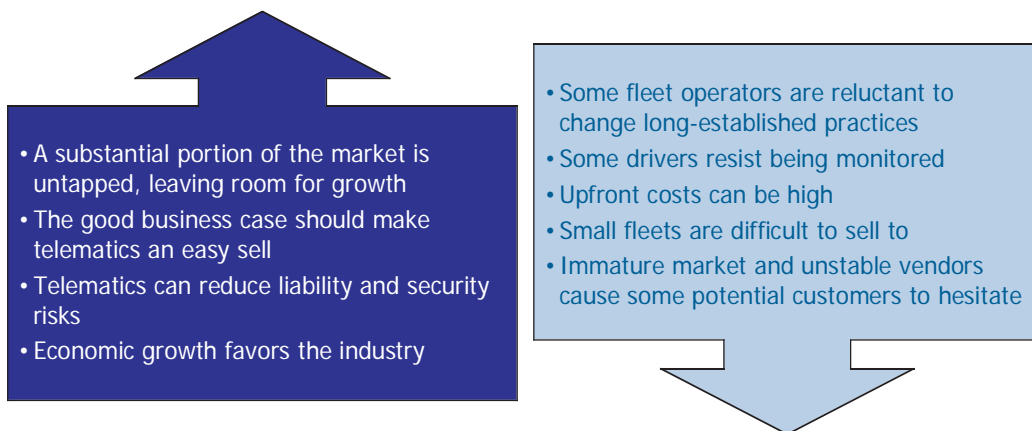
Given the favorable economics of commercial vehicle telematics, why has the market not grown more rapidly to date? A number of factors account for this, including:

- Trucking companies' reluctance to change business practices, necessary to realizing the benefits of telematics - skills must be acquired or appropriate personnel hired
- Low awareness of telematics among trucking companies
- Resistance to being monitored and to change old ways on the part of some drivers
- The failure of some early systems to perform as promised
- The failure of some early providers, leaving customers without service

- Lack of standardization in telematics offerings, increasing the time that fleets need for decision making
- High up-front cost, a hurdle given tight margins in the trucking industry, limiting potential customers' ability to invest in new technology
- The economic slowdown of 2001-2002, which squeezed trucking companies financially
- The fragmented nature of the trucking industry, with many small companies, which are expensive to sell to
- Cellular service providers also are fragmented, with some incompatible networks
- Hype during the high-tech boom, which raised expectations too high
- Rapidly evolving technology, which causes some potential customers to hesitate

Chart 5 summarizes major market drivers and restraints.

Chart 5: Market Drivers and Restraints (North America), 2006

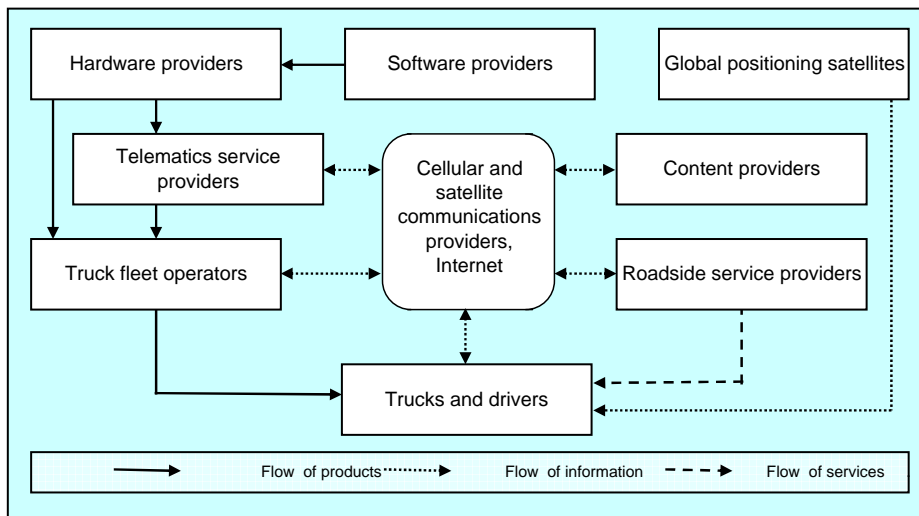


Source: Frost & Sullivan

THE COMMUNICATIONS ASPECT OF TELEMATICS

Chart 6 presents the industry structure as a flow chart, highlighting flows of products, information, and services. This Chart illustrates the central role that communications plays in CVT.

