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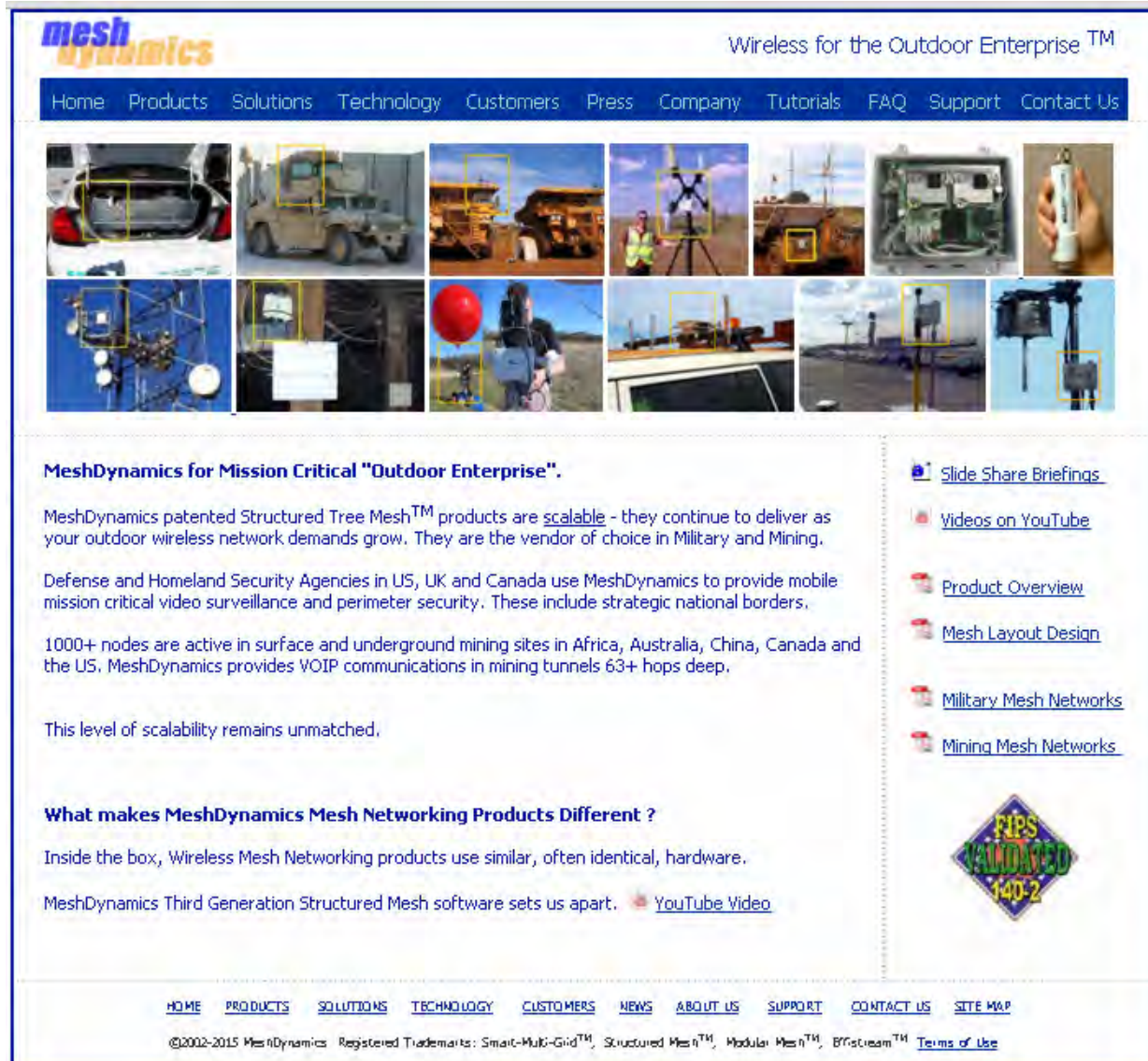
***Disruption Tolerant Networks and its relevance to IOT/M2M***

*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



**mesh dynamics** Wireless for the Outdoor Enterprise™

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**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.

1000+ nodes are active in surface and underground mining sites in Africa, Australia, China, Canada and the US. MeshDynamics provides VOIP 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](#)

- [Slide Share Briefings](#)
- [Videos on YouTube](#)
- [Product Overview](#)
- [Mesh Layout Design](#)
- [Military Mesh Networks](#)
- [Mining Mesh Networks](#)

**FIPS 140-2**

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# Disruption Tolerant Networks

