Disruption Tolerant Networks and its relevance to IOT/M2M

Extensible NMS Support for DTN Mesh Networks + Applications

MAC80211+OpenWRT Framework for Proprietary Devices

Representative SBC computers with OpenWRT BSP support
MeshDynamics Provides Mission Critical Connectivity

MeshDynamics for Mission Critical "Outdoor Enterprise".

MeshDynamics patented Structured Tree Mesh™ products are scalable - they continue to deliver as your outdoor wireless network demands grow. They are the vendor of choice in Military and Mining.

Defense and Homeland Security Agencies in US, UK, and Canada use MeshDynamics to provide mobile mission critical video surveillance and perimeter security. These include strategic national borders.

1,000+ nodes are active in surface and underground mining sites in Africa, Australia, China, Canada and the US. MeshDynamics provides VCP communications in mining tunnels 63+ hops deep.

This level of scalability remains unmatched.

What makes MeshDynamics Mesh Networking Products Different?

Inside the box, Wireless Mesh Networking products use similar, often identical, hardware.

MeshDynamics Third Generation Structured Mesh software sets us apart. ➤ YouTube Video
MeshDynamics has been developing an Open Source Platform for DTN for US Navy and US DOE. DTN Mesh Nodes support User Space Application Layer in OpenWRT for deep packet inspection, SDN based routing, Video, IFTTT rules, etc. DTN nodes provide autonomous, robust machine control with no assurance of internet connectivity.

**DTN Modes Supported by MeshDynamics**

- **DISRUPTIVE TOLERANT NETWORK**
- **FULLY DEVELOPED**
- **CONTIGUOUS**
(Autonomous) Applications Running on Mesh Node

Mesh Nodes NMS (Java + Eclipse)  
Machine Controller Snap ins  
Non IP Device Gateways (through App)

Device Heart Beats sent based on Pub/Sub

Applications/IFTTT  
App. Mgmnt Layer  
Pub/Sub  
Rule DB  
Monitor DB  
Application Coupling Layer  
Meshap + CFG8011/MAC80211.

“PORTS”: Radios,, Ethernet Ports, DIO, AIO Serial etc.

2. Operation: Agent is associated with a Physical “Port”.  
   Port Forwarding rules direct raw data to application on mesh node or cloud.
3. Audits etc. Agents and Application ingress/egress port activity logged and audited.
(Autonomous) Applications Running on Mesh Node

Mesh Tables maintain these “ports”

.. Clients connected to “Ports”

..
(Autonomous) Applications Running on Mesh Node

Mesh Tables maintain these “ports”

.. Clients connected to “Ports”

.. Applications resident in Network

M2M Virtual Network

Normal Operation
No Internet Connectivity
(Autonomous) Applications Running on Mesh Node

Mesh Tables maintain these “ports”

.. Clients connected to “Ports”

.. Applications resident in Network

.. Intermittent Cloud Applications

NMS Displays Machine Status History

M2M Virtual Network

Periodic Supervisory Control
Scalable Architecture for Internet of Things (M2M)

**Chirp Data Streams**
- Agent Device

**M2M “Small” Data Flows**
- Mesh Node
- Mesh Node
- Agent Device

**“Big” Data Analysis And Audit**
- Filter Gateway
- Integrator Function

**Normal Operation Mode**
- No Internet Connectivity needed
- Run on “Small” Data Pub/Sub

**Periodic Supervisory Control Mode**
- Cloud based applications connect
- “Small” Data Collection/Analysis
Scalable Pub/Sub Shuttles for Application Communities

Packets to-and-from end devices

Propagator Node (Edge Router)

“Shuttles” to/from different integrator functions

Chirps unloaded/reloaded

Shuttles to/from different destinations

Application: Real Time Publishing of applications/devices data flows to Subscribers/Applications

- Pub/Sub framework with periodic, timed, “shuttle” service between publishers/subscriber apps.
- MAC80211 “radio” abstractions for proprietary devices supported (every interface is port based)
- Applications ingress and egress ports monitored by supervisory audit/management subscribers.
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Open Standards Java Based NMS

Java Based NMS Engine (shown with default skin)

MeshDynamics OEM Licensing Opportunities. Modular OpenWRT + Application Layer + Cloud Management Platform © 2002-2015 MeshDynamics. All Rights Reserved
# NMS Customization API

## Package com.meshdynamics.api

### Interface Summary

<table>
<thead>
<tr>
<th>Interface</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMS.ConnectedDevice</td>
<td>Defines the properties of all devices connected to a <code>NMS.Node</code>.</td>
</tr>
<tr>
<td>NMS.NeighborNode</td>
<td>Defines the properties of all neighbor nodes detected by a <code>NMS.Node</code>.</td>
</tr>
<tr>
<td>NMS.Network</td>
<td>The network interface defines all properties and actions associated with a mesh network.</td>
</tr>
<tr>
<td>NMS.NetworkListener</td>
<td>The <code>NetworkListener</code> interface is used to receive events on a mesh network.</td>
</tr>
<tr>
<td>NMS.Node</td>
<td>The <code>Node</code> interface defines all the properties and actions that can be carried out on a mesh node.</td>
</tr>
<tr>
<td>NMS.ThreadRunnable</td>
<td>The <code>Runnable</code> interface is implemented by any class whose instances are executed by a thread.</td>
</tr>
</tbody>
</table>