Chart 6: The Telematics Value Chain



Communications is at the center of the commercial vehicle telematics industry.

Source: Frost & Sullivan

Wireless connectivity is a key aspect of CVT, necessary for communicating with a mobile workforce. To date, the primary choice has been between cellphone and satellite communications. Cellular communications is less expensive than conventional satellite communications, but cellular coverage is not ubiquitous and data rates are limited. Satellite communications coverage is essentially ubiquitous, but costs are higher. Some systems are bimodal, using cellular communications when available and satellite communications when necessary.

Hybrid wireless networks based on WiFi ("wireless fidelity") communications are a third, emerging option. WiFi is a short-range communications technology - the user must be near a "hotspot" to make a connection. WiFi networks can provide access to high-speed Internet at low cost, meaning that any service available through the Internet can be accessed through WiFi. WiFi hotspots can be connected by T1 lines or by satellite communications links. A satellite-linked network of WiFi hotspots can be established at much lower cost and much more quickly than a T1 network. WiFi data rates vary with factors such as:

- The distance between the transmitter and the receiver
- Obstructions between the transmitter and receiver

- Interference from other transmitters
- The power of the transmitter/ receiver

Data rates are automatically scaled in accordance with the quality of the signal, facilitating communications over greater ranges. Possible connection speeds are:

- 802.11b connections -- 1, 2, 5.5, or 11 megabits per second (Mbps)
- 802.11g connections -- 6, 9, 12, 18, 24, 36, 48, or 54 Mbps

Chart 7 summarizes the performance-cost characteristics of various wireless communications technologies.

Chart 7: Coverage, Bandwidth, and Cost Tradeoffs among Cellular, Satellite, and WiFi Communications Systems

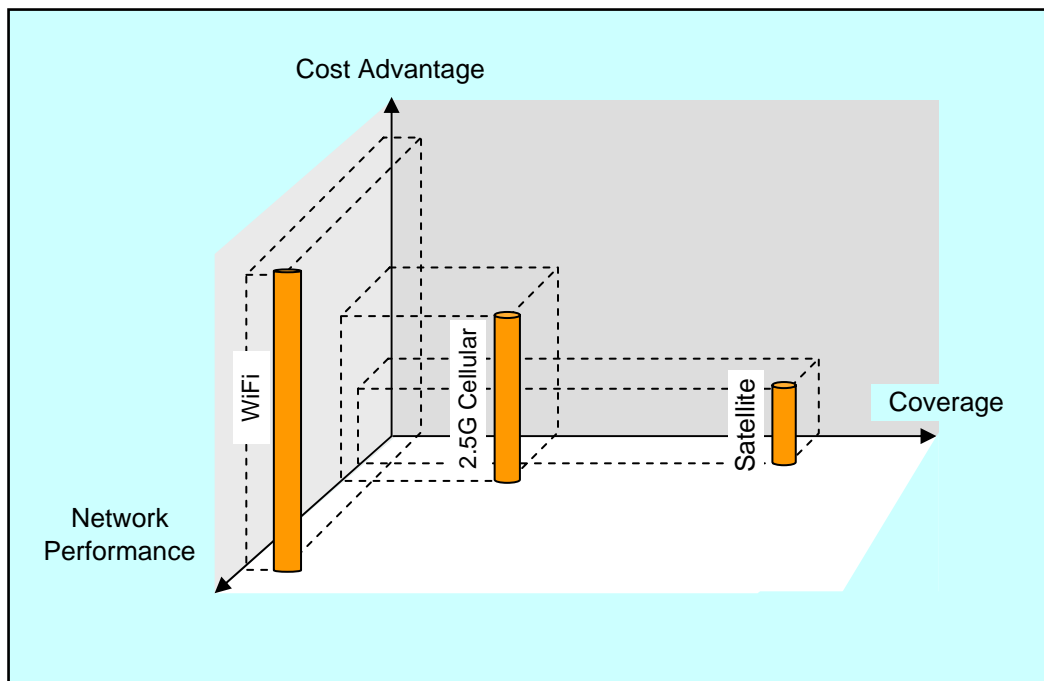
Technology	Coverage	Data Rates (Kbps)	Service Cost
Cellular (generation 1)	Good, but to be phased out	4.8 - 9.6	Low
Cellular (generation 2)	Good, but not ubiquitous	9.6 - 56	
Cellular (generation 2.5)	Initially limited, but expanding	50 - 130	
Cellular (generation 3)	Initially limited, but expanding	Up to 2048	
Satellite	Ubiquitous in the continental US	Uplink: 64 - 1024 Downlink: 256 - 2048	High*
WiFi (802.11b)	Hotspots only, in higher user-density areas	Up to 11,000	Nominal
WiFi (802.11g)		Up to 54,000	
915 Megahertz radio	Several miles	124	Moderate
WiMax (802.16a)	Urban area	Up to 75,000	NA