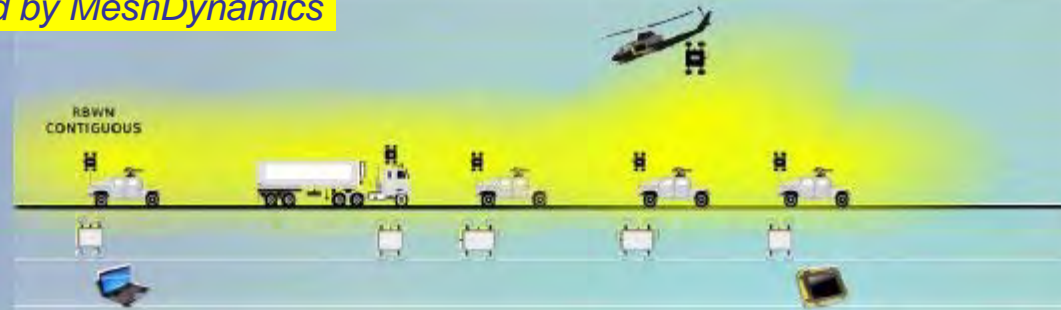


MeshDynamics has been developing an Open Source Platform for DTN for US Navy and US DOE. DTN Mesh Nodes support User Space Application Layer in OpenWRT for deep packet inspection, SDN based routing, Video, IFTTT rules. etc. DTN nodes provide autonomous, robust machine control with no assurance of internet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



