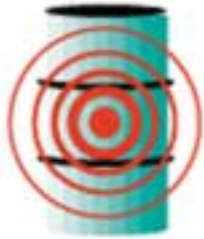




Wireless Applications For Supply Chain Assets

Real-Time Locating Systems - Vision



RTLS is leading
the **revolution**
in providing real-time
wireless applications
to locate, track and manage
inventory, assets and people
to **change** the way businesses
do business.

Agenda

- Supply Chain Visibility
- Real-Time Locating Systems
- Automotive Industry Applications
- Airline Applications
- Summary

Market Size

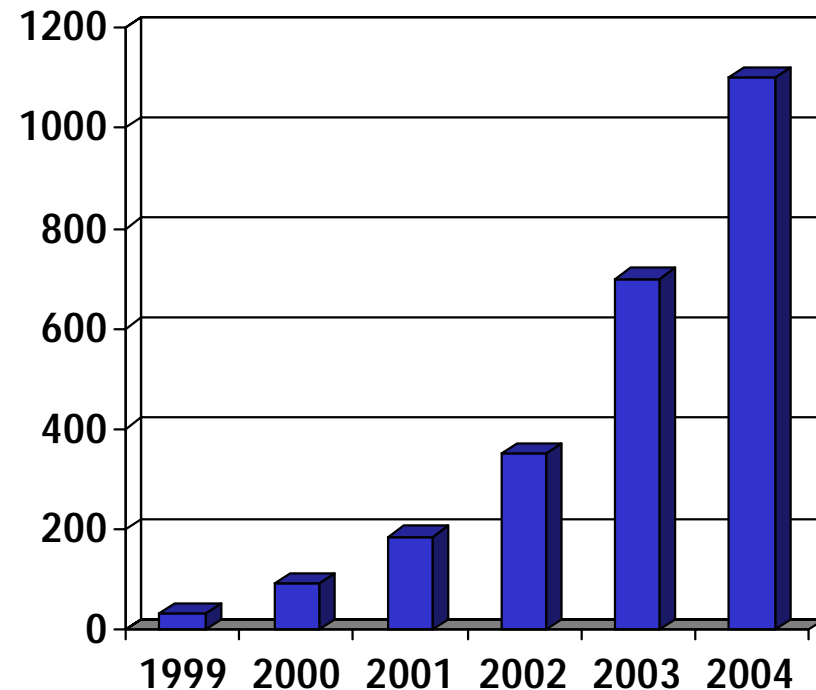
AMR Research report on Supply Chain Management (SCM)

November 2000 entitled: E-

Business Requires Supply-Chain Event Management (SCEM)''

- 88% CAGR makes it the fastest growing segment in SCM
- SCM's next frontier in supporting e-business strategies is SCEM
- SCEM is a new layer of the e-business SCM infrastructure

SCEM Market in \$M



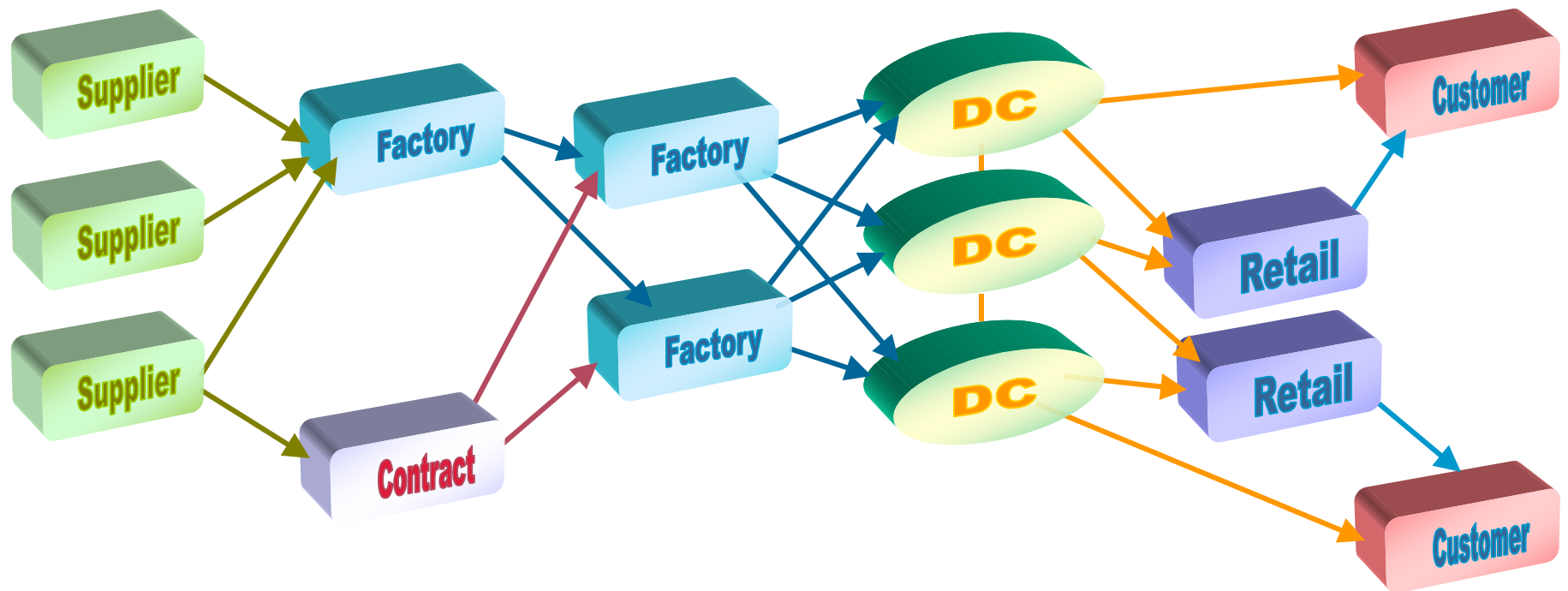
AMR Research, 2000

Wireless Applications

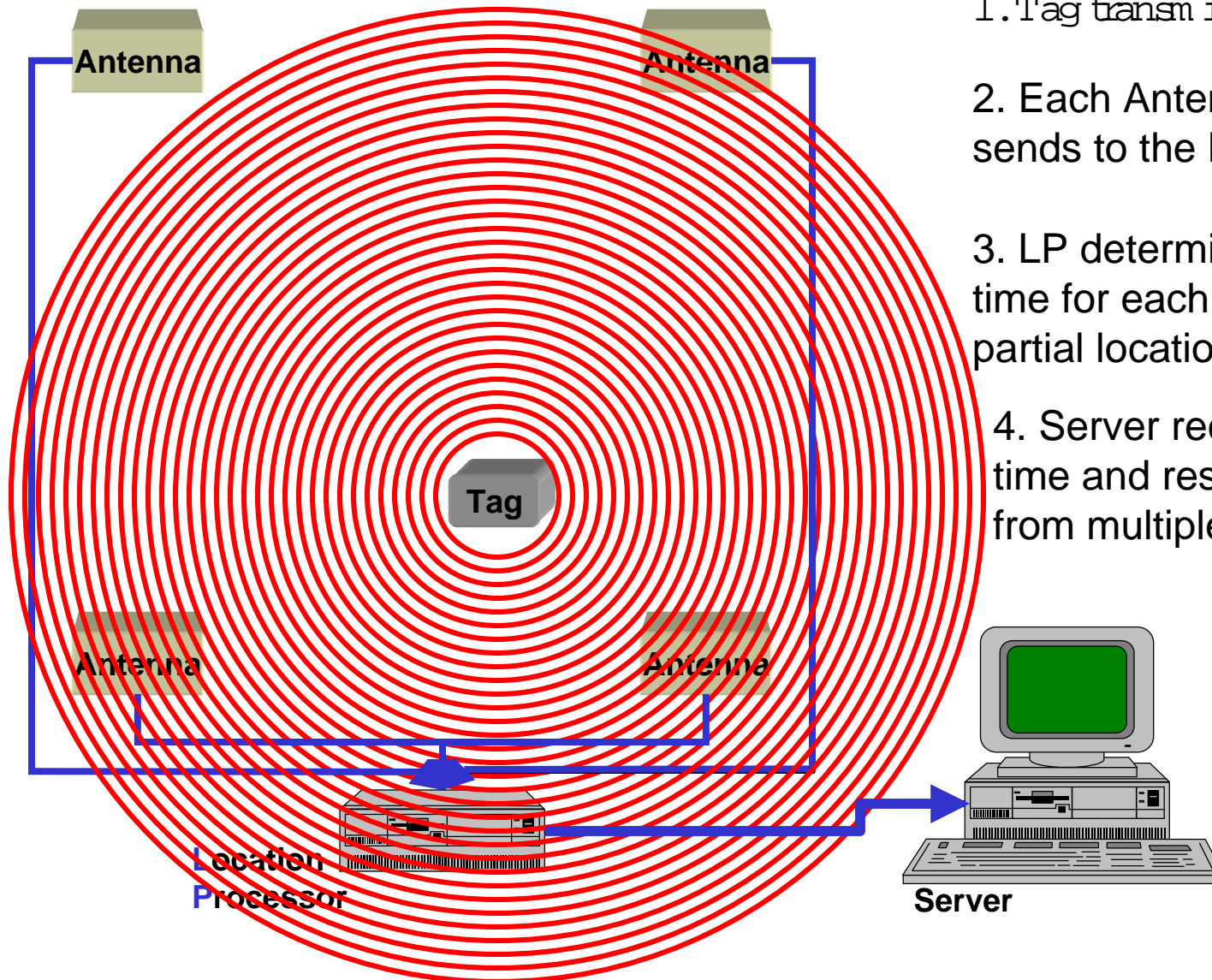
Focus: Wireless Applications **that** Connect the Assets **in the Supply Chain** with the People and Information Systems **that** Make the Decisions on How to Best Optimize the Performance **of the Supply Chain**