Source: Frost & Sullivan

WiMax is an interesting future technology, offering both fairly broad coverage and very high data rates. However, since standards for WiMax have not been established, implementation of WiMax-based networks is years away.

Chart 8 illustrates the coverage, bandwidth, and cost characteristics of cellular, satellite, and WiFi communications systems.

Chart 8: Coverage, Bandwidth, and Cost Tradeoffs among Cellular, Satellite, and WiFi Communications Systems



Source: Frost & Sullivan

For the first two waves of telematics applications, cellular communications links were perfectly adequate. However, third-wave broadband applications need substantially greater bandwidth, well beyond the capabilities of current cellular networks. Third-generation cellular networks will to an extent overcome the bandwidth limitations of second-generation networks, but their limited early coverage and high cost will make them a less-than-optimal solution for third-wave broadband applications. The high bandwidth and low cost of WiFi networks makes them a key element of a cost-effective multi-modal wireless solution for third-wave applications supporting high-speed Internet and streaming audio/video. Coverage is limited to hotspots, but studies show that drivers prefer to use broadband applications at truck stops, weigh stations, and other resting points.

EXAMPLES OF WIFI APPLICATIONS

Truck Stop Hotspots

Truck stops have been setting up hotspots to better serve their customers. Access may be sold on hourly, daily, monthly, or annual plans, or may be available for points earned under loyalty programs.

Flying J Inc., for example, has equipped more than 170 of its Travel Plazas and 141 additional locations across North America as hotspots. This network is still growing. Flying J charges \$200 per year for WiFi access at any of its sites, and also offers daily and monthly plans.

Similarly, TravelCenters of America has equipped most of its approximately 160 locations with WiFi hotspots, charging \$150 per year for access. TravelCenters also offers hourly, daily, and monthly plans.

Independent truck stops are offering service through independent service providers.

SiriCOMM Inc.

SiriCOMM Inc. is developing a hybrid communications network for creating a telematics solution that provides high data rates at low cost, with a trade-off in terms of coverage. SiriCOMM's network consists of a network of WiFi hotspots, which are connected to SiriCOMM's hub by satellite communications links. A satellite-linked network of hotspots can be established at much lower cost and much more quickly than a T1 network.

SiriCOMM's system stores information in the onboard unit for transmission to the service provider or fleet operator when the truck is in range of a hotspot. Similarly, messages to drivers are stored on local servers until they can be downloaded to the specific trucks for which they are intended. Messages are sent from SiriCOMM's hub to all of SiriCOMM's local servers at hotspots. When the intended recipient is in range of a hotspot, the message is transmitted. Notification that the message has been delivered is sent back to the hub, which then informs all hotspot servers to delete the message.

SiriCOMM arrived at this network architecture after determining that truck drivers use their telematics systems primarily at truck stops rather than while in motion. This fact presented a major cost-cutting opportunity.

