station bypass programs limit congestion into and out of the facilities. They are dangerous areas and DSRC has helped. It has also helped in reducing stops and starts, which benefits the environment.

3:15-4:00 Vendor input & discussion
Rick Weiland, Facilitator

Dick Schnacke, Intermec

Nobody cares more than the vendors about providing services the customers want. Everyone in the ITS community is engaged in the "ITS communications land grab," which includes various competing technologies vying for real estate to implement a multitude of applications – DSRC can fulfill these needs. The vendors also care very much about whether applications become real before they begin building products. He further mentioned that from their perspective it is easier to modify a 915MHz product than to build new. The vendors are facing crucial issues today and it's the toughest time to be in the business – there are too many opportunities all costing money.

He stressed the need to accommodate customers in the migration of systems and of the need to move gracefully. In addressing the potential safety applications, the vendors have concerns over liability issues.

Cost rules everything.

There is no reason to move from 915MHz to 5.9GHz to provide the same services that are being provided today. There are no unworkable problems at 915MHz. It works, is inexpensive, and is moving into other markets.

If it is felt there is a need for more bandwidth for more applications, protection for safety applications (e.g., primary status), and a fresh start towards interoperability, then we need to move to 5.9GHz. Everything else is to the favor of 915 products (e.g. physics, migration, cost). The market has been asking for more performance and 5.9GHz can give it, but not without cost.

Q. How much cost?
A. For initial rollout, a rough estimate of 2-3X current prices for low end products, 5X for high end products.

It was mentioned that some components in cell phones and transponders are shared, and that other industries can use 5.9GHz components as well, helping to defray costs. The DSRC industry has historically been cost-driven, and the 5.9GHz landscape is jumping off into uncharted territory. The NRE (non-recurring engineering) costs associated with 5.9GHz are not something they have been able to come to grips with yet, and typically can run into the millions. In their mind, value has to increase in proportion to the cost. The tag will have to service multiple applications and the user has to be given the opportunity to select more capability if he or she so chooses. The vendors would like to build products that offer "tiered" services and pricing, and have the ability to sell directly to the customer/end user. Today they don't have this option, they typically sell to an agency which selects vendors based on low-bid. There is a need to change the paradigm, even though the value benchmark has been established.

Q. What would constitute added value?
A. Traveler information, safety services, payment opportunities, nationwide interoperability

Mr. Schnacke discussed the chicken and egg dilemma – infrastructure vs tags. He noted that the end user can't and won't break this cycle, it must be solved institutionally.

Q. Can DSRC compete with stationary technologies?
A. Yes, if people want high-speed applications it's a natural to use them in stationary systems. High speed and guaranteed access works well with DSRC.

He noted that U.S. DOT can help by "proving the market," by seeding the infrastructure to break the chicken and egg dilemma, and by funding standards activities. ITS America can also help to help to prove the market and to cheerlead for interoperable standards.

Flexibility in products and services will be enhanced by a minimalist approach with FCC service rules. To support this minimalist approach, U.S. DOT should remain on the sidelines, since their involvement will challenge the minimalist approach.

Mr. Schnacke proposed the creation of a DSRC Industry Consortium – to develop and promote standards, gain industry commitment, address issues of mutual concern, and leverage resources in testing and analysis.

4:00-4:30 FCC Service Rules

Bob Kelly, Squire, Sanders & Dempsey
The FCC is expecting a Petition from ITS America detailing the proposed service rules in the new 5.9GHz band. This is a new approach for the FCC; which heretofore has used a Second Notice of Proposed Rulemaking. The October 21, 1999 Report & Order from the FCC clearly states in Paragraph 1 that standards development are being addressed by U.S. DOT. This stressed the DOT role vis-à-vis the standards input to the FCC. The DSRC definition in the R&O comes directly from the ITS National Program Plan. Petitions for Reconsideration (i.e., Appeals to the FCC R&O) close on December 27, 1999.

Day 2

Morning Issue Led Discussion
Rick Weiland, Facilitator

Rick Weiland outlined the process for the remainder of the workshop, and invited the attendees to ask any questions that were left over from yesterday's discussion.

Warren Havens, President of Telesaurus LLC discussed issues associated with multi-lateration and non multi-lateration systems in the 900MHz band, and proposed the possibility for creating a

teaming arrangement in moving to the 5.9GHz band, to build off of the strengths offered by each.

General questions/issues: What was the purpose for granting the 5.9GHz spectrum – to promote and develop safety-related services? What happens to the services rules if some of these applications don't come to fruition? Will the FCC institute restrictions in the future that would hamper incumbents in the band? If private investment is going into infotainment applications, will safety be overshadowed? Will the "free" frequencies be gobbled up quickly and if so, what are the rules for deciding which applications can use those allocations and what happens to those who "lose out"?

Bob Kelly said that it is very unlikely the FCC will retract the allocation and not to be concerned with this. Some of the questions/issues can't be addressed yet because the service rules are not in place. It is well known that there will be some commercial use of the band, which will in effect allow the cost to come down so safety related services will come down in cost. The ITS community needs to play a great role in helping create the service and licensing rules (e.g., auction vs. geographic area, site license, band managers, etc.). There are many ways to license the band – we need to provide advice to the FCC in this regard.

There is an experience to possibly draw upon for this – the 24.1GHz band. Radar detector manufacturers and receiver owners came together and developed a consortium to deal with the issue of broadcasting safety messages. The FCC R&O allowed the 24.1GHz band to be used for this purpose. The consortium in turn developed standards and protocols for these safety-related applications. It was noted that the experience can be drawn from. But that the 24.1GHz band may not serve the broad ITS interests in providing the applications and services that 5.9GHz has to offer.

It was noted that the FCC will likely assign services in three areas - public safety, private, and commercial. Should this group make a recommendation inclusive of all three and on the potential in each area? From a legal standpoint, the service can never be truly commercial mobile, it has to be interconnected with a public switched network. There are private carrier services in place to provide service – but they are not interconnected. This in reality leaves two choices – public safety or private carrier. If the decision is to go private, the band will more than likely be auctioned. Public safety services are excluded from having to go to auctions, the issue is how to license the band if commercial and public interests are both in competition. Should the position be to allow public safety to come in and get what they need, but still provide for a profit-driven entity to come in to develop (e.g., R&D, etc.).

With respect to communication zones for application areas, most applications in the commercial arena will be deployed on private property and have small zones. In contrast, public applications will more than likely have larger zones. Can the licenses be divided such to accommodate these needs?