Assets: The Missing Link

Connecting Assets to Information Systems and the Workforce Across the Supply Chain



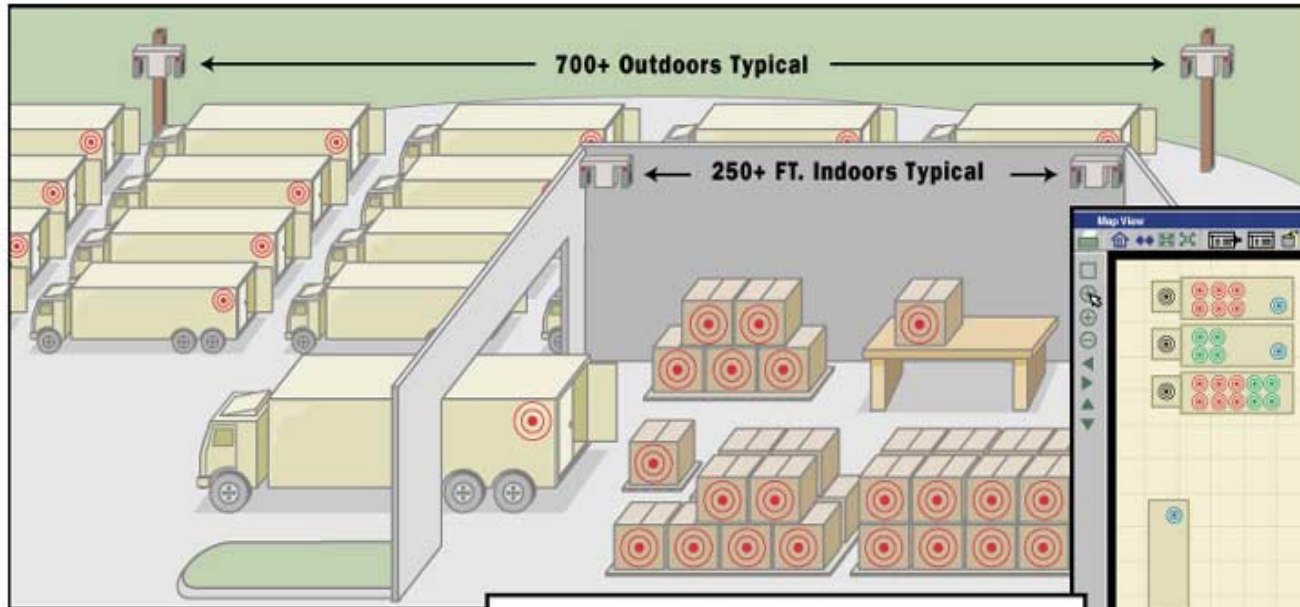
How RTLS Works



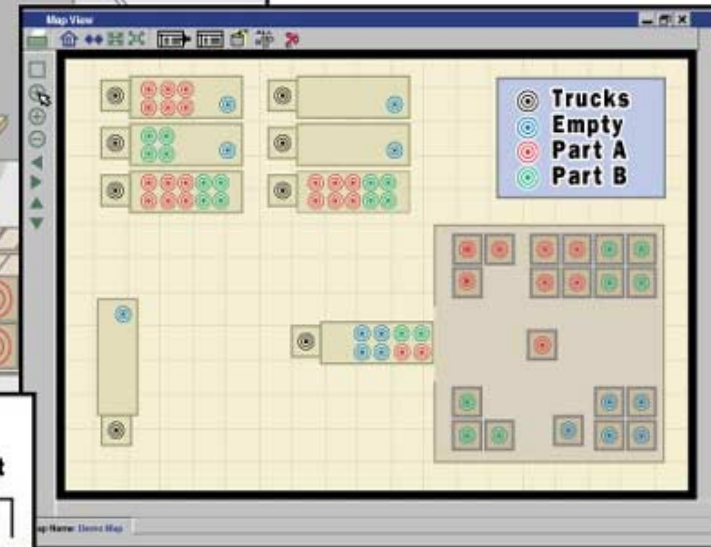
1. Tag transmits its ID
2. Each Antenna receives ID and sends to the LP
3. LP determines first arrival time for each antenna and partial location data
4. Server receives Tag ID and time and resolves location data from multiple LP's

Real Time Location Systems--RTLs

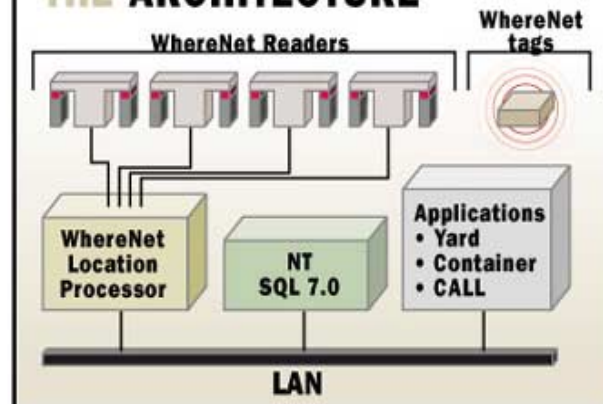
THE SITE



THE LOCATION



THE ARCHITECTURE



Solution Components

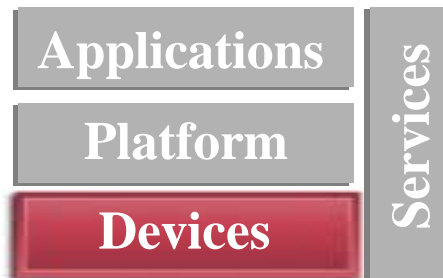
Applications

Real Time Visibility Platform

Wireless Data Devices

Services

Solution Components



Transmitters

- **Long-Read Range**
- **Long-Battery Life**
- **Short Packet Transmissions**
- **Long Packet Transmissions**
- **Turn/Off**
- **Programmable Transmissions Intervals**
- **Data Interface**