## DTN Modes Supported by MeshDynamics

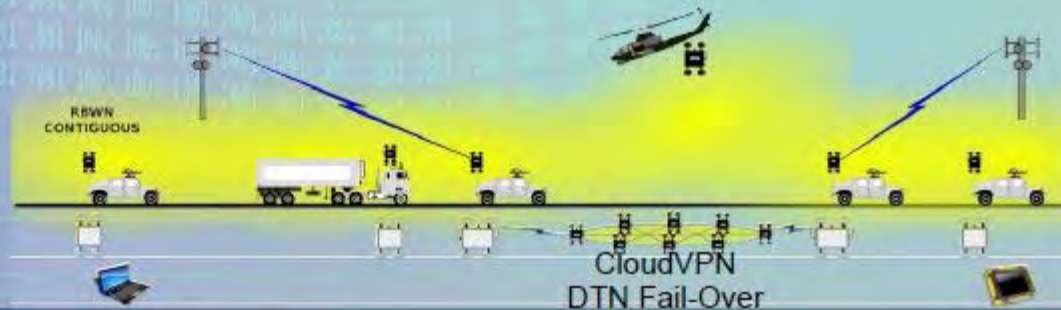
**CONTIGUOUS**



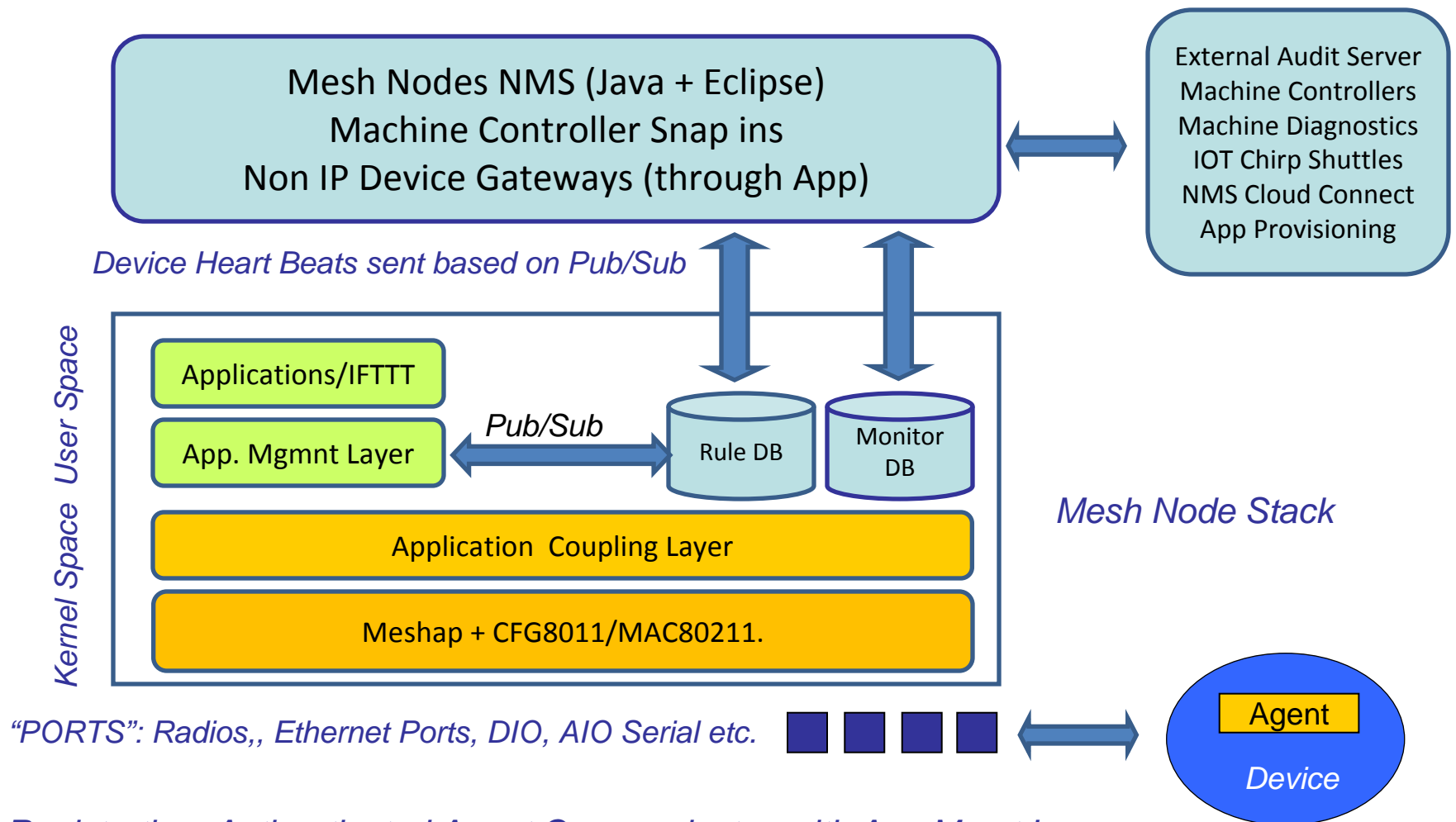
**DISRUPTIVE TOLERANT NETWORK**



**FULLY DEVELOPED**



# (Autonomous) Applications Running on Mesh Node



1. Registration: