ORBCOMM Messaging Application:
Mobile Asset Tracking

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Fred W. Seelig
Systems Engineering
Orbcomm Global, Dulles, VA
Roadmap

- Orbcomm System Overview
  - Satellites
  - Ground Network
  - Services
  - Markets

- Mobile Asset Tracking
  - Market
  - Products
  - Potentials
ORBCOMM System Overview
ORBCOMM System Overview

Satellites
(28 in 5 Orbital Planes)

Subscriber Links
Uplink
VHF
148-150 MHz
2,400 bps
Downlink
VHF
137-138 MHz
4,800/9,600 bps

Gateway Links
Uplink
VHF
148 MHz
56 Kbps
Downlink
VHF
137 MHz
56 Kbps

Gateway Earth Stations
(24+)
ORBCOMM System Overview (cont.)

**Gateway Link**
- OQPSK, RRC filt, $\alpha=0.4$
- 57.6 kb/sec
- 1 sec frame, 16 slots/frame
- Up: 148-150.1 MHz
- Down: 137-138 MHz

**Subscriber Link**
- SDPSK, RRC filt, $\alpha=0.4$
- 57.6 kb/sec
- 1 sec frame, 14 slots/frame
- Up: 148-150.1 MHz
- Down: 137-138 MHz
- 2.4 kb/sec
- 2 acq/comm slots, 4 reserv slots
- 4.8 kb/sec

**Satellite**
- GPS timing
- All timing referenced to satellite time
- Highly stable frequency oscillator
- GES and SCs slave their freqs to satellite

**56 kbps Duplex**
- Redundant: landlines + VSAT

**Remote sites**

- **Customer Communications**
  - Customer
  - HQ
  - IS Dept

**Int’l Frame Relay or Internet VPN**
- PSTN, leased lines, frame relay, Internet, X.400

**GCC**
- NCC - Network Control
- SCC - Satellite Control
Space Segment (Satellite)

- 28 Satellites in Five Orbital Planes (To be expanded to 36)
  - 2 Spacecraft @ 70° Inclination
  - 2 Spacecraft @ 108° Inclination
  - 24 Spacecraft (3 Planes of 8) @ 45° Inclination
- 740 and 830 km Orbits for 70° and 108° Inclination Planes
- 820 km Circular Orbit for 45° Inclination Planes
- Launch Each 45° Inclination Plane (8 Spacecraft) on a Single Pegasus Launch Vehicle
Operational Ground Segment

- 15 Gateway Earth Stations installed/under construction on 5 continents

- Network Control Center
  Dulles, VA
  24 x 7

- Redundant backup communications, including C-band VSAT, frame relay, and DDS circuits
Low Cost, Versatile Subscriber Units

Personal Communicator

OEM Module

Meter Reading Unit

Data Communicator

Data Communicator

Data Communicator
Overall Business Status

- Basic satellite network completed
  - 28 satellites launched on 5 rockets
  - Additional satellites planned for better coverage

- Ground network and distribution partners expanded
  - 15 gateways installed or under construction on 5 continents
  - 190 countries/dependent territories covered by 17 service providers
  - 90 domestic and international VARs

- Subscriber equipment and applications software products available
  - 16 product types from 5 manufacturers from $150 to $995
  - 25 completed applications ready for easy IT integration
  - Second/third-generation products, more applications on the way in 1999
Global satellite-based two-way data communications network
  • Fixed asset monitoring
  • Mobile vehicle tracking
  • Messaging/wireless e-mail

Addressable market >150 million subscribers in 8-10 market segments

Competitive position based on first-to-market advantages, low cost structure, worldwide distribution network and strong strategic partners
Large, Diversified Addressable Market

- Mobile Asset Tracking
- Fixed Asset Monitoring
- Other Applications
- Messaging
Mobile Asset Tracking Market

Existing Methods
- Yard checks or driver call-ins
- Terrestrial wireless
- GEO satellite

Benefits
- Increased productivity
- Reduced losses
- Reduced maintenance costs
- New/improved service
Fixed Asset Monitoring Market

- **Existing Methods**
  - Physical site visit
  - Terrestrial wireless
  - GEO satellite

- **Benefits**
  - Reduced costs
  - Faster response time
  - More accurate data
  - Better decisions
ORBCOMM Has 17 Service Distribution Partners Covering 190 Countries

Licensees Responsibilities
- Build and operate gateway
- Secure regulatory authority
- Market ORBCOMM services