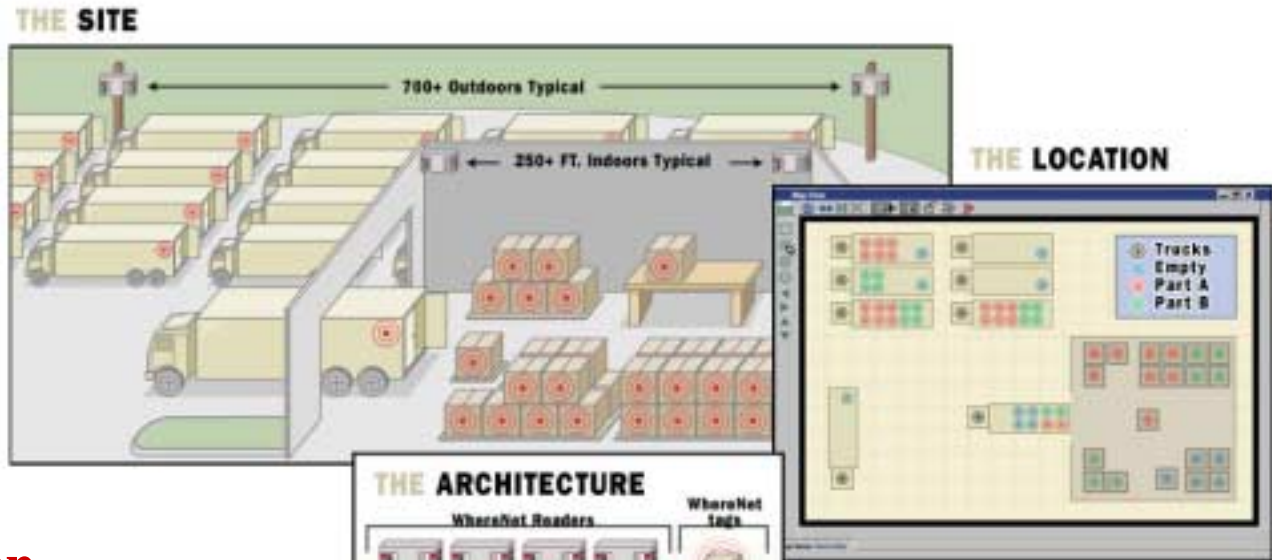
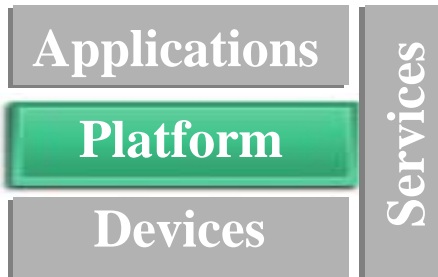


Chips Sets Available for Imbedding in:

- **Vehicles**
- **Ground Support Equipment**
- **Mobile Computers and PDA's**
- **High Value High Tech Devices**



Solution Components



Visibility Software

- **Location Application**
- **System Management**
- **System Monitoring**
- **Installation Tools**
- **Mapping Tools**
- **Database**
- **Report Builder**
- **Alert Manager**
- **API's**

Hardware Infrastructure

- **Antennas**
- **Antenna Processing Cards (DSP)**
- **Location Processors**
- **Reference Beacons**



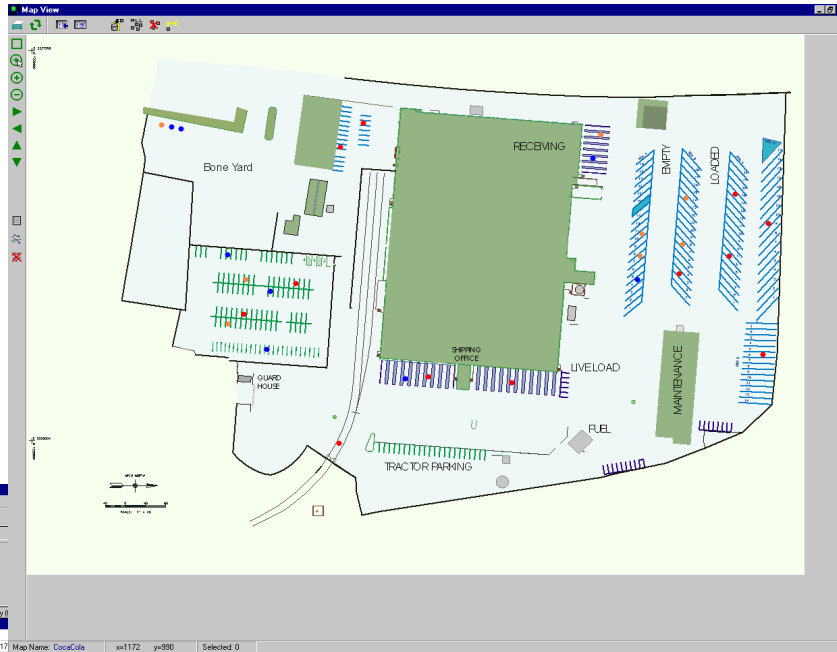
Solution Components

Applications

Platform

Devices

Services



Resource Viewer

Trailer on Site | Trailer Event Detail | OnSite Trailer History

Trailer Number	Status	Days in Status	Location	Chassis	Make	Model	Year	Arrival Time	W	D	Y
TAN00456	Boxes	0.78	Site Arrival	Shelby	Nations Way			12/20/98 1:23:00 PM			
CUR90003	Bags	0.83	Site Arrival	Blue	Dies			12/30/98 12:05:00 PM			
TAN11252	Loaded DB	0.84	OnSite	Ryder				12/30/98 11:45:00 AM	0	17	
404989	Empty	0.86	Site Departure	CLC	+PRDN			12/30/98 11:17:00 AM	1	0	
CUR30002	Jugs	0.88	Bone/Yard	Lumber	LUMC			12/30/98 10:54:00 AM	3	0	
3300123	Ingredients	0.94	OnSite	1st American	FIAC			12/30/98 9:29:00 AM	0	170	No 00FF00
FE8203	Bags	0.95	OnSite	Cardinal	CLNI			12/30/98 9:18:00 AM	0	170	No 00CC00
TAN44760	Empty	0.97	OnSite	Cardinal	CLNI			12/30/98 8:45:00 AM	0	170	No FFFFFF
404574	Bags	1.69	Bone/Yard	1st American	FIAC			12/29/98 3:33:00 PM	3	0	No 00CC00
7527483	Boxes	1.71	OnSite	Macs	MCUI			12/29/98 3:05:00 PM	0	170	No 0080FF
FE8443	Ingredients	1.74	OnSite	Blue Bayou	+PRDN			12/29/98 2:18:00 PM	0	170	Yes 00FF00
TAN30001	Empty	1.76	LiveLoad	Sea Mar	SEMR			12/29/98 1:53:00 PM	5	0	No FFFFFF
CUR00134	Jugs	1.81	Bone/Yard	Ryder	+FIAC			12/29/98 12:35:00 PM	3	0	No 00FF00
CUR00283	Ingredients	1.87	OnSite	Davis	+PRDN			12/29/98 11:05:00 AM	0	170	Yes 00FF00
FE8306	Platons	1.88	Bone/Yard	Lumber	LUMC			12/29/98 10:49:00 AM	3	0	Yes 000000
TAN70032	Empty	1.90	OnSite	Nations Way	NWTP			12/29/98 10:21:00 AM	0	170	No FFFFFF
CUR90003	Jugs	2.05	OnSite	1st American	FIAC			12/29/98 4:28:00 PM	0	170	No 00FF00
CUR98811	Bags	2.66	LiveLoad	Macs	MCUI			12/29/98 4:13:00 PM	5	0	No 00CC00
TAN43731	Pallets	2.68	Bone/Yard	Blue Bayou	+PRDN			12/29/98 3:37:00 PM	3	0	No FF0000
FE849	Boxes	2.79	LiveLoad	Sea Mar	SEMR			12/29/98 1:07:00 PM	5	0	No 0080FF
CUR20031	Bags	2.83	LiveLoad	Ryder	+FIAC			12/29/98 12:56:00 PM	5	0	No 00CC00
FE5421	Empty	2.85	OnSite	Davis	+PRDN			12/29/98 11:43:00 AM	0	170	Yes FFFFFF
TAN30786	Pallets	2.87	Bone/Yard	Lumber	LUMC			12/29/98 11:15:00 AM	3	0	No FF0000
TAN00224	Jugs	2.87	OnSite	1st American	FIAC			12/29/98 11:05:00 AM	0	170	No 00FF00
402569	Boxes	2.90	LiveLoad	Avault	AVRT			12/29/98 10:27:00 AM	5	0	No 0080FF
FE239	Ingredients	2.91	Bone/Yard	Cardinal	CLNI			12/29/98 10:12:00 AM	3	0	Yes 00FF00
TAN00405	Bags	2.91	LiveLoad	1st American	FIAC			12/29/98 10:05:00 AM	5	0	No 00CC00
FE238	Out-of-Service	30.84	Site Departure	Sea Mar	SEMR			11/30/98 11:50:00 AM	1	0	Yes 8000FF
FE330	Empty	31.95	OnSite	Ryder	+FIAC			11/29/98 9:07:00 AM	0	170	Yes FFFFFF