Authenticated Agent Communicates with App.Mgmt Layer.

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.

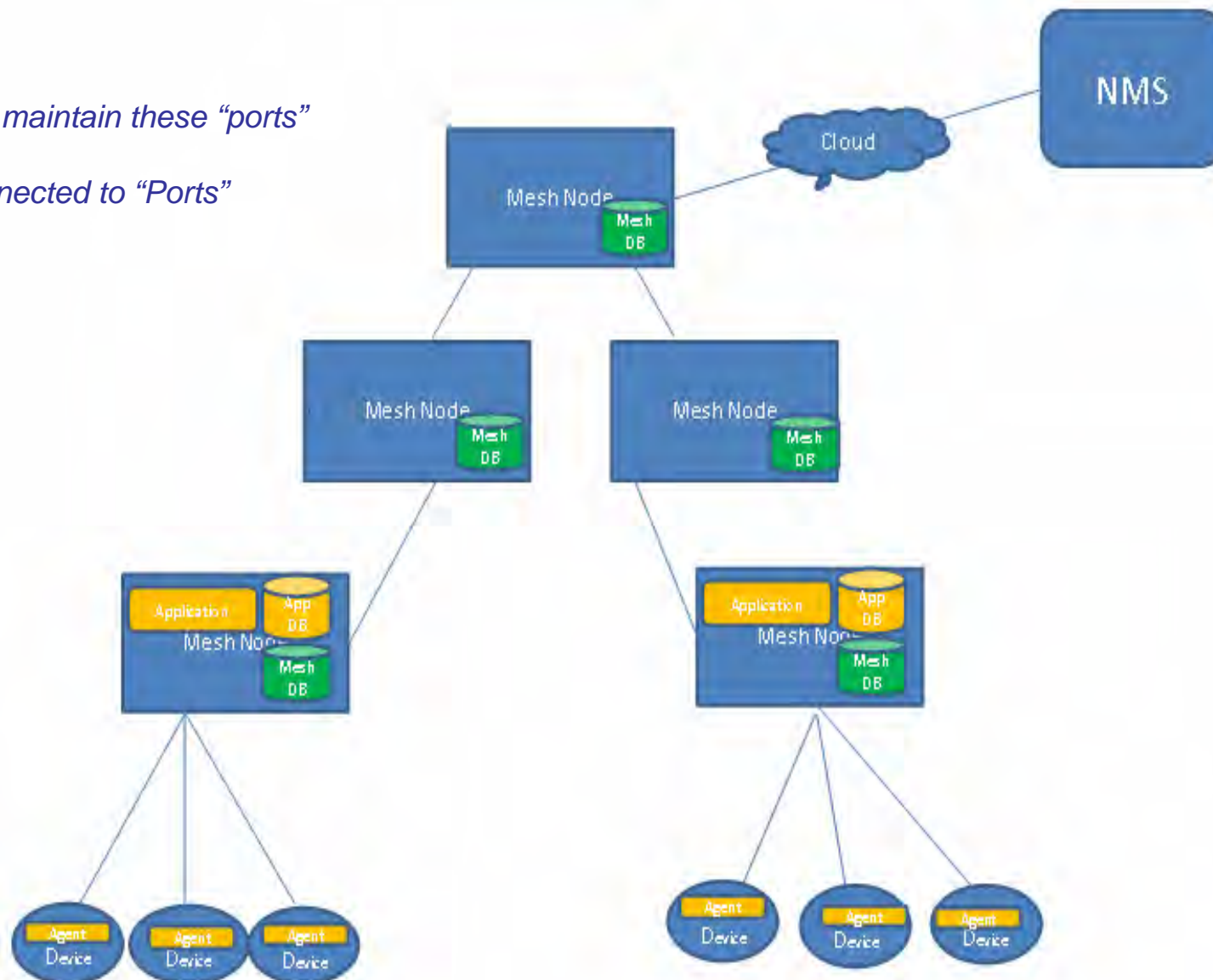


# (Autonomous) Applications Running on Mesh Node

*Mesh Tables maintain these “ports”*

*.. Clients connected to “Ports”*

..