Public infrastructure and roadside beacons – how to operate and maintain? Shared resources? It would be useful for U.S. DOT to provide guidance to the State DOTs on ownership and usage arrangements.

Vendor concerns: Non-recurring engineer costs (NRE), risk, and market. NRE – can't be helped by the U.S. DOT; Risk – validation testing of standard can help; Market – any area of responsibility where U.S. DOT could exercise control would assist in proving the market (e.g., roadside warnings, traveler information). The vendors still questions whether safety services have real value and if they can be made to work, but they can be proven or disproven in pilot programs

ABS was mentioned as an example that people are paying for – safety sells. How many people would pay for air bags and seat belts if they weren't mandatory? The automakers are convinced that safety sells and feel there has been a change in driver attitudes. Safety also validates sales. Safety features with incentives will accelerate the market.

To facilitate the remainder of the workshop discussion, Dick Schnacke's slide presentation (see appendix A) from the previous day was utilized as a launching point. The following information supplements the slides included in appendix A. At this point in the workshop proceedings the primary data collection was accomplished through slide projection and in some cases items below may be redundant or missing. The remarks below, provided here are data, are the collected remarks of the various individual participants, and do not necessarily represent consensus or a general conclusion.

Issue: What is the availability of applications?

Now and within one year – ETC, weigh station bypass, borders, parking, taxi and limo control, diagnostic and engine data, fleet management (CVO/rail/transit), priority control for emergency vehicles and transit, traffic probes, access/yard control, fuel payment.

3 year time frame – VIN reading, vehicle-vehicle and vehicle-infrastructure through radar systems, cooperative ACC, dynamic information off databuses to following vehicle, traveler information systems, cargo/container ID, security seals, baggage monitoring, waste management systems, vehicle emissions, safety warning systems

Issue: What are the leading technology candidates for implementation?

2.45GHz proprietary and non-proprietary in ISM band, DSRC at 5.9GHz, Bluetooth, 802.11a, 802.11b, Cellular, WAP, 3G (3rd generation cell phone systems), Mobil Speedpass, SWS (Safety Warning Systems at 24.1GHz), 915 MHz, 5.8GHz – CEN, Infrared

Are any applications solely within the purview of DSRC?

High-speed mobile applications, collision avoidance, intersection collision avoidance, vehicle-vehicle collision warning, roadside-vehicle collision warning, IDB and CVO on-board vehicle transfer

Issue: What are the obstacles and challenges at 5.9GHz?

Business – affordability, market validation, liability, chicken and egg dilemma, international standards and markets.

Technology – Lack of a standard, ensuring interoperability, providing products at affordable prices, rapid pace of change in wireless community, migration, legacy system inertia.

Institutional – same as today, more complex because of more institutions, sunk costs.

Regulatory – band use rules, licensing.

Issue: What is the appropriate role for U.S. DOT?

Proving the market, DOT could mandate a 5.9GHz product, endorse and support the application process with the FCC, transfer of current other technology into the DSRC path (e.g. log data), endorse what is good and legitimate. [This needs some smoothing out]

If the DSRC path is through the vehicle, U.S. DOT should be working more with the automobile industry. From the OEM perspective, they need to have a standard and need to sell on huge volumes. The device needs to help sell the car for users to receive benefit. If the beacon systems are built on the highway, the OEMs will incorporate the transceiver products to communicate. There needs to be a large number of equipped vehicles on the roadways to realize significant benefits. The U.S. DOT should consider mandating tags in all vehicles.

Can DOT help build the infrastructure network? No. The state, local, and municipal governments own the roads, and U.S. DOT doesn't tell them what to do.

Can U.S. DOT mandate the services and performance parameters by a certain date, but not specify the frequency or technology? You need to have a common frequency to have interoperability.

Consider issuing mandates for both vehicle equipment and infrastructure.

Consider alternative funding sources and incentives to accelerate deployment of the infrastructure (e.g., making trust funds available, 100% federal money). Merely making the infrastructure an allowable expense under different budget categories won't get the job done.

The DSRC infrastructure is not there; however, other wireless networks are there now or are being built, which is a problem for the DSRC community. As an example, Bluetooth products are being developed ahead of the standards work. It is the application that provides the loyalty and differentiation to the customer – not the technology.

Issue: What is the appropriate role for ITS America?

Create business consortiums for developing and promoting specific applications. Given the broad and diverse range of interests, help to provide structure and organization to the continued deliberations on this issue. Provide assistance to the FCC in helping to write the NPRM – by getting industry consensus and providing input. Provide access and the opportunity of engagement to the full range of interested parties. Provide outreach and awareness to the community.

Issue: What should be the interaction between U.S. DOT and FCC?
A minimalist approach. Just to comment on the FCC rulemakings to ensure public safety applications are provided for in the service rules.

Next steps

- DSRC Industry Consortium to develop a draft standard to be crisply defined as an enabling device.
- Consortium to drive standard with safety applications built in that will address both the business case and the technical needs.
- The standard will be developed to provide tiered services. so customers are able to pick and choose their technology.
- U.S. DOT can support the effort in determining what will be the "basic" level of service.
- U.S. DOT and the consortium could meet to arrive at mutually agreeable set of specifications to advocate and accelerate.
- Need to more formally engage the OEMs.

UPDATED 5.9 GHz DSRC APPLICATION REQUIREMENTS*

DERIVED REQUIREMENTS

- Data Rate - 1 to 10 Mbps (discussing 0.5 Mbps min. and 12 Mbps max.)
- Max Speed - 200 km/h
- Max Range - 1000 m
- 1000 m range must support 1 Mbps
- Enable Dedicated Service
- Must be Able to Negotiate an Allocation of Spatial Resources
- Implement a tier of device types to scale device capability from 1 to 12 Mbps or 6 to 1000 m range or both to match application requirements to device complexity

A

* - Awaiting Ratification in the February meeting

DSRC APPLICATION REQUIREMENTS DISTRIBUTION

CORE APPLICATIONS (< 15 m RANGE) (FOR ALL VEHICLES)

- *ACCESS CONTROL*
- PROBE DATA COLLECTION
- TRAFFIC INFORMATION ()
- TOLL COLLECTION
- *PARKING LOT PAYMENT*
- GAS PAYMENT #
- DRIVE-THRU PAYMENT#
- IDB DATA TRANSFER []
  - DIAGNOSTIC DATA []
  - REPAIR-SERVICE RECORD []
  - VEHICLE COMPUTER PROGRAM UPDATES []
  - MAP and MUSIC DATA UPDATES []
- RENTAL CAR PROCESSING #

CORE APPLICATIONS (100- 325 m RANGE) (FOR ALL VEHICLES)

- IN-VEHICLE SIGNING ()
  - WORK ZONE WARNING ()
  - HIGHWAY/RAIL INTERSECTION WARNING ()
  - ROAD CONDITION WARNING ()
- INTERSECTION COLLISION AVOIDANCE !