Category: Trailers Record Count: 29

Warnings: 5 Server Status: not running. Number low battery logs: 0

WhereNet Applications

- Vehicle Inventory Management
- Container Management
- Yard Management
- Parts Replenishment
- Asset Management

Solution Components

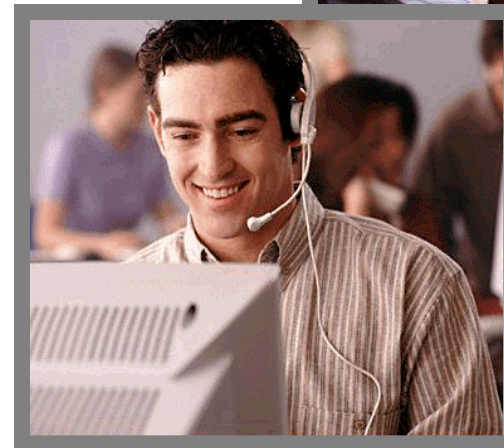
Applications

Platform

Devices

Services

- Installation Services
- Consulting Services
- Maintenance & Support
- Partner Certification & Training



Complementary Technology

	RTLS	GPS/Cellular	Bluetooth
Application/User Focus	B2B – People who distribute, manage, and service vehicles	B2C – Vehicle consumers	P2P - Point to Point personal comm. devices
Coverage	Local Area (site coverage)	Wide Area (cellular coverage)	Personal Area (10ft.)
Availability	Now	Now and Future	Future
Transmitter Costs	<\$25	>\$150	<\$50
Monthly Service Fees per Vehicle	None	\$15 plus	None
Location	Indoor & Outdoor with 10ft. accuracy	Outdoors - 30ft accuracy	Not Applicable
Site Densities	Thousands of vehicles simultaneously	Depends on the capacity of local cell towers	Not Applicable

Visibility Networks

- Providing New Levels of Visibility
- Creating Mobile Decision Support Networks
 - Empowering Mobile Management
 - Enabling New Business Process
- Increasing Material Flow Velocity





Real Time Location Solutions for the Automotive Industry

Applications

- Container Management
- Wireless Call
- Yard Management
- Vehicle Inventory Management (VIMS)

Container Management

Features

- Permanent container identification
- Real-Time Unit level visibility
 - Location history and traceability
- Associate container and content
- Location accuracy to 10 feet
- Web enabled application
 - Real-time visibility throughout the enabled network
- Potential to automate receive and ship transactions

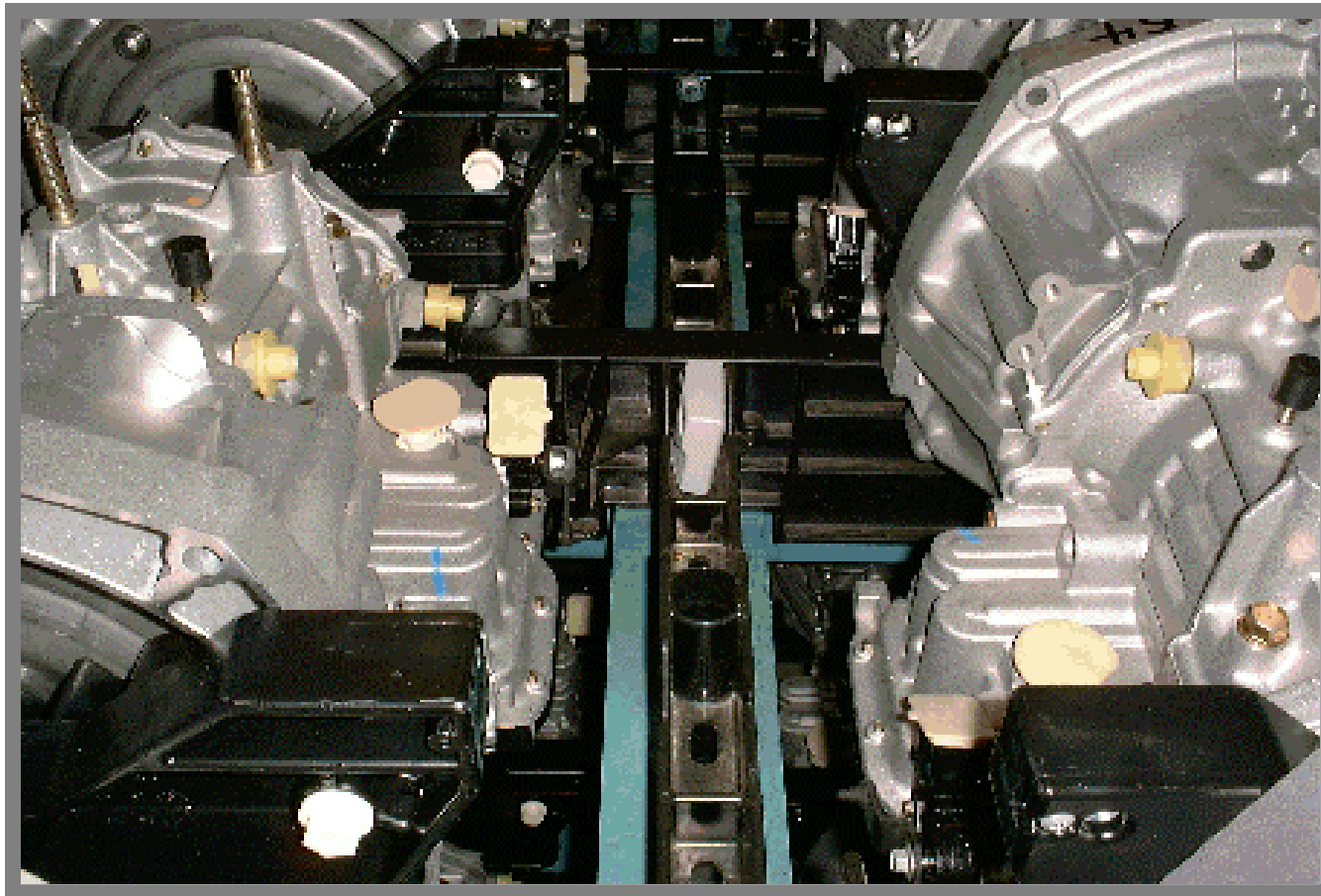
Benefits

- Minimize container loss
- Reduce material handling costs
- Reduce expediting costs
- Reduce obsolete inventory
- Improve material turns
- Reduce container investment
- Improve space utilization