ORBCOMM Responsibilities
- Provide gateway hardware, software and training
- Maintain space segment and manage global system
Mobile Tracking
Definition of the Trailer Management Problem

- Low asset utilization
- High trailer-to-tractor ratios
- Costly errors from faulty trailer information
- Inefficient collection and management of trailer information
- Detention problems
- Trailer pool inefficiencies
- Cargo theft claims
- Customer service impaired by trailer management problems
- Driver frustration
Integrated Tracker and Sensor Suite

- **Antenna**
- **Cargo Status Monitor**
- **Trailer Connect Sensor**
- **Integrated Tracker Unit**
  - Communicator/Integrated GPS
  - Battery/Charger
  - Sensor Electronics
  - Embedded Software
  - Tested to SAEJ 1455 Environments
- **Door Sensor**
Very Low Profile Tracker Antenna

- Trailer roof optimal location for antenna
- Very low profile roof-top mount
  - Must be no greater than .7 in. tall to stay under trailer height limit of 13 ft. 6 in.
  - Two Very Low Profile antenna models
    - Scientific Atlanta
      15.25 in. x 22.25 in. x .65 in.
    - Ball Wireless
      17 in. x 23.75 in. x .65 in.
  - GPS antenna integration
Tracker and Cargo Monitor

Hardware Subsystems
## Daily Energy Use - Typical Application

<table>
<thead>
<tr>
<th>Mode</th>
<th>Current</th>
<th>Duration</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep</td>
<td>22 uA</td>
<td>24 Hr</td>
<td>0.528 mA-Hr</td>
</tr>
<tr>
<td>Process</td>
<td>120 mA</td>
<td>2 Min</td>
<td>4.000 mA-Hr</td>
</tr>
<tr>
<td>GPS Fix</td>
<td>145 mA</td>
<td>90 Sec</td>
<td>3.625 mA-Hr</td>
</tr>
<tr>
<td>Receive</td>
<td>170 mA</td>
<td>10 Min</td>
<td>28.33 mA-Hr</td>
</tr>
<tr>
<td>Transmit</td>
<td>1.2 A</td>
<td>100 mSec</td>
<td>0.033 mA-Hr</td>
</tr>
<tr>
<td>Tractor Com.</td>
<td>1.0 A (est)</td>
<td>1 Sec</td>
<td>0.278 mA-Hr</td>
</tr>
<tr>
<td>Cargo Status</td>
<td>250 mA (est)</td>
<td>1 Sec</td>
<td>0.070 mA-Hr</td>
</tr>
<tr>
<td>Daily Use</td>
<td></td>
<td></td>
<td>36.86 mA-Hr</td>
</tr>
<tr>
<td>Time Between Recharge:</td>
<td></td>
<td></td>
<td>~ 43 Days</td>
</tr>
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</table>
Tracker Software Functionality

- Tracker conserves battery power
  - Typically in a low power state for maximum battery conservation

- Tracker can be programmed to exit low power state when it detects:
  - Change in state of door switch
  - Keyed power from tractor
  - Terminal voltage of internal battery drops below the preset threshold
  - Timer alarm caused by periodic position reporting event (every two hours)
  - Timer alarm caused by satellite pass time event
  - Change in state of connect switch
Current Product Issues/Potential

Issues
- Tracker dimensions - will not fit into all trailers
- No power interface on containers to charge battery

Potential
- Growth/expansion capability
  - 1708 interface (PLC4Trucks)
    - Tractor ID
    - Engine monitoring
- Additional sensors
  - Security
  - Tire pressure
  - Weight
  - Volume
Customized Applications Software

- Trailers empty and available
- Trailer assigned by dispatcher
- Trailer loaded at customer lot
- Trailer en route
- Trailer located on schedule—piggyback
- Trailer arrived at consignee facility
Information to People Who Can Act on It

Data from Asset
Data processed through Vantage Information System

Operational Information
Timely, accurate trailer information integrated into existing fleet management software
- Trailer Status
- Load Status
- Mapping
- Exception Alerts

Management Information
Desktop access to summary performance data and management reports
- Trailer Utilization Manager
- Detention Manager
- Trailer Pool Manager
- Mapping
Customer Reaction

“ORBCOMM/Vantage have a very strong focus on the key factors that will create benefits for carriers, not only from a technology perspective, but from a business application perspective as well. We believe they are the emerging leader in this technology space.”

—Paul Mueller
Vice President, Communications and Networking Services
Schneider National