APPLICATIONS FOR HEAVY TRUCKS, BUSES, TRAINS, EV (< 15 - 325 m RANGE)

- ROLLOVER WARNING
- LOW BRIDGE WARNING
- MAINLINE SCREENING
- BORDER CLEARANCE
- ON-BOARD SAFETY DATA TRANSFER
- UNIQUE CVO FLEET MANAGEMENT
- *DRIVER'S DAILY LOG*
- *VEHICLE SAFETY INSPECTION*
- TRANSIT VEHICLE DATA TRANSFER (gate)
- TRANSIT VEHICLE DATA TRANSFER (yard)
- *TRANSIT VEHICLE REFUELING*
- *LOCOMOTIVE FUEL MONITORING*
- TRANSIT VEHICLE SIGNAL PRIORITY !

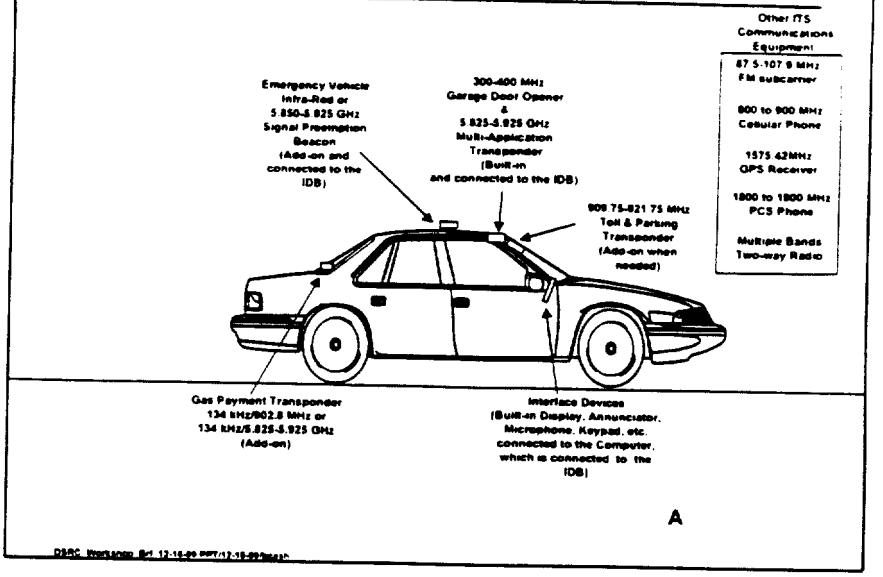
APPLICATIONS FOR HEAVY TRUCKS, BUSES, TRAINS, EV (1000 m RANGE)

- LOCOMOTIVE DATA TRANSFER*
- EMERGENCY VEHICLE SIGNAL PREEMPTION !

REGULAR@ - Very Low Cost, Low Speed, Less than 15m (50 ft) range, Low Data Rate and Very High Location Accuracy
ITALIC - Low Cost, Low speed, Less than 15 m (50 ft) Range and 500 kbps
BOLD - Low Cost, High Speed, Less Than 30m (100 ft) Range, and 500 kbps
BLUE[] - Low Cost, Low speed, less than 15 m (50 ft) Range, and 1 Mbps or Greater
YELLOW () - Low Cost, High Speed, 325 m (1100 ft) Range or Greater, and .01 to 1 Mbps
MAGENTA - Moderate Cost, Low Speed, 15 to 325 m (50 to 1100 ft) Range, and 1 to 10 Mbps and Greater
MAGENTA* - Moderate Cost, Low Speed, 1000 m (3000 ft) Range, and 1 to 10 Mbps and Greater
RED !- Moderate Cost, High Speed, 300 to 1000 m (1000 to 3000 ft) Range, and 1 Mbps

A

Common Vehicle On-Board Equipment



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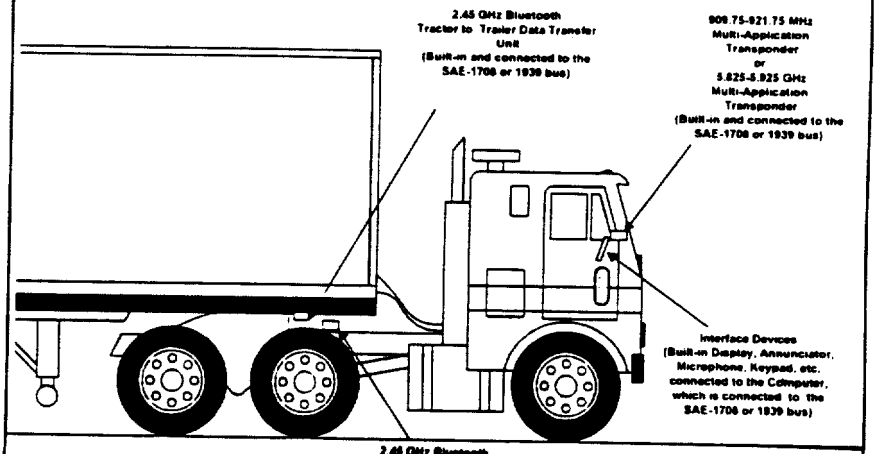
CVO On-Board Equipment



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5.9 GHz DSRC REQUIREMENTS BRIEFING

Broady Cash, ARINC

Prepared for 5.9 GHz DSRC Stakeholders Workshop for ITS Applications on 12/16/99

DSRC TARGETED APPLICATIONS by RANGE and VEHICLE CATEGORIES

CORE APPLICATIONS (< 15 m RANGE) (FOR ALL VEHICLES)

- ACCESS CONTROL*
- PROBE DATA COLLECTION*
- TRAFFIC INFORMATION*
- *TOLL COLLECTION*
- PARKING LOT PAYMENT*
- GAS PAYMENT #
- DRIVE-THRU PAYMENT #
- IDB DATA TRANSFER
  - DIAGNOSTIC DATA
  - REPAIR-SERVICE RECORD
  - VEHICLE COMPUTER PROGRAM UPDATES
  - MAP and MUSIC DATA UPDATES
- RENTAL CAR PROCESSING