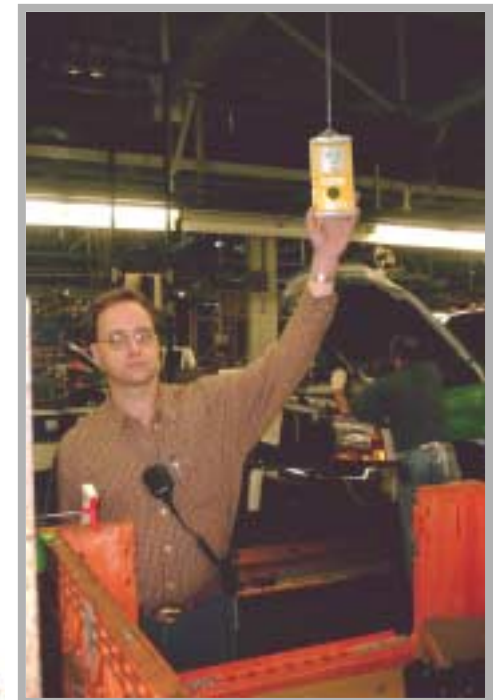
Container Management

Real-time Visibility of All
"Tagged" Containers

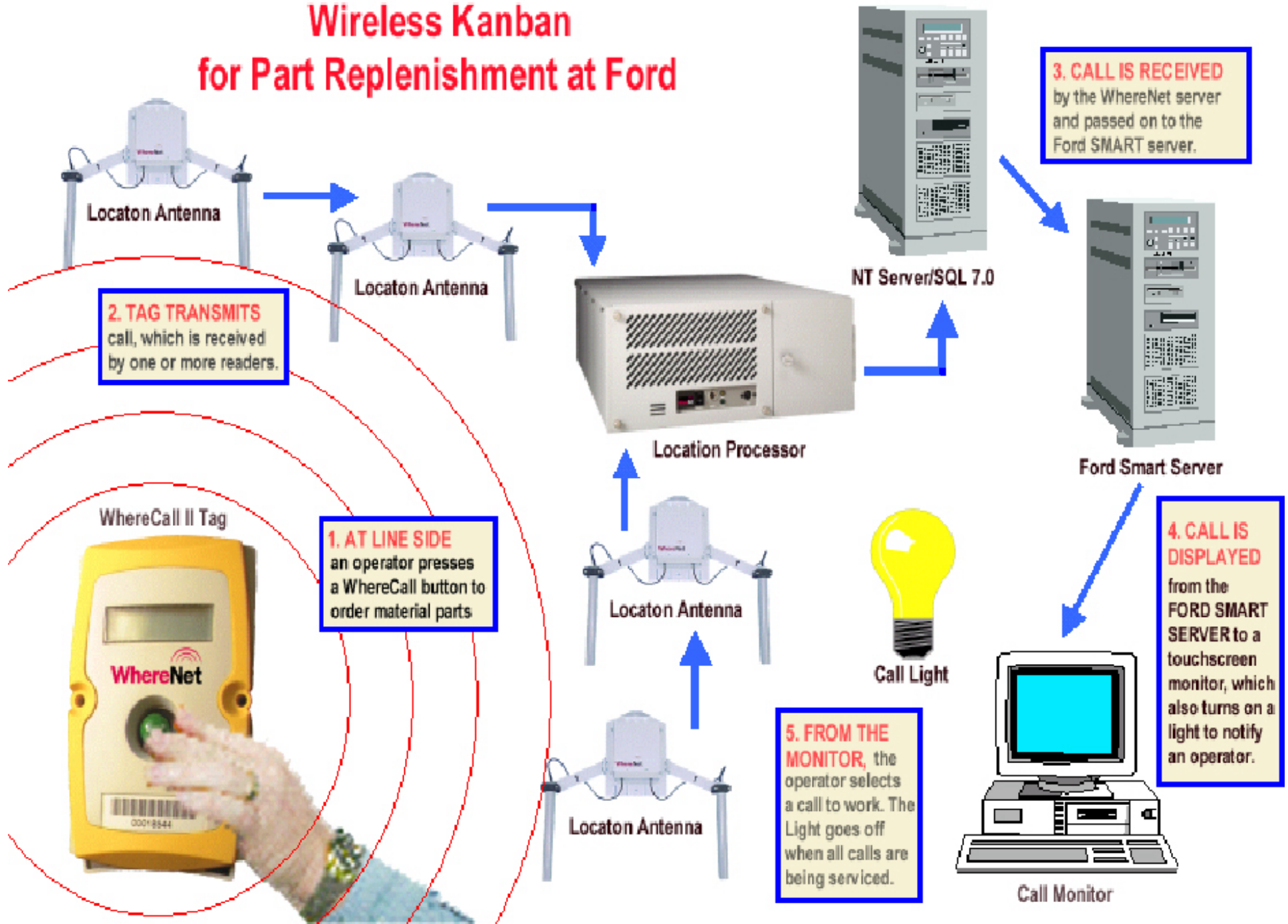


Wireless Parts Replenishment

- Wireless Pendants
 - Wireless Version Costs Less Than Half of Wired System
 - No Cost to Relocate
 - Mounted in Difficult Places
 - Integrated to existing systems
 - Wireless parts replenishment
 - LCD Display for elapsed time
 - Flexible mounting options
 - PLC integration
 - Quality Alert options possible
- Infrastructure Shared with Other RTLS Applications
- Locate Capability Supports "Nomadic" Manufacturing



Wireless Kanban for Part Replenishment at Ford



Wireless Call

- Return on Investment
 - Lower cost to install
 - Faster installation
 - Rapid relocation
 - Inexpensive relocation
 - Flexible tag locations
 - Long battery life
 - Infrastructure supports multiple applications



YMS / Conveyance Overview

- Standardized solution (Ford & Industry)
- Focus is Integrated Assessment Metrics
- Automation of business processes
- Automation of data capture
- Real-time report generation
- Permanently "tagging" trailers
- Web access



Key Features

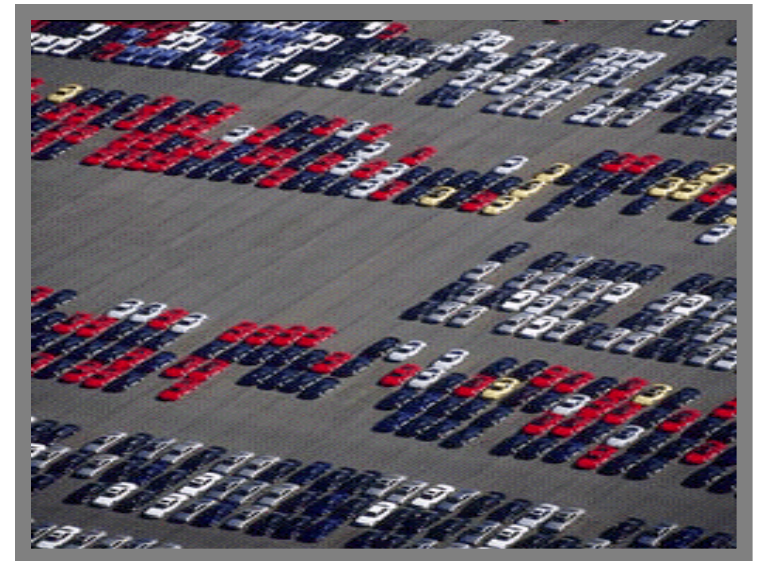
- Window Time Scheduling (Appointment Processing)
- Trailer Inspection & reporting
- Operational Reports
- Single-Click Data Entry
- Build upon: Location Status, History, Switcher Dispatching, Utilization reports, and Alerts

Key Benefits

- Performance Reporting
 - Actual unload time vs. the “plan”
 - Site utilization
 - On-time Performance
 - Trailer Quality & repair history
- Maximize Resource Planning and Scheduling
- Trend analysis
- Automated capture of gate arrival/gate departure times, dock arrival/dock departure times

Vehicle Inventory Management

- Newly Assembled Vehicles
- Thousands of Vehicles must be Shipped per Day by Various Conveyances
 - Assembling Shipments is Complex Operation
 - Unfound Vehicles Cause Significant Delays
 - Delays Cost Manufacturer \$5-10/Day/Vehicle
- Vehicles Shipped with Quality Problems Cost Thousands of Dollars to Repair After Shipment
- Incomplete Loads Require Additional Transports



Vehicle Inventory Management

Features

- Real-time visibility of all vehicles on site
- Inventory management (status, LIFO / FIFO, destination)
- Real-time customer order visibility
- Quality-hold measures
- Automated load make-up & verification



Benefits

- Reduced vehicle dwell
- Improved vehicle delivery times
- Lower labor costs for vehicle handling
- Substantial Quality Savings
- Security
- Improved repair time