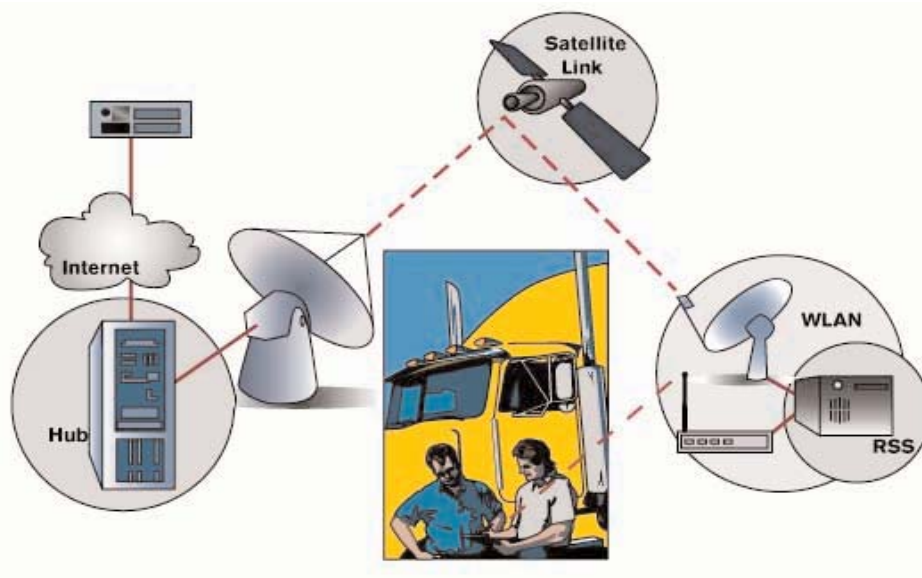
This system is not limited to text messages - its high bandwidth allows subscribers to connect to the Internet at the hotspots and download substantial files. SiriCOMM's low-cost high-bandwidth network solution could become the preferred network for the second wave of telematics applications targeting the human aspect of trucking operations.

The network's capability could enable fleet operators to provide connectivity, training (distance learning), information, and entertainment to their drivers. Driver satisfaction increases when drivers can stay in touch with their families and manage their financial affairs while on the road. Higher satisfaction, in turn, should reduce turnover.

SiriCOMM is developing a network of hotspots that should number 1,500 access points when completed in early 2007. In mid-2006, SiriCOMM has about 600 operational hotspots at truck stops and selected PrePass locations.

SiriCOMM is primarily a network provider. It partners with DriverTech Fleet Management Systems as an application provider and Maptuit Corp. as a content provider. Chart 9 illustrates SiriCOMM's system.

Chart 9: SiriCOMM's Network Technology (North America), 2006



WLAN = wireless local area network
RSS = remote site server

Source: SiriCOMM

Mack Trucks - DataMax and InfoMax

Mack Trucks' DataMax system records a truck's daily activity onboard the truck. When the truck returns to the yard at the end of the workday, InfoMax Wireless automatically transmits this information to the dispatcher via a secure WiFi link. Parameters that can be monitored include:

- Trip summaries
- Life-of-vehicle summaries

- Maintenance, fault, and diagnostic information
- Engine duty cycle
- Daily stop-and-go activity

Manual downloading is eliminated, and onboard systems can be reprogrammed whenever a truck is in the yard. The system is customizable to let the dispatcher extract exactly the information needed at predetermined intervals. Customized reports can be generated from this information. Optional GPS capability allows InfoMax to track a truck's location, which is useful for automated fuel tax filings and mapping of historical locations.

The system is available on new Mack trucks, and can be retrofitted on trucks with the necessary electronics.

MobiApps

MobiApps provides hybrid wireless communications systems based on WiFi, cellular, and satellite connections, converging these technologies to provide its customers with global communications at low cost.