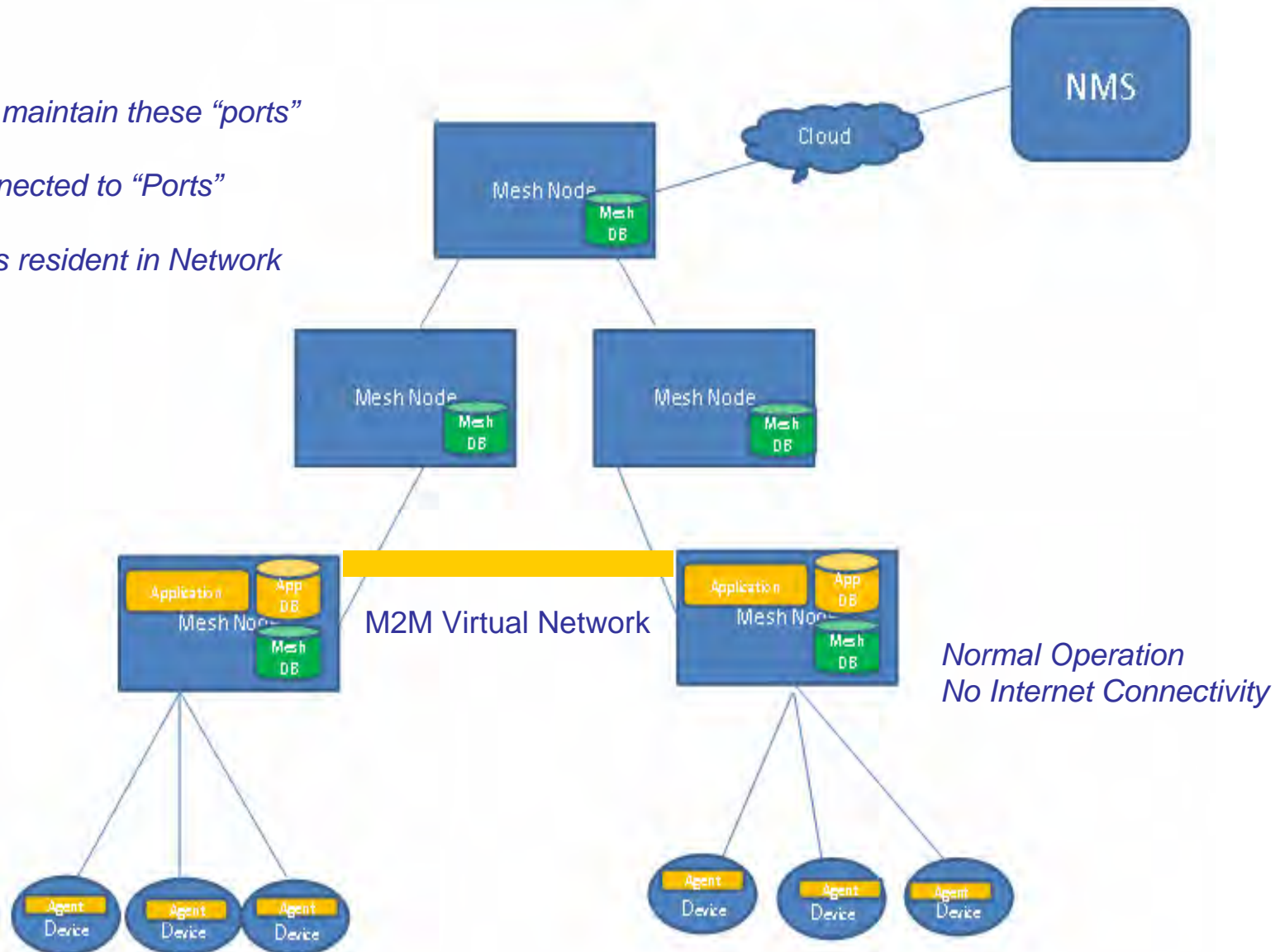


# (Autonomous) Applications Running on Mesh Node

*Mesh Tables maintain these “ports”*

*.. Clients connected to “Ports”*

*.. Applications resident in Network*



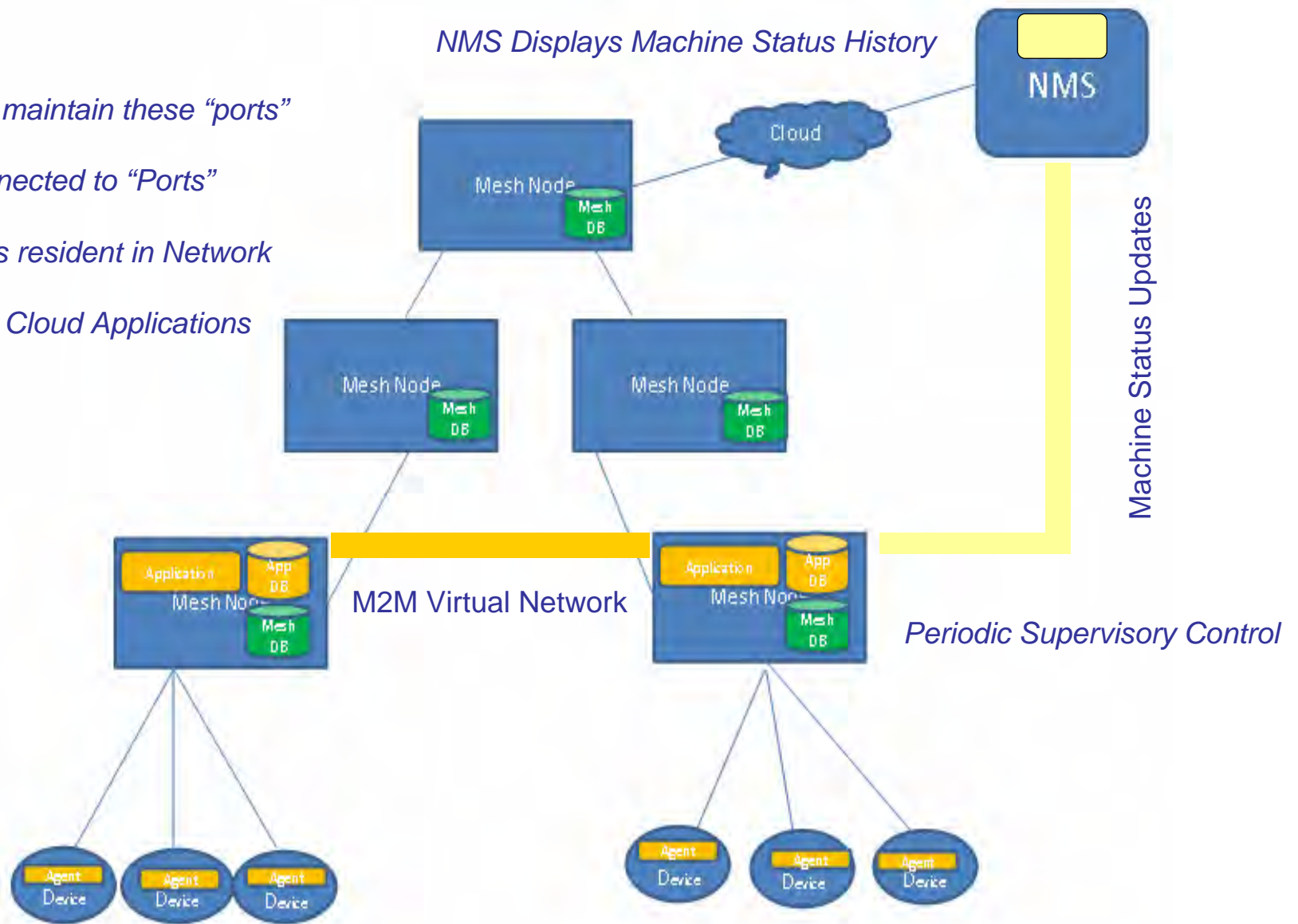
# (Autonomous) Applications Running on Mesh Node