Scan the VIN



Associate VIN & RTLS Tag

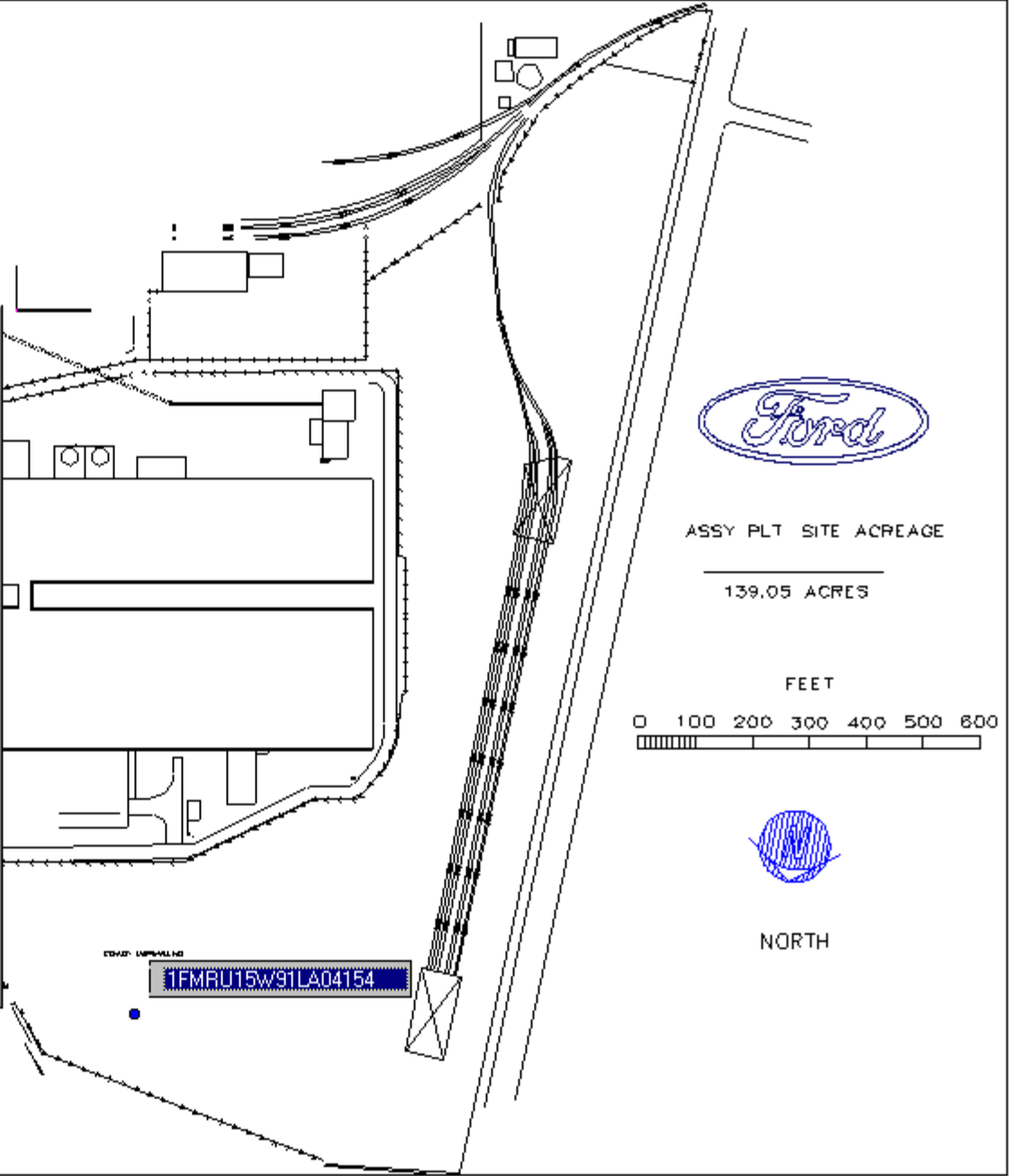


Hang Tag on Rear View Mirror



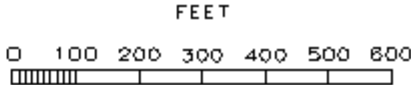


Information	
Last 8	1LA04154
VIN	1FMRU15W91LA04154
Tag ID	118032
Ship Mode	Rail
Route Code	RC27
Location	CONVOY MARSHALLING
Deviated	RC27
Shippable Status	Not Shippable
Process Status	Produced
Process Date	8/9/00 4:59:29 PM
Hrs Shippable	0
Location Group	YARD
Time Since Last Locate (min)	1.20
Hold	Pre-Delivery
Hold Date	8/9/00 4:59:29 PM
Dwell	Pre-Delivery
Dwell Date	8/9/00 4:59:29 PM
Exception	
Exception Date	
Scheduled Date	8/9/00
Actual Produced Date	8/9/00 4:59:29 PM
Hours Since Produced	499
Emissions	No
Body	No
VIN-9	1FMRU15W9
x (ft)	1289
y (ft)	281



ASSY PLT SITE ACREAGE

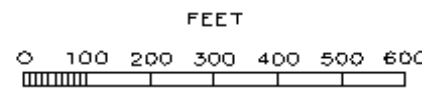
139.05 ACRES



NORTH




ASSY PLT. SITE ACREAGE
139.05 ACRES



NORTH

Value Proposition

Application	Vehicle Inventory Mgt.
Investment	\$600K
Annual Savings: Inventory reduction Quality related costs Labor reductions	\$400K \$350K <u>\$100K</u> \$850K
Intangibles	Improved Customer Satisfaction
Payback	<9 Months

90 Days to Install  Rapid Time to Benefit

Future Opportunities - VIMS

- Vehicle Integration
 - Location device connected to Service Jack
 - Tag built into the vehicle at manufacturer
- Improved Dealership Services
 - Automatic check-in & registration
 - Vehicle status is automatically downloaded
- Consumer Applications
 - Toll roads
 - Rental Car agencies
 - Status (mileage, fuel state, availability)

Vehicle Telemetry Features

- Data transmitted by vehicle (real-time)
 - VIN
 - Mileage (1/500th of a mile)
 - Fuel level (1/255th of a tank)
 - Battery state
 - Other vehicle data (on demand)
- Real-time, accurate vehicle location
- Automated transactions
 - Check-in & check-out
 - Location verification
 - Zone inventories
- Low cost