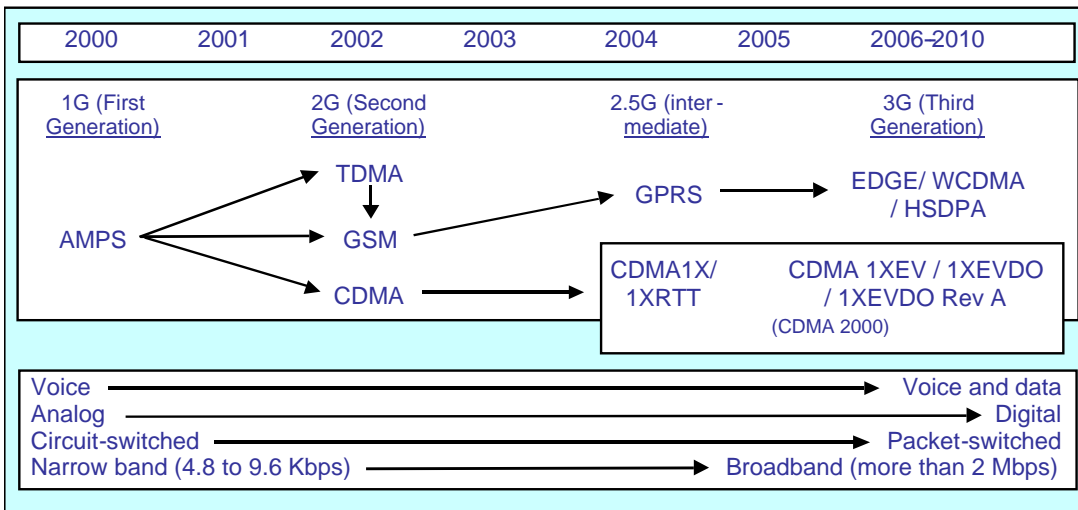
Operating globally, MobiApps targets mobile and fixed assets for its services. For mobile assets such as vehicles, trailers, railcars, containers, heavy equipment, and boats and ships, dispatchers may want to monitor location and operating parameters. For remote fixed assets, operators may want to remotely monitor factors such as consumption or production, maintenance needs, or tank levels.

NEXT-GENERATION WIRELESS COMMUNICATIONS TECHNOLOGIES

Cellular communications networks are evolving to more-advanced technologies that support higher data rates. After February 2008, wireless carriers will no longer be required to support analog networks, although they may continue to do so if demand warrants. In the meantime, Generation 2.5 networks are being developed, with Generation 3 networks to follow. This will increase the capabilities of CVT systems that use cellular communications, allowing the exchange of more data between trucks and fleet operators.

However, the build-out of 3G networks still is some years in the future. Chart 10 illustrates the evolution of cellular communications technologies.

Chart 10: Evolution of Cellular Communications Networks (North America), 2000-2010

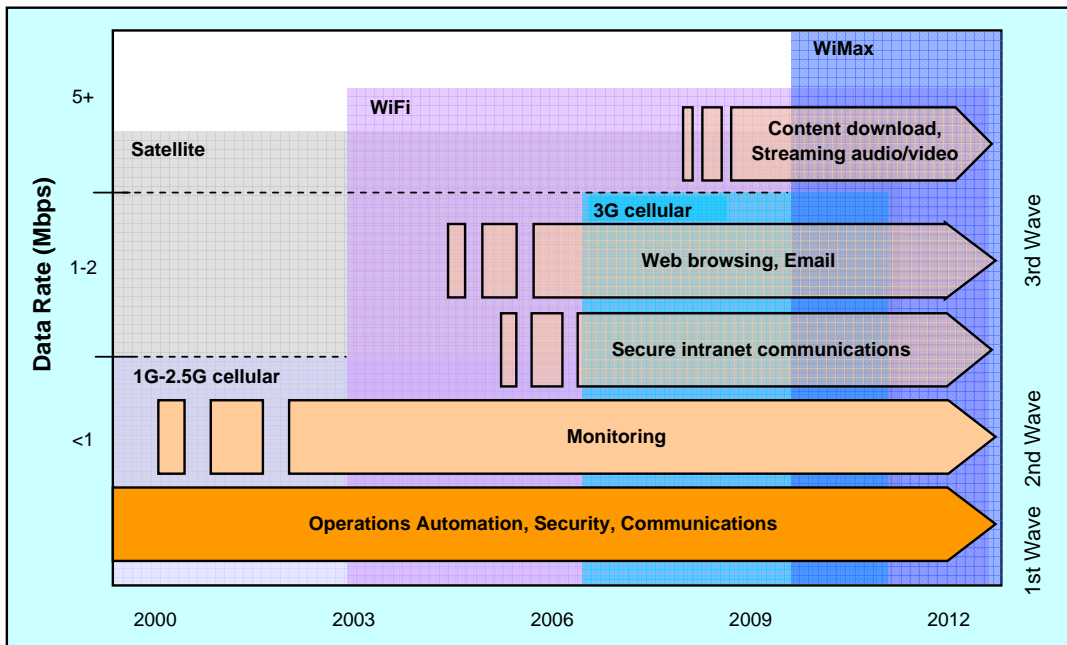


Source: Frost & Sullivan

Users should have little problem taking advantage of new communications technologies, as new technologies tend to be backward compatible. This means that applications that ran on an older technology can be easily ported to a newer technology.