*Mesh Tables maintain these "ports"*

*.. Clients connected to "Ports"*

*.. Applications resident in Network*

*.. Intermittent Cloud Applications*

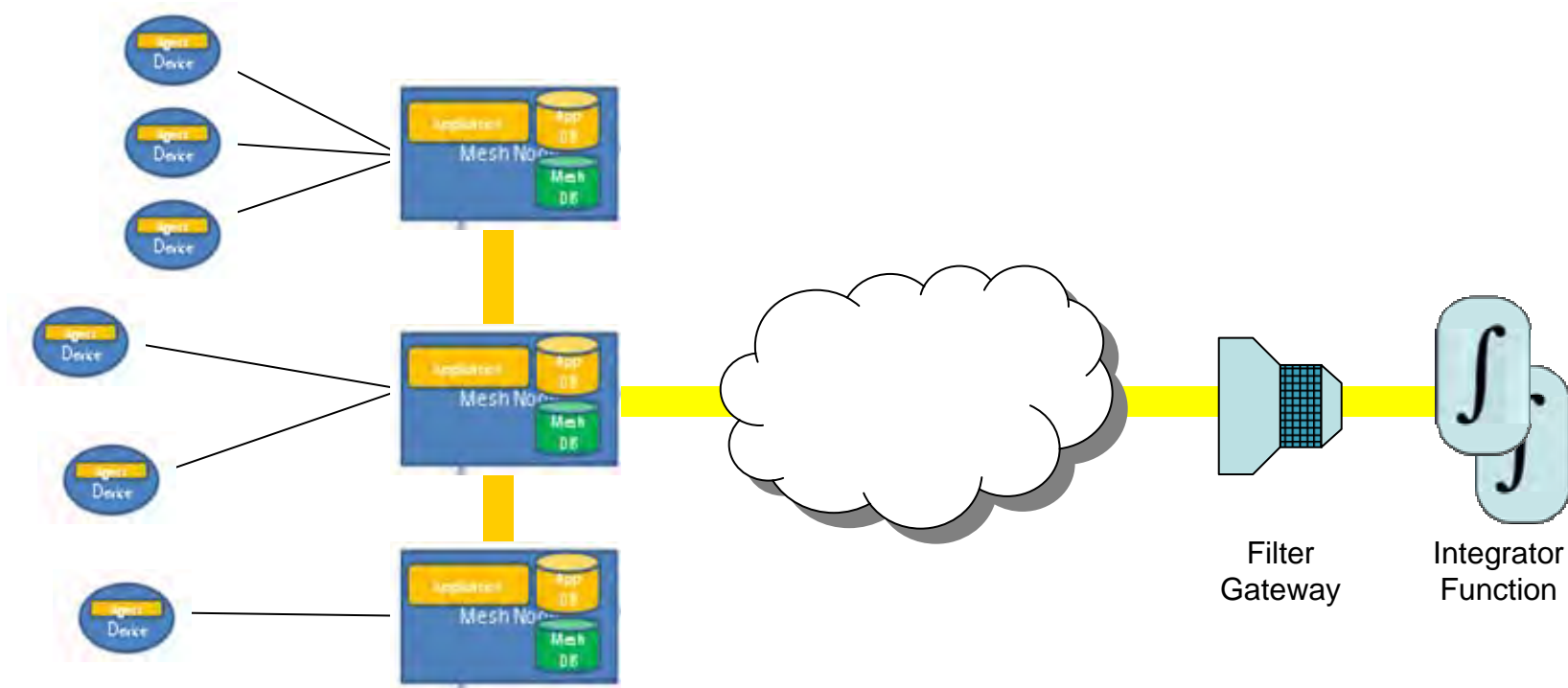


# Scalable Architecture for Internet of Things (M2M)

*Chirp Data Streams*

*M2M “Small” Data Flows*

*“Big” Data Analysis And Audit*



*Normal Operation Mode*

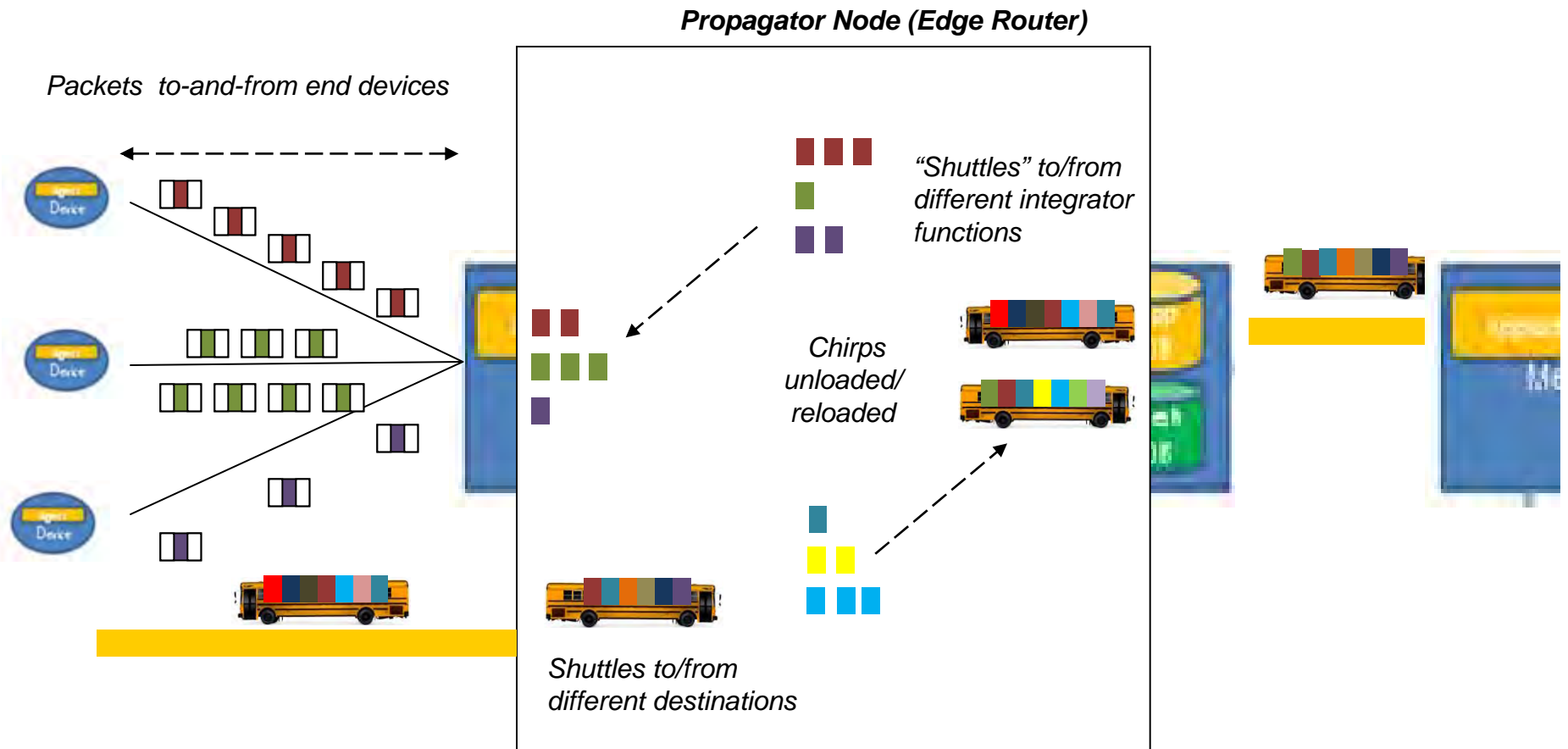
*No Internet Connectivity needed  
Run on “Small” Data Pub/Sub*