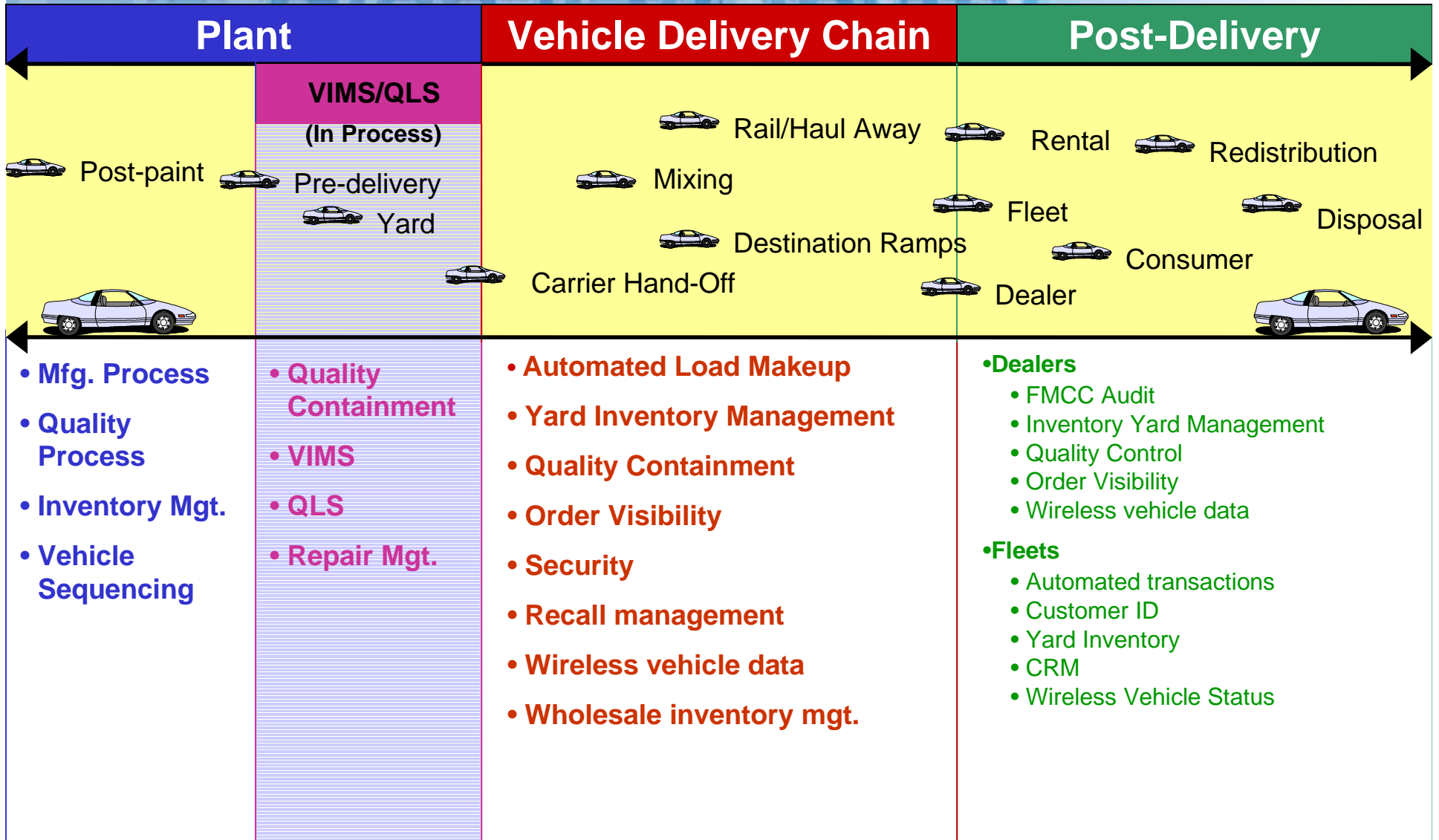
Automotive Telemetry

The screenshot displays a software interface titled "WhereNet Map View - Automotive Telemetry Report". The main area shows a yellow floor plan with various rooms labeled: "Dock", "Mace Garage", "MACHINE SHOP", and "AREA M". A green dot on the floor plan is circled, with a tooltip above it displaying the VIN "1LNHM86S71Y630630". An "Information" popup window is open, showing the following data:

Tag ID	1000011
VIN	1LNHM86S71Y630630
Mileage	2714.236
Fuel	0.98
Battery	11.875
VIN Last Updated	1/26/01 12:29:11 PM
Telemetry Last Updated	1/26/01 12:29:41 PM
Status Bits	11
x (ft)	267
y (ft)	178

The interface includes a toolbar with navigation icons and a Windows taskbar at the bottom showing "Resource Manager" and system icons.

Vehicle Visibility Applications



The background is a light blue gradient with a large, faint '@' symbol on the left. Various business-related terms are scattered across the background in different colors and sizes, including 'e-BUSINESS', 'IMPROVE COMPETITIVENESS', 'SUPPLY CHAIN', 'NETWORK', and 'BUSINESS SOLUTIONS'. Two horizontal red lines are positioned near the top and bottom of the slide.

Real-Time Visibility Solutions for the Airline Industry

Applications

- Cargo Operations
- Ground Support Equipment
- Aircraft Maintenance
- Ramp Operations
- Mail Operations

RTLS at the Gate

Transmitter mounted on mail cart



RTLS for Management of Ground Equipment

Transmitter mounted on dolly



Examples of RTLS Antenna Installations

On pole behind freight house



On ceiling of freight house



On outside of freight house



Airport Gate Antenna Installation

Antennas on terminal at gate A23



Antenna Installation

Antenna on gate A22



Cargo Operations

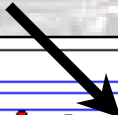
- Associate Cargo with Wheeled Vehicle
- Track ULD 's and Pallets
- Real Time Plane Side Status
- Special Cargo Monitoring
 - High Value
 - Temperature and Time Sensitive
- Application in Process with the FAA for type certification of WheelTag on ULD 's

Mail Operations

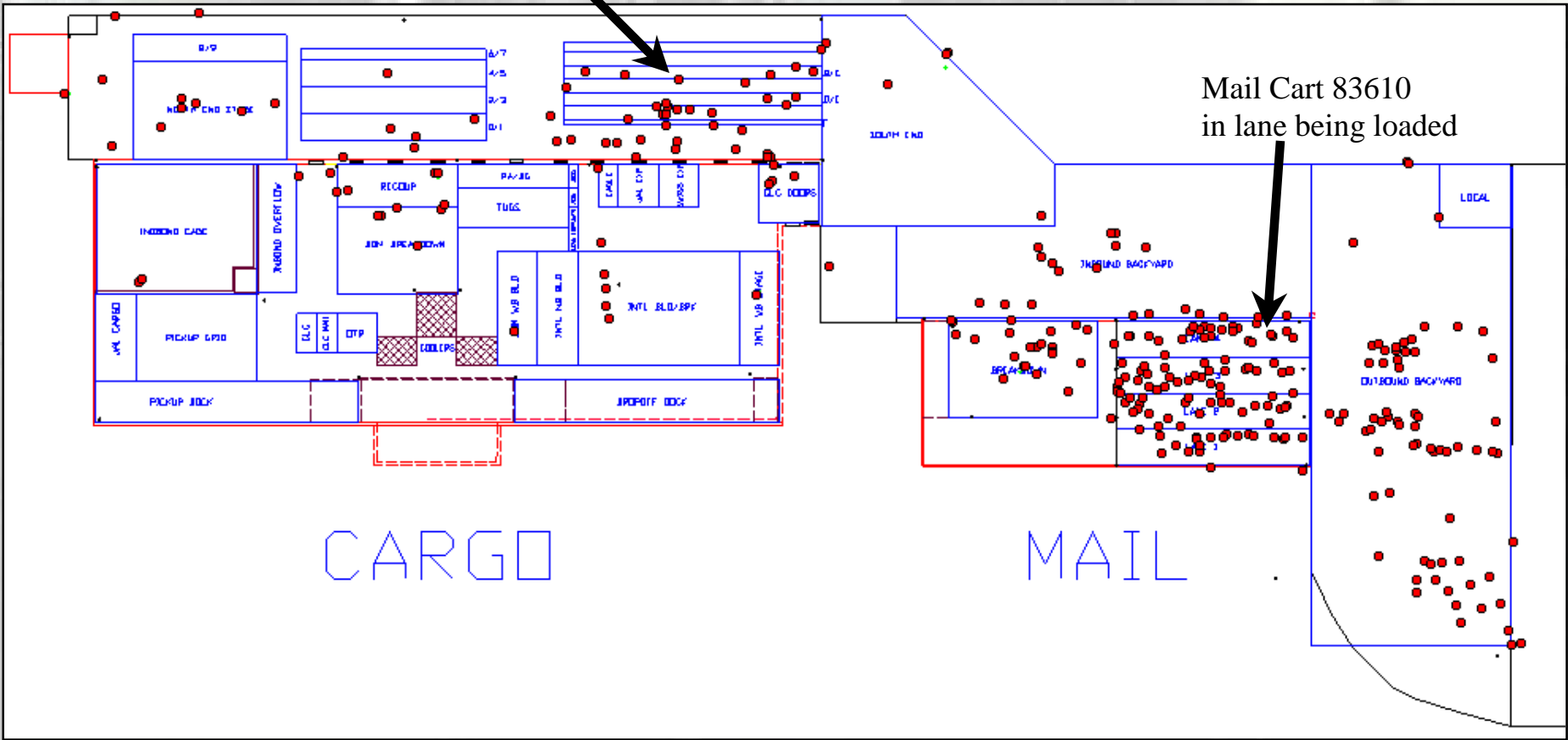
- Total visibility for all mail assets (tugs, carts, trucks),
- Eliminate disputes between Cargo and Ramp operations on gate deliveries.
 - Exact record for when an asset arrived at a particular gate and all movements thereafter.
- Reduce mail penalties and increased mail revenue with faster reaction time to gate changes and missed flights.
- View Mail and Cargo assets at the Postal Service Center, bone-yards, and GSE shop.