CORE APPLICATIONS (100- 325 m RANGE) (FOR ALL VEHICLES)

- IN-VEHICLE SIGNING
  - WORK ZONE WARNING
  - HIGHWAY/RAIL INTERSECTION WARNING
  - ROAD CONDITION WARNING
- INTERSECTION COLLISION AVOIDANCE

APPLICATIONS FOR HEAVY TRUCKS, BUSES, TRAINS, EV (< 15 - 325 m RANGE)

- ROLLOVER WARNING
- LOW BRIDGE WARNING
- *MAINLINE SCREENING*
- *BORDER CLEARANCE*
- *ON-BOARD SAFETY DATA TRANSFER*
- UNIQUE CVO FLEET MANAGEMENT
- *DRIVER'S DAILY LOG*
- *VEHICLE SAFETY INSPECTION*
- TRANSIT VEHICLE DATA TRANSFER (gate)
- TRANSIT VEHICLE DATA TRANSFER (yard)
- TRANSIT VEHICLE REFUELING
- LOCOMOTIVE FUEL MONITORING
- TRANSIT VEHICLE SIGNAL PRIORITY

APPLICATIONS FOR HEAVY TRUCKS, BUSES, TRAINS, EV (1000 m RANGE)

- EMERGENCY VEHICLE SIGNAL PREEMPTION
- LOCOMOTIVE DATA TRANSFER

CVO - Commercial Vehicle Operations
EV - Emergency Vehicles
IDB - ITS Data Bus
THRU - Through
ITALIC - Primarily 915 MHz Applications

REGULAR # - Currently 134 kHz DL + 903 MHz UL
BOLD - Primarily 5.9 GHz Applications
BOLD* - Both 915 MHz and 5.9 GHz Applications
UNDERLINE - One-Way Communication
TEXT WITHOUT to the OBE

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UPDATED 5.9 GHz DSRC APPLICATION REQUIREMENTS*

- Interoperable across North America and all devices
- All Weather Operation
- Two-way (point to point) Communication
- One-way (roadside to vehicle) Communication
- Extremely low latency
- Secure (only authorized users can read transmitted data)
- Reliable (High MTBF and communications performance as indicated in the specific requirements)
- Maintainable (Low MTTR)
- Easy to use
- Scalable (grow from one to multiple lanes of service)
- Widely Installable (few incompatible sites)
- Multimodal (road and rail)
- Non-Interference with 915 MHz systems
- Non-Interference to incumbent (primary allocation) 5.9 GHz systems
- Minimize interference with secondary allocation 5.9 GHz systems
- Tolerant of inadvertent interference from incumbent 5.9 GHz systems
- Market acceptable cost

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* - Awaiting Ratification in the February meeting

UPDATED 5.9 GHz DSRC APPLICATION REQUIREMENTS*

- Transaction Size -- 500 Bits to 100 Mbytes or more
- Traffic Speed -- 0 to 200 km/h (0 to 120 mph)
- Traffic Density -- 3000 v/h/l - (1 to 8 lanes)
- Minimum Beacon Separation -- 3 m (10 ft)
- Minimum Application Separation -- 15 m (50 ft)
- Broadcast Reception Range for all On-board Equipment -- 325 m (1100 ft)
- Two-way Range for all devices -- 15 m (50 ft)
- Two-way Range for some devices -- 30 m (100 ft)
- Two-way Range for some devices -- 300 m (1000 ft)
- Two-way Range for some devices -- 1000 m (3000 ft)
- Communication zones -- 2 to 1000 m (7 to 3000 ft)
- Transaction Success Rate -- 99.0 to 99.995 %
- Enable Licensed Operation
- Implement Vehicle Location
- Implement Lane Discrimination
- Implement a High Density of Applications
- Support Multiple Overlapping Communication Zones
- Meet FCC, Industry Canada, and Mexican Government Regulations
- Enable Non-interference Between Neighboring DSRC Applications
- Enable An Entry Level - low cost - device
- Does Not Require Usage Fees

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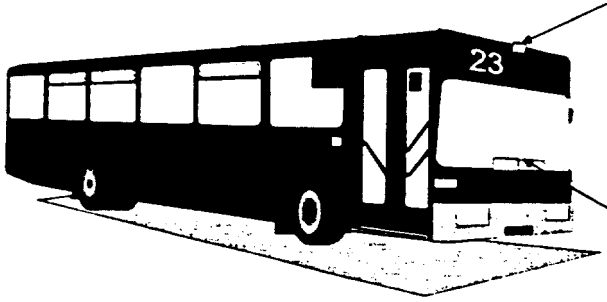
* - Awaiting Ratification in the February meeting

TRANSIT
On-Board Equipment



5.825-5.925 GHz
Multi-Application
Transponder
(Built-in and connected to the
SAE-1708, 1939, or EIA-709
LonWorks interface bus)

Interface Devices
(Built-in Display, Annunciator,
Microphone, Keypad, etc.
connected to the Computer,
which is connected to the
SAE-1708, 1939, or EIA-709
LonWorks interface bus)