*Periodic Supervisory Control Mode*

*Cloud based applications connect  
“Small” Data Collection/Analysis*



# Scalable Pub/Sub Shuttles for Application Communities



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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*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*

# Open Standards Java Based NMS

The screenshot displays the MeshDynamics Network Viewer 7.0 interface. On the left, a 'Properties' panel for a device named 'meshap' is visible, showing details such as hardware information (Firmware Version: 2.209.0, Model Info: MD4350-AA-G), IP settings (IP Address: 192.168.0.100), and mesh settings (HeartBeat Interval: 15). The main window shows a network topology with several nodes connected by blue lines. The nodes are labeled with IDs: 4220, 38 C, 4350, 4455, and HPC:2. A 'meshap' node is also shown. The bottom of the interface features a 'Station Activity' table with columns for No, MacAddress, TimeStamp, STA Address, and Status.

No	MacAddress	TimeStamp	STA Address	Status
1	00:12:ce:00:0a:52	Mon Oct 03 13:45:13 PDT 2005	00:12:ce:00:0a:52	Associated
2	00:12:ce:00:08:06	Mon Oct 03 13:45:13 PDT 2005	00:12:ce:00:08:06	Associated
3	00:12:ce:00:08:12	Mon Oct 03 13:45:13 PDT 2005	00:12:ce:00:08:12	Associated
4	00:12:ce:00:08:12	Mon Oct 03 13:45:13 PDT 2005	00:12:ce:00:08:12	Associated
5	00:12:ce:00:08:a8	Mon Oct 03 13:46:05 PDT 2005	00:12:ce:00:09:7a	Associated
6	00:12:ce:00:09:7a	Mon Oct 03 14:40:00 PDT 2005	00:12:ce:00:09:7a	Associated
7	00:12:ce:00:09:74	Mon Oct 03 14:53:04 PDT 2005	00:12:ce:00:09:7a	Associated

Java Based NMS Engine (shown with default skin)

# NMS Customization API

support.meshdynamics.com/downloads/nmsapi/

## All Classes

[NMS](#)  
[NMS.ACLConfiguration](#)  
[NMS.ACLEntry](#)  
[NMS.ConnectedDevice](#)  
[NMS.EffistreamRule](#)  
[NMS.GeneralConfiguration](#)  
[NMS.Hashtable](#)  
[NMS.InterfaceConfiguration](#)  
[NMS.NeighborNode](#)  
[NMS.Network](#)  
[NMS.NetworkListener](#)  
[NMS.Node](#)  
[NMS.ObjectArray](#)  
[NMS.ShortArray](#)  
[NMS.Thread](#)  
[NMS.Thread.Runnable](#)  
[NMS.VlanConfiguration](#)  
[NMS.WEPSecurity](#)  
[NMS.WPAEnterpriseSecurity](#)  
[NMS.WPAPersonalSecurity](#)

[Package](#) [Class](#) [Tree](#) [Deprecated](#) [Index](#) [Help](#)

[PREV PACKAGE](#) [NEXT PACKAGE](#)

[FRAMES](#) [NO FRAMES](#)

## Package com.meshdynamics.api

### Interface Summary

<a href="#">NMS.ConnectedDevice</a>	Defines the properties of all devices connected to a <a href="#">NMS.Node</a> .
<a href="#">NMS.NeighborNode</a>	Defines the properties of all neighbor nodes detected by a <a href="#">NMS.Node</a> .
<a href="#">NMS.Network</a>	The <a href="#">Network</a> interface defines all properties and actions associated with a mesh network.
<a href="#">NMS.NetworkListener</a>	The <a href="#">NetworkListener</a> interface is used to receive events on a mesh network.
<a href="#">NMS.Node</a>	The <a href="#">Node</a> interface defines all the properties and actions that can be carried out on a mesh node.
<a href="#">NMS.Thread.Runnable</a>	The <a href="#">Runnable</a> interface is implemented by any class whose instances are executed by a thread.