Real-Time Map of Indoor Locates

Dolly 113311 with
AKN.1234.AA in lane
ready to be pulled



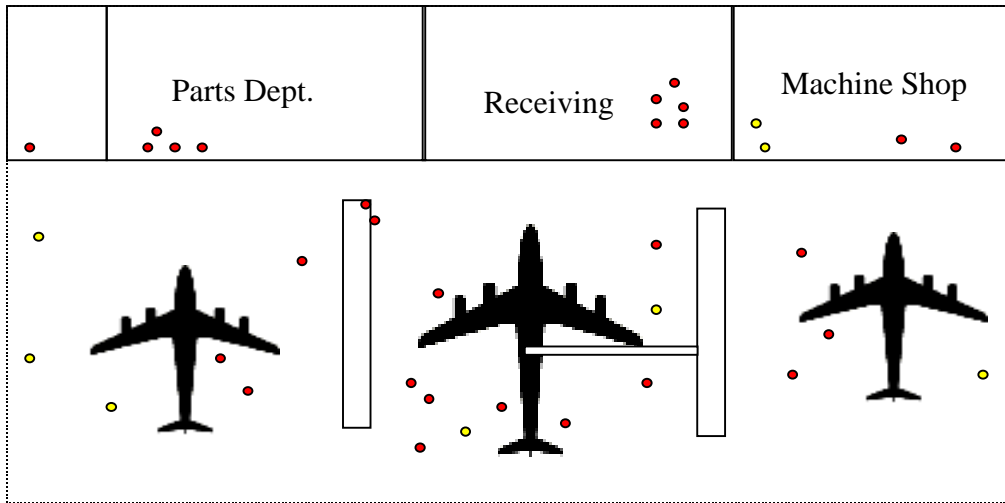
Mail Cart 83610
in lane being loaded



Ground Support Vehicle Maintenance

- Reduce time needed for Preventive Maintenance (PM) Searches for GSE .
 - Mechanics spending more time on repairs, less on searches.
- Real time inventory for all vehicles in the GSE maintenance yards and buildings.
- Ramp and Cargo have real time visibility for all vehicles ready to return to service
- Integration of WhereTag into the GSE can provide real time monitoring of vehicle performance

Aircraft Maintenance



View either and map or Tabular report.

- Aircraft parts
- Tools/Machinery

ID	Part Name	Location	Status	Asset ID	Asset Name	Asset Type	Asset Value
3011001	Wing	GA	OK	1001001	1001001	Wing	1001001
3011002	Wing	GA	OK	1001001	1001001	Wing	1001001
3011003	Wing	GA	OK	1001001	1001001	Wing	1001001
3011004	Wing	GA	OK	1001001	1001001	Wing	1001001
3011005	Wing	GA	OK	1001001	1001001	Wing	1001001
3011006	Wing	GA	OK	1001001	1001001	Wing	1001001
3011007	Wing	GA	OK	1001001	1001001	Wing	1001001
3011008	Wing	GA	OK	1001001	1001001	Wing	1001001
3011009	Wing	GA	OK	1001001	1001001	Wing	1001001
3011010	Wing	GA	OK	1001001	1001001	Wing	1001001

Features

- Real-time visibility on a map of the maintenance facility tracking tooling, mobile machinery, and aircraft parts.
- Query the software so the map will only show the tool, machine, or part that you are looking for.
- View the history of that asset, see all the places that that asset has been and how long it has been in each location.

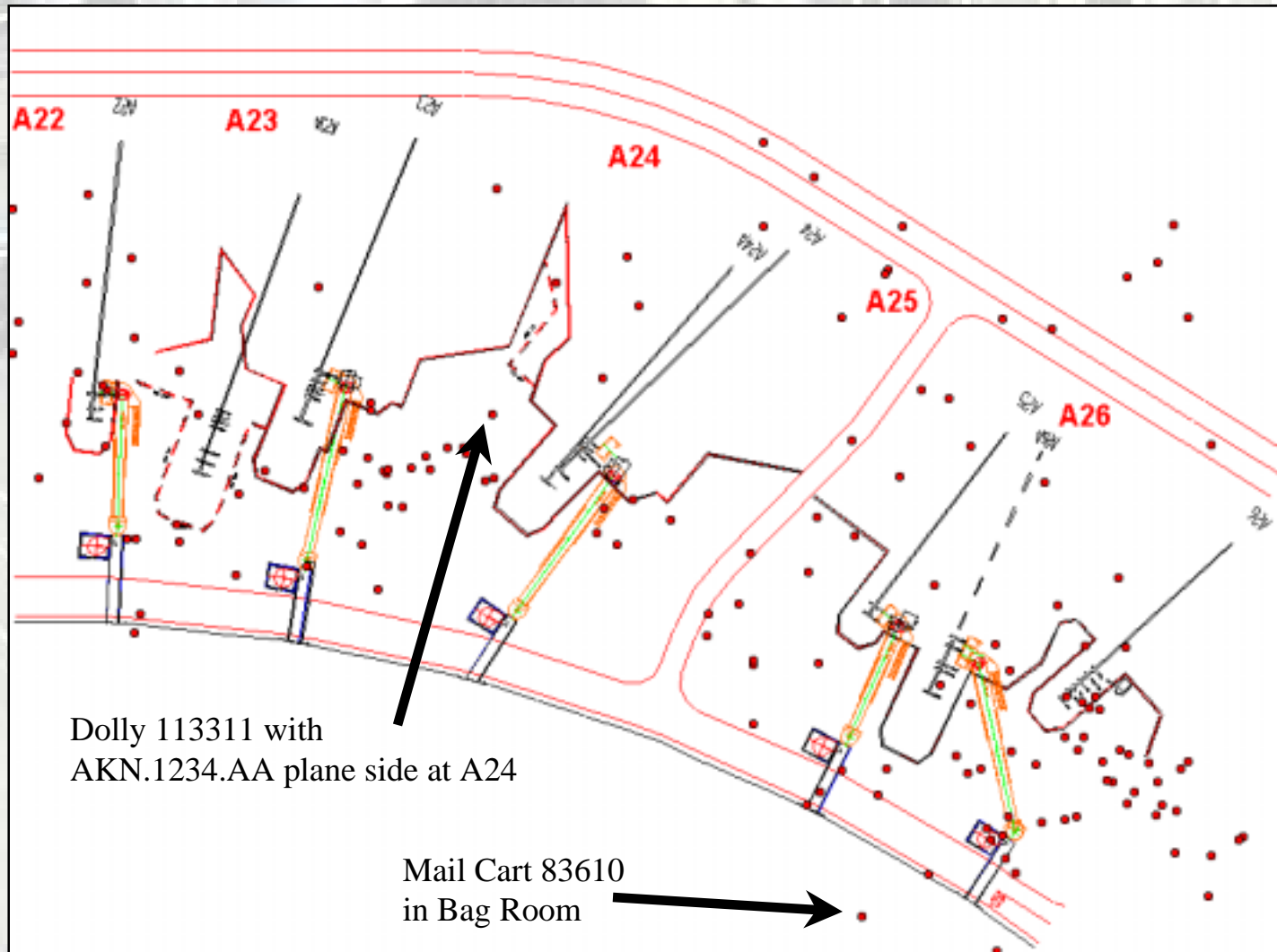
Benefits

- Eliminate downtime waiting for tooling, machinery, or parts to be found and brought to where they are needed.
- Real Time inventory level views to ID potential parts shortages
- Decreased plane downtime.

Ramp Operations

- Real time location for all Ramp vehicles
 - Real time visibility reporting, by gate, for all assigned equipment.
- Real time location for all tow bar and APU 's
- Track tugs and baggage carts as they deliver late arriving baggage to waiting aircraft.
- Gate changes – track equipment impacted by gate changes.
- Historical data on vehicle movements for accident investigations or process improvements.

RTLS Map of Outdoor Locates



Summary

- RTLS provides visibility to supply chain assets
- Fortune 100's are using the technology today
- Benefits include:
 - Reduced cycle times
 - Reduce inventories
 - Reduce levels of assets
 - Improved worker and customer satisfaction



Wireless Applications For Supply Chain Assets
