LocoMate™ RSU | Road Side Unit with NEMA Enclosure

Key Benefits

Hardware
- Wireless access for vehicular environment
- 5.700 to 5.925 GHz frequencies
- 10 MHz and 20 MHz channel bandwidth
- Weather proof NEMA, IP67 rated enclosure
- Fully Power-Over-Ethernet enabled
- Options for 2 DSRC radio
- Utilize radio designed by Arada Systems
- High throughput capability for varied Applications
- Efficient handling of WSMP (WAVE Short Messaging Protocol) and IP traffic

Software
- WAVE Standards Support
  - 802.11p
  - 1609.2
  - 1609.3
  - 1609.4
  - SAE J2735
- Fast channel switching capabilities
- Switching capability between control and service channels
- Multi-channel synchronization between service users
- Exclusive packet control
  - tx power control per packet
  - data rate control per packet
- Remote application support
- Software development kit (SDK) for application development

WAVE Mode
- Support for 5.9 GHz spectrum with 10 MHz channel width
- Support for WAVE data and management frames
- Support for multi channel (control channel and service channel) using single radio
- <= 3 mS channel switch time irrespective of traffic conditions
- Can preempt messages in transmit queue
- Support for multiple priority queues
- Support for GPS-based synchronization

Product Highlights

An integration of GPS and Wi-Fi, LocoMate™ RSU is ideal for telematic applications by allowing vehicles on the road to talk to each other or to another road side unit (RSU). The special Industrial Grade NEMA enclosure option provides for special outdoor Road Side Unit deployment.

It is fully compliant with Omni-Air’s certification and is used in worldwide deployments including the US Department of Transportation’s Safety Pilot in Ann Arbor, Michigan. Product applications include: Signal Coordination, Emergency Vehicle Management, Train Crossing, Tolling, Taxi Management, Geo-Fencing, MESH, and CLOUD.

LocoMate™ RSU comes in an industrial outdoor NEMA rated enclosure that allows for seamless outdoor deployments with a full DSRC WAVE software solution. The solution comes integrated with GPS, Bluetooth and high-power 802.11p radios.
WAVE Protocols
- 802.11p (WAVE)
- EEE 1609.2
- IEEE 1609.3
- IEEE 1609.4
- SAE J2735

Frequency
- 5.85 - 5.925 GHz
- 5.7 - 5.8 GHz (Europe)

DSRC Radio
- High power miniPCI optimized for 5.9 GHz
- 5.9 GHz: +23dBm at 64QAM from -40°C - +85°C

GPS Device
- GPS with internal RF antenna
- Accuracy <1m

Power Supply
- 802.3af PoE compliant
- IEC60950 compliant

Multi-channel operation
- Consistent 3 mS channel switch time

Supplementary 802.11 MAC features
- Control Channel (CCH) and Service Channels coordination
- 50 mS channel dwell time
- CCH for broadcast, high-priority and single-use safety messages and SCH for IP data

Channel Access
- Alternative, continuous

Channel Switching
- Consistent 3 mS switch time at every 50 mS

Software Queuing
- Transmit queues per channel
- Prioritized channel access queues, with configurable channel access parameters

Database Configuration
- CLI
- Database file backup, restore

Platform
- Linux/Unix compatible
- SDK with C libraries

Interactive Communication
- ssh/telnet

IP Protocols
- ipv4 / ipv6

Network Configuration
- Wired and DSRC
- ipv4 configuration
- ipv6 configuration
- SIT Tunnel Support

US DOT RSE spec
- QPL vendor

GPS Applications
- Approx. 1m accuracy
- Path history implementation
- Path prediction implementation

Local Time Synchronization
- GPS along with PPS

Security
- Signing and verification of messages, encryption and decryption of messages
- Signing and verification of WSAs

Message Logging
- DSRC Transmit packets, DSRC Receive Packets, Ethernet packets
- System events
- Heartbeat messages with configuration (ipv4 or ipv6)
- Log offload configuration (ipv4 or ipv6)
- Wave Service Announcement configuration

LEDs
- DSRC packet transmission
- Firmware upgrade

Software Development Kit
- Linux based tool chain
- Application library
- Sample applications
- Programmer guide
- User guide
- SAE J2735 ASN library
- Sample applications include the following J2735 message formats: BSM, SPAT, MAP, TIM
- Sample applications include GPS data extraction

Data and Management Planes
- UDP/TCP and WAVE Short Messaging Protocol (WSMP) support
- Managers WAVE Basic Service Set (WBSS)
- Application management

Channel Bandwidth
- WAVE mode (802.11p) at 5.9 GHz: reduced to 10 MHz, supports 20 MHz channels

DSRC Message Set - SAE J2735
- BSM Part I, BSM Part II
- SPAT, MAP, TIM

Flash/RAM
- 16 MB Flash
- 64 MB SDRAM (512 Mbits)

Shared Library
Applications Shared Library with Windows/Linux support for application development

Applications Support
- Menu-driven tool
- IP based applications
- WSM-based applications
- Periodic transmit of GPS data
- Remote and logging applications

Certificate Management
- 1609 certificate update
- Support for time limited 1609 certificate