### Class Summary

<table>
<thead>
<tr>
<th>Class</th>
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</tr>
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<tbody>
<tr>
<td>NMS</td>
<td>NMS is the primary class for using the Meshdynamics Network Management System (NMS) API.</td>
</tr>
<tr>
<td>NMS.ACLConfiguration</td>
<td>Defines the Access Control List configuration for a node.</td>
</tr>
<tr>
<td>NMS.ACLEntry</td>
<td>Defines an Access Control List entry.</td>
</tr>
<tr>
<td>NMS.EfficientRule</td>
<td>Defines an Efficient QoS rule.</td>
</tr>
<tr>
<td>NMS.GeneralConfiguration</td>
<td>Defines all Node level fields used by a <code>NMS.Node</code>.</td>
</tr>
<tr>
<td>NMS.Hashtable</td>
<td>The <code>Hashtable</code> class provides an implementation of a <code>Hashtable</code> of <code>ObjectKey</code> and <code>ObjectValue</code> pairs.</td>
</tr>
<tr>
<td>NMS.InterfaceConfiguration</td>
<td>Defines the interface level settings for a <code>NMS.Node</code>.</td>
</tr>
<tr>
<td>NMS.ObjectArray</td>
<td>The <code>ObjectArray</code> class provides an interface to a growable array that stores object references.</td>
</tr>
<tr>
<td>NMS.ShortArray</td>
<td>Defines an array of short integers.</td>
</tr>
<tr>
<td>NMS.Thread</td>
<td>The <code>Thread</code> class provides multi-threading functionality to scripting platforms.</td>
</tr>
<tr>
<td>NMS.VlanConfiguration</td>
<td>Defines the settings for a Virtual LAN in a <code>NMS.Node</code>.</td>
</tr>
<tr>
<td>NMS.WEPSecurity</td>
<td>Defines the information used by the IEEE 802.11 Wired Equivalent Privacy (WEP) setting by a Node’s downlink interface.</td>
</tr>
<tr>
<td>NMS.WPAEnterpriseSecurity</td>
<td>Defines the information used for the Wi-Fi Protected Access security setting by a Node’s downlink interface in an enterprise environment.</td>
</tr>
<tr>
<td>NMS.WPAPersonalSecurity</td>
<td>Defines the information used for the Wi-Fi Protected Access (WPA) security setting by a node's downlink interface.</td>
</tr>
</tbody>
</table>
Example: Periodic Stream Logs
Database logs all mesh node heart beat information. Database also logs customer application data if requested.

Examples:
- Sensor updates from serial line interface e.g. battery power
- GPS location of specific mobile clients.
- Node level Network Performance History

Example: Logging M2M Data Streams

<table>
<thead>
<tr>
<th>TIME</th>
<th>SQNR</th>
<th>TEMP</th>
<th>TXPKTS</th>
<th>RXPKTS</th>
<th>PARENTS</th>
<th>CHILDREN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-10-01 15:35:47.0</td>
<td>23644</td>
<td>42</td>
<td>969831</td>
<td>320916</td>
<td>00:12:CE:00:29:6C@-44 dBm, 54 Mbps</td>
<td>00:12:CE:00:22:04@-81 dBm, 54 Mbps</td>
</tr>
</tbody>
</table>

- 00:12:CE:00:29:6C@-44 dBm, 54 Mbps
- 00:12:CE:00:22:04@-81 dBm, 54 Mbps
- 00:12:CE:00:1E:D4@-63 dBm, 54 Mbps
- 00:12:CE:00:16:9A@-85 dBm, 54 Mbps
- 00:12:CE:00:23:24@-43 dBm, 54 Mbps
- 00:12:CE:00:20:D8@-49 dBm, 54 Mbps
- 00:12:CE:00:20:A2@-44 dBm, 54 Mbps
- 00:12:CE:00:6C@-57 dBm, 54 Mbps

Node Heartbeat Details
Example: GPS locations from Heart Beat
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Open Source Library of MAC80211 based drivers for 11abgn/bluetooth etc:
OpenWRT + MAC80211 + Applications Network Stack

User Space

Application Management Layer

Application Coupling Layer

Rule DB

Monitor DB

Kernel Space

Cfg80211

Mesh Functionality

Meshap Coupling Layer

Mac80211

Drivers
Dual Processors for Multiple High Performance Radios

CPU 1

Network Protocol Stack

Mesh Engine (Master)

L2 Wifi

CPU 2

Network Protocol Stack

Mesh Engine (Slave)

Wifi L2

Routing Mesh tables sync

Virtual interfaces for Radio &

IoT Ports in CPU2 on CPU1

L2 Switch
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140 mm x 100 mm

6-miniPCIe,

Ana. Video, Audio
Dig. IO USB Serial
Optional SATA drive

Representative SBC with OpenWRT BSP Support

105 mm x 100 mm

4-miniPCIe, (3 Back)

Ana. Video, Audio
Dig. IO USB Serial
Optional SATA drive

Representative SBC with OpenWRT BSP Support

35 mm X 70 mm 1-miniPCie, App Connector HDMI

http://www.gateworks.com/product/item/ventana-gw5510-single-board-computer

Plethora of 80211, Cellular, Bluetooth radios with MAC80211 drivers from Qualcomm / Atheros, Broadcom etc


http://trac.gateworks.com/wiki/OpenWrt/wireless