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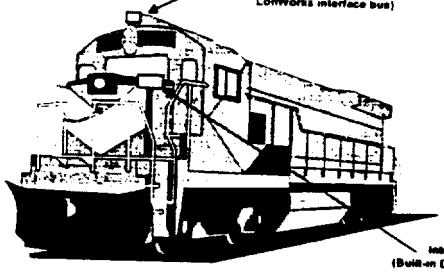
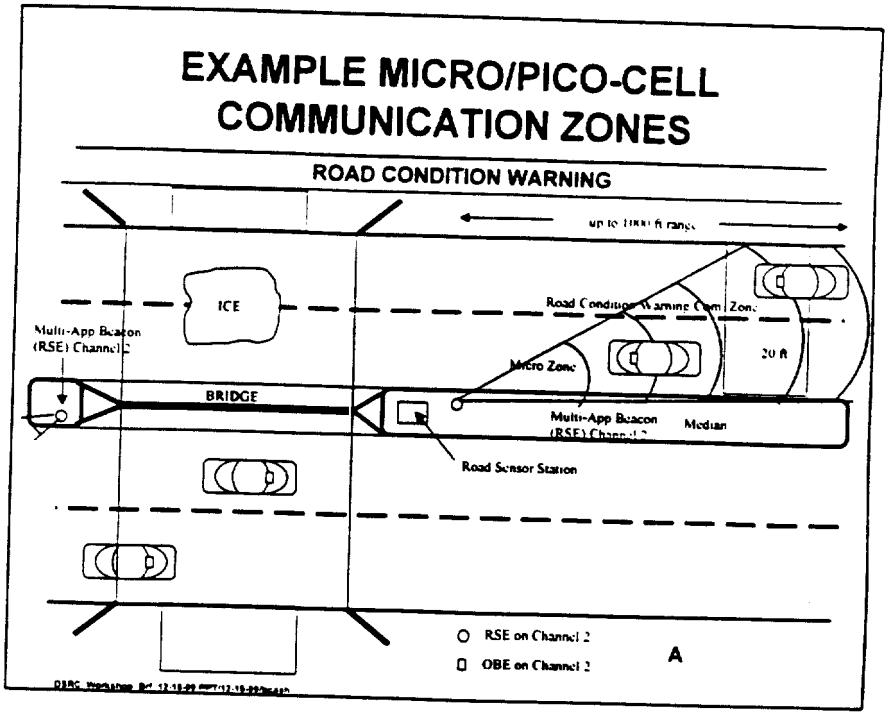
LOCOMOTIVE
On-Board Equipment

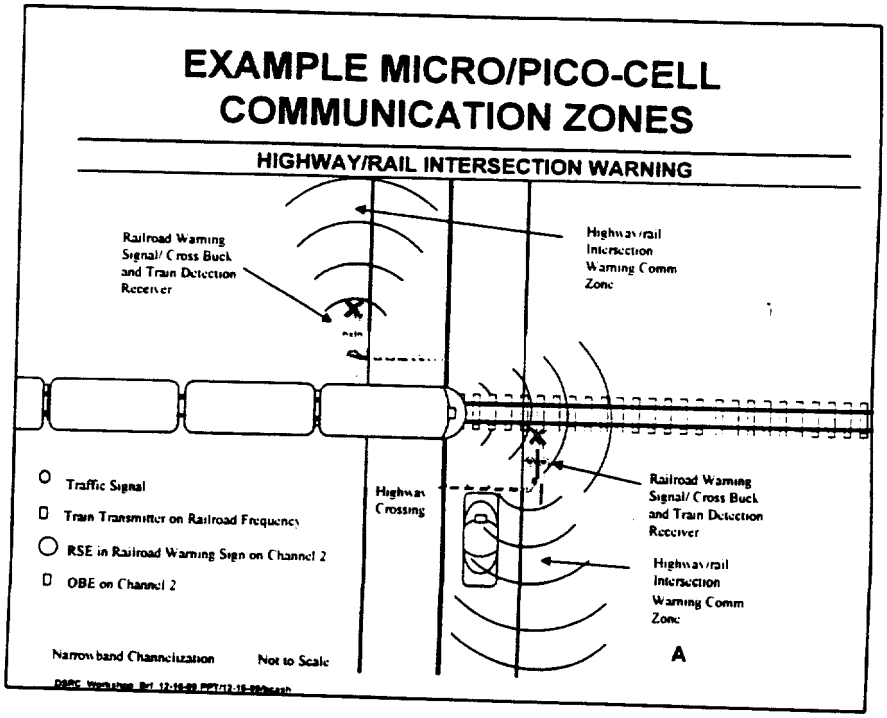


5825-5.925 GHz
Multi-Application
Transponder
(Built-in and connected to an
SAE-1708, 1939, or EIA-709
LonWorks interface bus)

Interface Devices
(Built-in Display, Annunciator,
Microphone, Keypad, etc.
connected to the Computer,
which is connected to an
SAE-1708, 1939, or EIA-709
LonWorks interface bus)

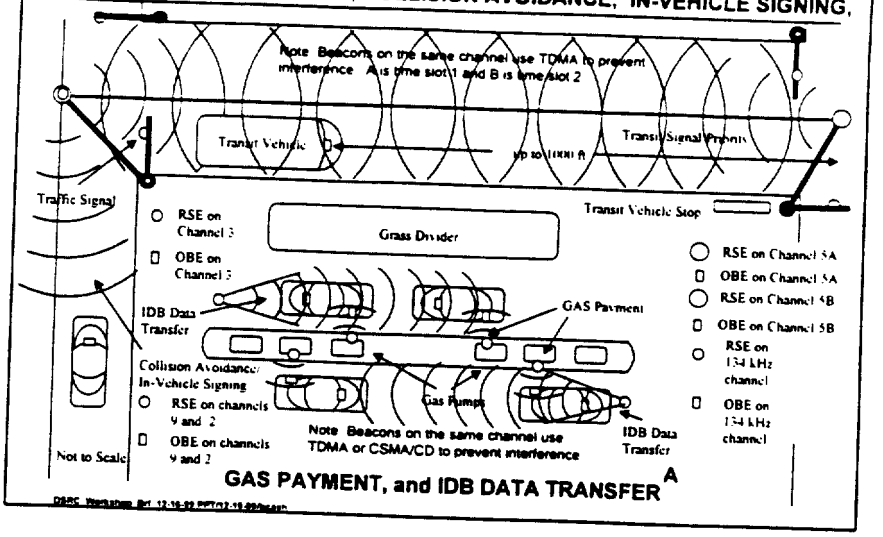
A


EXAMPLE MICRO/PICO-CELL COMMUNICATION ZONES
ROAD CONDITION WARNING
ICE
Multi-App Beacon (RSE) Channel 2
BRIDGE
Micro Zone
20 ft
Multi-App Beacon
Median
Road Sensor Station
RSE on Channel 2
OBE on Channel 2
A


EXAMPLE MICRO/PICO-CELL COMMUNICATION ZONES
HIGHWAY/RAIL INTERSECTION WARNING
Railroad Warning Signal/ Cross Buck and Train Detection Receiver
Highway/rail Intersection Warning Comm Zone
Traffic Signal
Train Transmitter on Railroad Frequency
RSE in Railroad Warning Sign on Channel 2
OBE on Channel 2
Highway Crossing
Railroad Warning Signal/ Cross Buck and Train Detection Receiver
Highway/rail Intersection Warning Comm Zone
Narrowband Channelization
Not to Scale
A