Chart II presents the timeline of technology and application adoption.

Chart II: Timeline of Technology and Application Adoption (North America), 2000-2012



Source: Frost & Sullivan

ECONOMIC ASPECT OF TELEMATICS

Unlike passenger vehicle telematics, commercial vehicle telematics is driven by return-on-investment (ROI) considerations. Many fleets have implemented CVT systems on the basis of positive expected ROI, and have in fact realized those returns. Service providers indicate that they experience very low turnover of customers, indicating that CVT systems are delivering the promised returns. These returns can grow over time as fleet operators learn to take advantage of more of the capabilities of their systems. Typically, fleets start with location and basic communications functionality and progress to more-advanced functions.

The need for bandwidth grows as additional functionality is explored, and the challenge for communications providers is to provide bandwidth cost-effectively. The natural trend for customers to incorporate functions needing higher bandwidth as their experience with CVT grows is accelerated by declining communications costs.

In addition to positive ROI, security aspects are providing an impetus for trucking companies to adopt CVT. Haulers of hazardous materials and of high-value cargoes have great interest in protecting their trucks through tracking and monitoring by telematics. However, CVT's successes in helping recover stolen trucks are relatively unknown, because neither the trucking companies nor their customers are keen to publicize stories of attempted thefts.

CVT service providers seek to cut costs and expand services, to increase their customers' ROIs. They know that they must do this both to increase their own market shares and to grow the total market.

CONCLUSION

A trimodal telematics platform supported by a hybrid satellite-WiFi network (WiFi hotspots connected via satellite), cellular networks, and 915 MHz radio provides a holistic solution to the challenges faced by the trucking industry, where driver hiring and retention are emerging as a key success factor. Such a platform combines cellular networks wide coverage and cost-effectiveness for narrow-band applications, hybrid satellite-WiFi networks cost-effectiveness for broadband applications (at hotspots where it is of most value) and 915 MHz radio's suitability for extracting operating data from trucks in motion.

Benefits of a trimodal telematics platform include:

- Addresses both the human and operational aspects of the industry
- Brings the power of the Internet to drivers
- Empowers drivers by connecting them to their companies, enabling operations to include driver input in decision making
- Brings remote education, training, and other Intranet applications to drivers
- Enables performance-based compensation and career advancement for drivers
- Enriches drivers' lives by letting them stay connected with family and friends, providing access to infotainment, and enabling them to manage their day-to-day affairs while on the road
- Reduces the stress of drivers' jobs by automating paperwork and monitoring truck performance and maintenance scheduling

A trimodal telematics platform addresses both the operational and human aspects of the trucking industry. It empowers drivers and enriches their work environment, resulting in greater job satisfaction, and hence improvement in driver hiring and retention - the biggest challenge currently faced by the trucking industry.

CONTACT US

Palo Alto

New York

San Antonio

Toronto

Buenos Aires

Sao Paulo

London

Oxford

Frankfurt

Paris

Israel

Beijing

Chennai

Kuala Lumpur

Mumbai

Shanghai

Singapore

Sydney

Tokyo

Silicon Valley
2400 Geng Road, Suite 201
Palo Alto, CA 94303
Tel 650.475.4500
Fax 650.475.1570

San Antonio
7550 West Interstate 10, Suite 400,
San Antonio, Texas 78229-5616
Tel 210.348.1000
Fax 210.348.1003

London
4, Grosvenor Gardens,
London SW1W 0DH, UK
Tel 44(0)20 7730 3438
Fax 44(0)20 7730 3343

877.GoFrost
myfrost@frost.com
<http://www.frost.com>

ABOUT FROST & SULLIVAN

Frost & Sullivan, a global growth consulting company, has been partnering with clients to support the development of innovative strategies for more than 40 years. The company's industry expertise integrates growth consulting, growth partnership services and corporate management training to identify and develop opportunities. Frost & Sullivan serves an extensive clientele that includes Global 1000 companies, emerging companies, and the investment community, by providing comprehensive industry coverage that reflects a unique global perspective and combines ongoing analysis of markets, technologies, econometrics, and demographics. For more information, visit <http://www.frost.com>.