<table>
<thead>
<tr>
<th>DSRC Channel Support</th>
<th>Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 MHz Channels</td>
<td></td>
</tr>
<tr>
<td>172</td>
<td>5860</td>
</tr>
<tr>
<td>174</td>
<td>5870</td>
</tr>
<tr>
<td>176</td>
<td>5880</td>
</tr>
<tr>
<td>178</td>
<td>5890</td>
</tr>
<tr>
<td>180</td>
<td>5900</td>
</tr>
<tr>
<td>182</td>
<td>5910</td>
</tr>
<tr>
<td>184</td>
<td>5920</td>
</tr>
<tr>
<td>20 MHz Channels</td>
<td>Frequency (MHz)</td>
</tr>
<tr>
<td>173</td>
<td>5865</td>
</tr>
<tr>
<td>175</td>
<td>5875</td>
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<tr>
<td>177</td>
<td>5885</td>
</tr>
<tr>
<td>179</td>
<td>5895</td>
</tr>
<tr>
<td>181</td>
<td>5905</td>
</tr>
<tr>
<td>183</td>
<td>5915</td>
</tr>
</tbody>
</table>

| Throughput Traffic Test Results Half-Rates on Channel 172 (Mbps) Without Channel Switch |
|----------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Rates       | 3M            | 4.5M          | 6M            | 9M            | 12M           | 18M           | 24M           | 27M           |
| TCP         | 2.36          | 3.37          | 4.34          | 6.32          | 7.97          | 11.23         | 13.54         | 14.75         |
| UDP         | 2.38          | 3.50          | 4.37          | 6.99          | 9.00          | 12.96         | 15.81         | 17.32         |

| Throughput Traffic Test Results Full-Rates on Channel 175 (Mbps) Without Channel Switch |
|----------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 20 MHz Data Rates | TCP | UDP |
| 6M                   | 4.7      | 5.0         |
| 9M                   | 6.7      | 7.2         |
| 12M                  | 9.8      | 10.5        |
| 18M                  | 12.9     | 14.52       |
| 24M                  | 16.6     | 18.61       |
| 36M                  | 22.630   | 26.022      |
| 48M                  | 27.782   | 32.231      |
Specifications

TCP/UDP Throughput in Different Channels

<table>
<thead>
<tr>
<th>Operation</th>
<th>TCP (Mbps)</th>
<th>UDP (Mbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAVE operation in 20 MHz</td>
<td>27.780</td>
<td>32.231</td>
</tr>
<tr>
<td>(max. phy rate=54 Mbps)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAVE operation in 10 MHz</td>
<td>14.75</td>
<td>17.32</td>
</tr>
<tr>
<td>(max. phy rate=27 Mbps)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAVE operation in 10 MHz,</td>
<td>6.9</td>
<td>8.6</td>
</tr>
<tr>
<td>with periodic channel switch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average per Packet Latency Values with Different Content Type Messages

<table>
<thead>
<tr>
<th>Latency Conditions</th>
<th>Plain</th>
<th>Sign/Sign Verify</th>
<th>Encrypted/Decrypted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average packet interval with 100 mS</td>
<td>102 mS</td>
<td>112 mS</td>
<td>139 mS</td>
</tr>
<tr>
<td>transmit periodicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latency</td>
<td>2 mS</td>
<td>10 mS</td>
<td>35-40 mS</td>
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</table>

802.11p Radio Specifications

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Data Rate</th>
<th>TX</th>
<th>RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPSK</td>
<td>3 Mbps</td>
<td>23±1dBm</td>
<td>-95±2dBm</td>
</tr>
<tr>
<td>16QAM</td>
<td>18 Mbps</td>
<td>23±1dBm</td>
<td>-83±2dBm</td>
</tr>
<tr>
<td>64QAM</td>
<td>27 Mbps</td>
<td>23±1dBm</td>
<td>-77±2dBm</td>
</tr>
</tbody>
</table>

Other Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenna Interface</td>
<td>N-Connector</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +80°C (output power specified over full temperature profile)</td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>10 MHz, 20 MHz (FCC “Class C” Mask Compliant)</td>
</tr>
<tr>
<td>Operating Voltage/Current</td>
<td>Input Voltage Range: 48-52V DC / 400mA Max.</td>
</tr>
</tbody>
</table>

Antenna Information

<table>
<thead>
<tr>
<th>Antenna Configuration</th>
<th>V.S.W.R. (MAX)</th>
<th>Antenna Gain</th>
<th>Impedance</th>
<th>Radiation</th>
<th>Impedance</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5:1</td>
<td>12 dBi</td>
<td>50 Ohms</td>
<td>Omni Directional</td>
<td>Polarization</td>
<td>Vertical</td>
</tr>
<tr>
<td>Vertical Beam Width</td>
<td>8 Degrees</td>
<td>Horizontal Beam Width</td>
<td>360 Degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Power</td>
<td>100 watts</td>
<td>Max, nominal, Min. EIRP</td>
<td>34dBm, 30dBm, 10dBm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Antenna Patterns

Ordering Information

LocoMate™ 200 RSU (Single unit, single radio)
LocoMate™ 201 RSU (Single unit, two radios)
LocoMate™ 202 RSU Kit (Two Locomate™ 201 PoE Switch)
sales@aradasystems.com

Arada Systems is a leader in technologies meant for vehicle-based communication networks, particularly for applications such as toll collection, vehicle safety services, and commerce transactions via cars. LocoMate™ is being evaluated for real-time communication between vehicles and roadside access points or other vehicles creating a real-time public safety network.