DSRC APPLICATION REQUIREMENTS DENSITY EXAMPLE

TRANSIT SIGNAL PRIORITY, COLLISION AVOIDANCE, IN-VEHICLE SIGNING,



GAS PAYMENT, and IDB DATA TRANSFER A

Communication Technique Comparison

	MOBIL Speedpass	SWS	915 MHz DSRC (FHWS)	5.8 GHz DSRC (CEN)
Data rate	Est. (<< 250 kbps)*	Est. (<< 250 kbps)*	500 kbps DL/ 500 kbps UL	500 kbps DL/ 250 kbps UL
Service	Dedicated	Dedicated	Dedicated	Dedicated
Channels	1*	1*	1*	2*
Latency	N/A	N/A	.002 sec	.002 sec
Max Range	10 m	> 1000 m	< 100 m	10 m
Speed	N/A	> 200 km/h	> 200 km/h	> 200 km/h
Protection	Licensed	Licensed	Licensed	Licensed
Charge	No-charge	No-charge	No-charge	No-charge

GREEN - Large Advantage RED* - Large Disadvantage for multi-application use

A

Communication Technique Comparison

	Bluetooth	5.9 GHz DSRC (Narrowband)	W-LAN	UNII	3G
Data rate	1 Mbps	1- 4 Mbps/ 8 - 12 Mbps	1- 11 Mbps	6 - 54 Mbps	0.144 - 2 Mbps
Service	Shared	Dedicated	Shared	Shared	Shared
Channels	1 (79 FH)	9 (pair)	3 (units)	12 (units)	N/A
Latency	2- 5 sec*	.002 sec	.002 sec	.002 sec	1- 60 sec*
Max Range	< 10 m^	> 2000 m	> 1000 m	> 2000 m	30 km
Speed	>110 km/h	> 200 km/h	>110 km/h	>110 km/h	< 250 km/h
Protection	Un-Licensed	Licensed	Un-Licensed	Un-Licensed	Licensed
Charge	No-charge	No-charge	No-charge	No-charge	Fee/unit of use*

^ - In-vehicle to roadside range could be less because of non optimal antenna placement, windshield loss, and reflections
GREEN - Large Advantage RED* - Large Disadvantage Bluetooth uses FHSS W-LAN uses DSSS UNII uses OFDM
MAGENTA - Advantage over closest competitor

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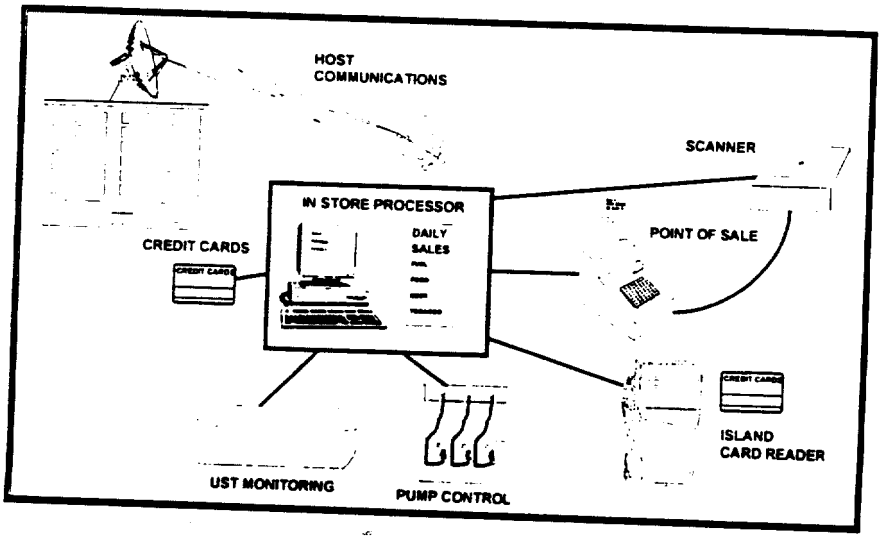
5.9 GHz Stakeholders Workshop

December 16, 1999

Washington, D.C.

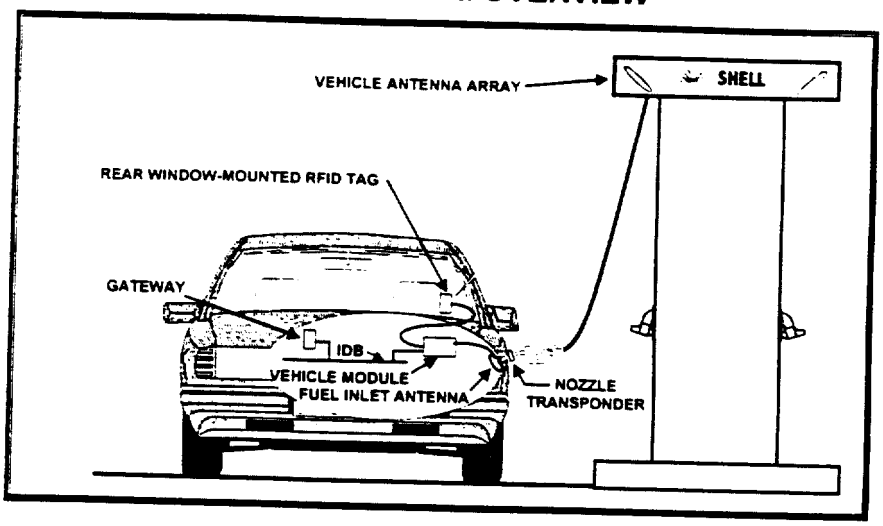
Ben Bates, Equiva

RETAIL BUSINESS OPERATIONS



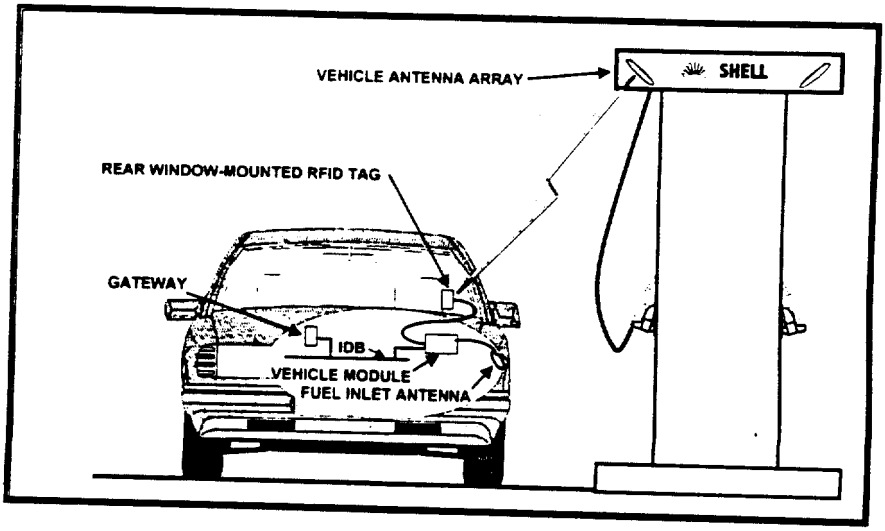
SHELL OIL RFID FUELING SOLUTION

SYSTEM OVERVIEW



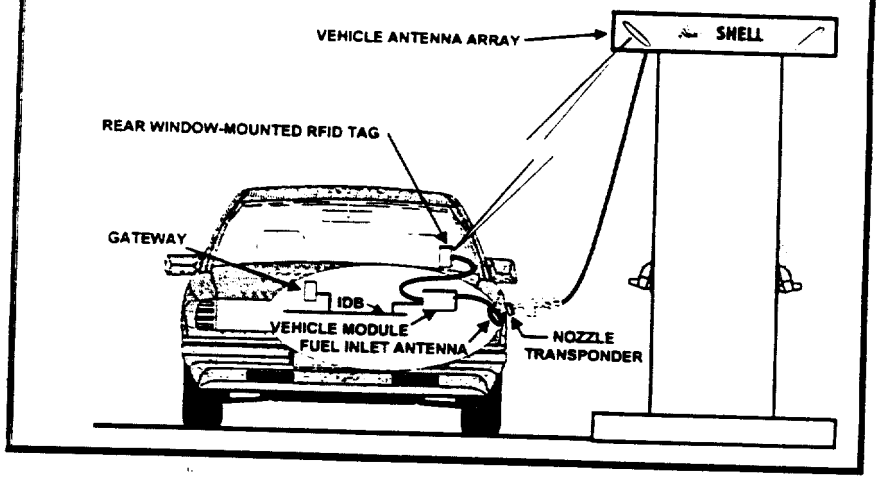
SHELL OIL RFID FUELING SOLUTION

VEHICLE IDENTIFICATION



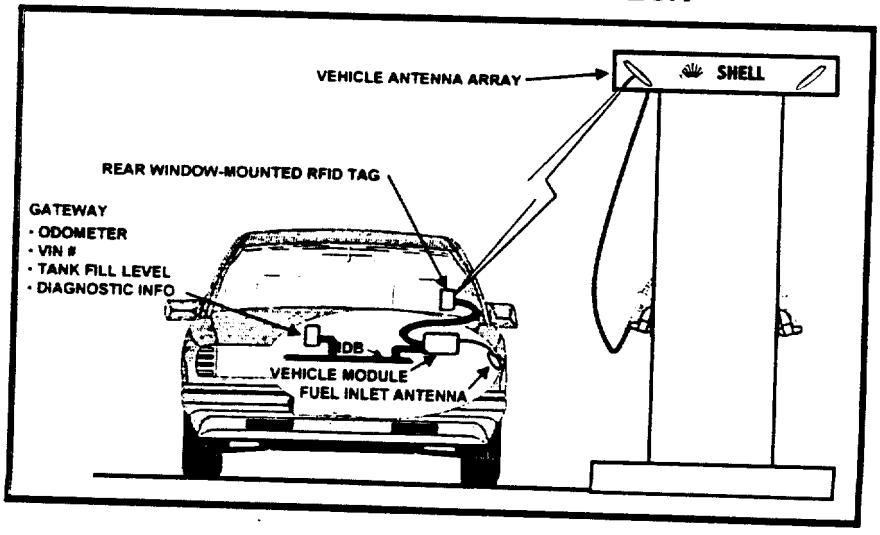
SHELL OIL RFID FUELING SOLUTION

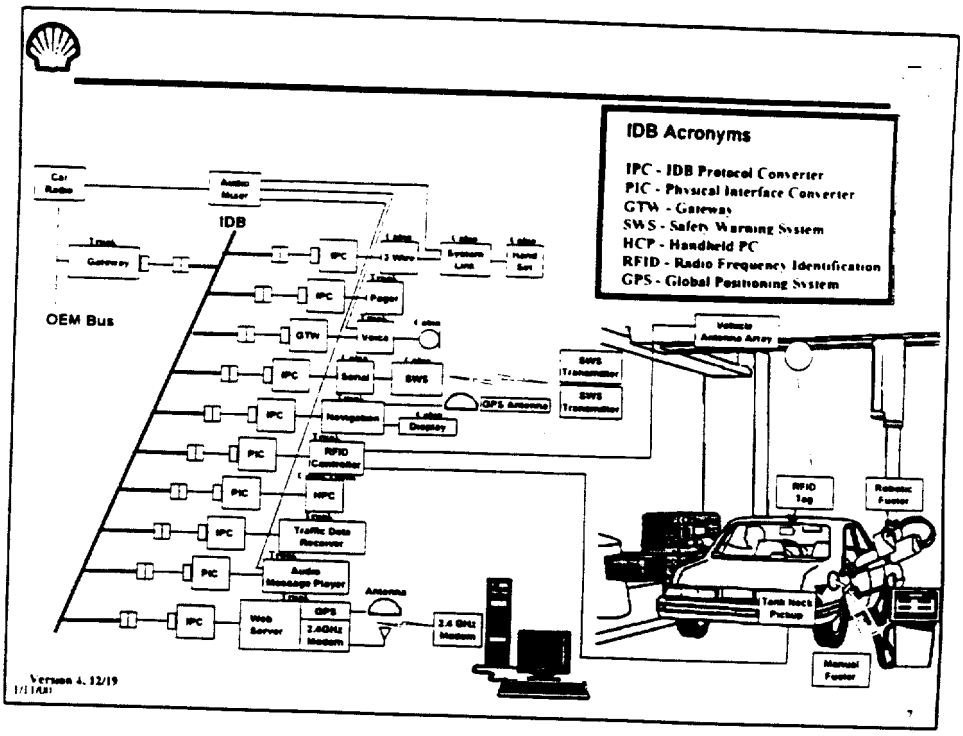
FUEL MANAGEMENT



SHELL OIL RFID FUELING SOLUTION

VEHICLE SYSTEM CHECK





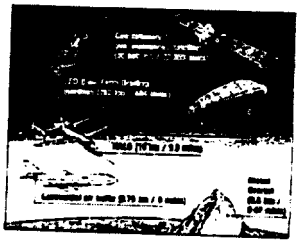
SmartPump

- Fully Automated Fueling Capability
- RFID Device is used to identify vehicle and location of fuel inlet
- Vehicle diagnostic link demonstrated at CES 1999

Spheres of Connectivity

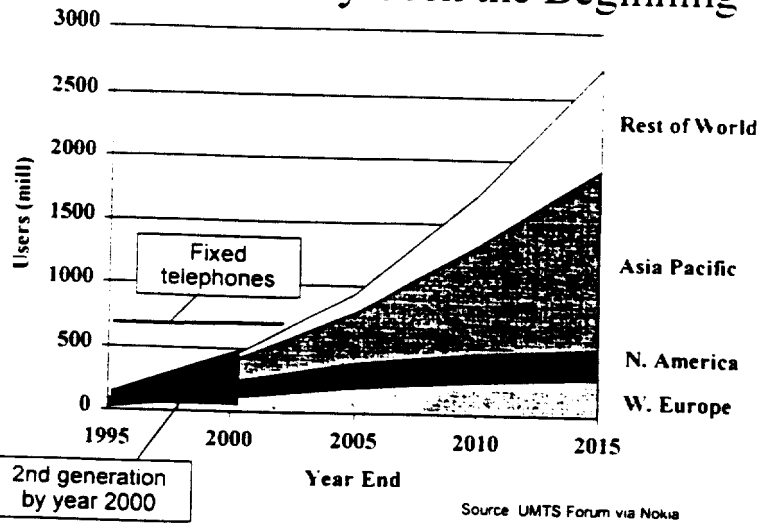
- Cable Replacement (Bluetooth)
- Short Distance Wireless (DSRC, 802.11, etc.)
- Wireless Personal Area Networks (WAP)
- Wireless LANs
- Public Wireless Networks

Wireless Developments



- WAP for ecommerce
- HomeRF SWAP
- 802.11 LANs
- LMDS broadband MAN
- G3 Cellular - UMTS, WCDMA
- Teledesic - LEO WAN
- Wireless Digital Fountain
- Passive Picocell
- General Packet Radio Services GPRS
- BT Microsoft Alliance
- Cisco-Motorola New World framework
- IBM "Pervasive Computing"
- Sun-Cisco Wireless IP

Wireless Information Society - We Have Only Seen the Beginning



11

Competitive Technology Summary (from Bluetooth Developers Conference 6/8/99)

Category	Home-RF (1.09)	802.11	Bluetooth	IrDA (AIR)
Market	Home WLAN	WLAN	Cable	Cable
Technology	RF: 2.4 GHz FHSS	RF: 2.4 GHz FHSS. DSSS	RF: 2.4 GHz FHSS	Optical 850 nm
Power	20 dBm	20 dBm	0/20* dBm	?
Symbol rate	0.8/1.6 M	11 M	1 M	4 M/115K
Distance	50m	30m	0-10m/50m	0-3m/5m
Topology	128 devices CSMA	128 devices CSMA	8 devices Pt-to-MP	10 devices Pt-to-MP
Security	Optional	Optional WEP	Auth. Key mgmt. Encry	App Layer

* Standard Bluetooth is rated at 0dbm power. Hi-power Bluetooth at 20dbm

12

The Emergence of the New Economy

Key directions and implications

- The information technology revolution is re-defining the petroleum industry
- Industry, value chain and company boundaries are blurring and reforming: The winning business model will be driven by non-fuel revenue
- Advances in are taking place on several fronts. Shell/Texaco will need to understand among the field of advances which technologies are important (802.11+, Bluetooth, Microsoft Strategy, 3G Cellular, WAP, Mobile Computers)
- DSRC will have to move much faster to play a significant role in this arena
- Desire a ubiquitous standard for telemetry that is cheap and reliable to put the most innovative value added services

ITS America
5.9 GHz Stakeholders Workshop for ITS Applications

December 16, 1999

Rena R. Barta
Program Director

E-ZPass

- What is the E-ZPass Interagency Group?
- Current Implementation
- Current Application
- Future Applications
- IAG Expectation of Technology at 5.9 GHz

E-ZPass

E-ZPass Interagency Group

- New York State Thruway Authority
  MTA Bridges & Tunnels
  Port Authority of NY & NJ
  New Jersey Turnpike Authority
  New Jersey Highway Authority
  South Jersey Transportation Authority
  Pennsylvania Turnpike Commission
- Delaware River Port Authority
- Delaware Department of Transportation
  Maryland Transportation Authority
  New York State Bridge Authority

E-ZPass Interagency Group

- Massachusetts Turnpike Authority
- Tobin Bridge, Boston Mass.
- West Virginia Turnpike Authority
- Peace Bridge Authority

E-ZPass Operational Sites

- New York State Thruway Authority - 09/94
- MTA Bridges & Tunnels - 10/95
- Port Authority of NY & NJ - 06/97
- New York State Bridge Authority - 02/98
- South Jersey Transportation Authority - 11/98
- Delaware Department of Transportation -11/98
- Massachusetts Turnpike Authority - 11/99
- Tobin Bridge - 11/99
- New Jersey Highway Authority - 12/99

E-ZPass

Scheduled Implementations

- West Virginia Turnpike Authority - 12/17/99
- Delaware River Port Authority - 12/18/99

E-ZPass

Key Elements of a Regional System

- Compatible in-lane electronic components for vehicle tags and toll lane equipment
- Customer Service Center with reciprocity among participating toll agencies
- One Tag - One Account
- Interagency Agreements

Interagency Agreements

- Operating Agreement
- Reciprocity Agreement
- Inter-CSC File Specification
- Inter-CSC Report Specification
- Customer Service Center Guidelines

What is involved in establishing Interagency Reciprocity?

- Multiple Agencies
- Multiple Service Centers
- Multiple Service Center Providers
- File Transfers
- Money Settlement
- Reporting

Current Implementation Status

- 7 Agencies currently operating in 7 states
- 2 Agencies will implement by the end of the month
- 3 Agencies will implement in 1999
- Over 3.2 million tags issued to customers
- Over 2.5 million accounts opened
- Between 12% and 60% market penetration
- Between 10% and 40% customers shared between agencies