### Class Summary

<a href="#">NMS</a>	NMS is the primary class for using the Meshdynamics Network Management System (NMS) API.
<a href="#">NMS.ACLConfiguration</a>	Defines the Access Control List configuration for a node.
<a href="#">NMS.ACLEntry</a>	Defines an Access Control List entry.
<a href="#">NMS.EffistreamRule</a>	Defines a Effistream QoS rule.
<a href="#">NMS.GeneralConfiguration</a>	Defines all Node level fields used by a <a href="#">NMS.Node</a> .
<a href="#">NMS.Hashtable</a>	The <a href="#">Hashtable</a> class provides an implementation of a Hashtable of generic 'Object' keys and generic 'Object' values.
<a href="#">NMS.InterfaceConfiguration</a>	Defines the interface level settings for a <a href="#">NMS.Node</a> .
<a href="#">NMS.ObjectArray</a>	The <a href="#">ObjectArray</a> class provides an interface to a growable array that stores object references.
<a href="#">NMS.ShortArray</a>	Defines an array of short integers.
<a href="#">NMS.Thread</a>	The <a href="#">Thread</a> class provides multi-threading functionality to scripting platforms.
<a href="#">NMS.VlanConfiguration</a>	Defines the settings for a Virtual-LAN in a <a href="#">NMS.Node</a> .
<a href="#">NMS.WEPSecurity</a>	Defines the information used by the IEEE 802.11 <b>Wired Equivalent Privacy</b> (WEP) setting by a Node's downlink interface.
<a href="#">NMS.WPAEnterpriseSecurity</a>	Defines the information used for the Wifi Protected Access security setting by a Node's downlink interface in an enterprise environment.
<a href="#">NMS.WPAPersonalSecurity</a>	Defines the information used for the Wifi Protected Access (WPA) security setting by a node's downlink interface.



# Example: Periodic Stream Logs



# Example: Logging M2M Data Streams

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

**Node Heartbeat Details**

Node 00:12:CE:00:11:96

TIME	SQNR	TEMP	TXPKTS	RXPKTS	PARENTS	CHILDREN
2007-10-01 15:35:47.0	23644	42	969831	320916	<a href="#">00:12:CE:00:29:6C@-44 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:1E:D4@-63 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:22:04@-61 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:16:9A@-65 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:23:24@-46 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:20:D8@-49 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:20:A2@-44 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:00:6C@-57 dBm, 54 Mbps</a>	<a href="#">00:12:CE:00:22:04</a> <a href="#">00:12:CE:00:16:9A</a> <a href="#">00:12:CE:00:20:A2</a>
2007-10-01 15:16:33.0	23567	42	966799	320129	<a href="#">00:12:CE:00:29:6C@-45 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:1E:D4@-62 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:22:04@-61 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:16:9A@-65 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:20:D8@-46 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:20:A2@-45 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:00:6C@-58 dBm, 54 Mbps</a>	<a href="#">00:12:CE:00:22:04</a> <a href="#">00:12:CE:00:16:9A</a> <a href="#">00:12:CE:00:20:A2</a>
2007-10-01 15:16:18.0	23566	42	966761	320114	<a href="#">00:12:CE:00:29:6C@-45 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:1E:D4@-62 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:22:04@-61 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:16:9A@-65 dBm, 54 Mbps</a> <a href="#">00:12:CE:00:20:D8@-46 dBm, 54 Mbps</a>	<a href="#">00:12:CE:00:22:04</a> <a href="#">00:12:CE:00:16:9A</a> <a href="#">00:12:CE:00:20:A2</a>

# Example: GPS locations from Heart Beat

The screenshot displays the Meshviewer Management Viewport interface. On the left, a 'Properties' pane shows details for a node named 'M1ED4'. The main area features a map with several mesh nodes connected by lines, with signal strength values like [-74/48] and [-47/54] visible. At the bottom, a table lists active nodes with their MAC addresses, IP addresses, names, timestamps, and signal/rate data.

Mac Address	IP Address	Node Name	Time Stamp	Model No	Rx Signal (dBm)	Rx Rate (Mbps)	Tx Signal (dBm)	Tx Rate (Mbps)
00:12:CE:00:20:08	192.168.254.51	meshap	Feb 19, 10:52:57	MD4350-AA0x	--	--	--	--
00:12:CE:00:16:66	192.168.254.31	Togor1	Feb 19, 10:52:56	MD4350-AA0x	-74	36	-73	48
00:12:CE:00:1E:D4	192.168.254.55	M1ED4	Feb 19, 10:52:49	MD4350-AA0x	-69	54	-69	54
00:12:CE:00:00:60	192.168.254.52	meshap	Feb 19, 10:52:58	MD4350-AA0x	-47	54	-51	54
00:12:CE:00:11:96	192.168.254.57	M1196	Feb 19, 10:52:56	MD4450-AA01	-69	48	-77	24

Nodes = 7, RUNNING = 7, SELECTED = 1

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*Disruption Tolerant Networks and its relevance to IOT/M2M*

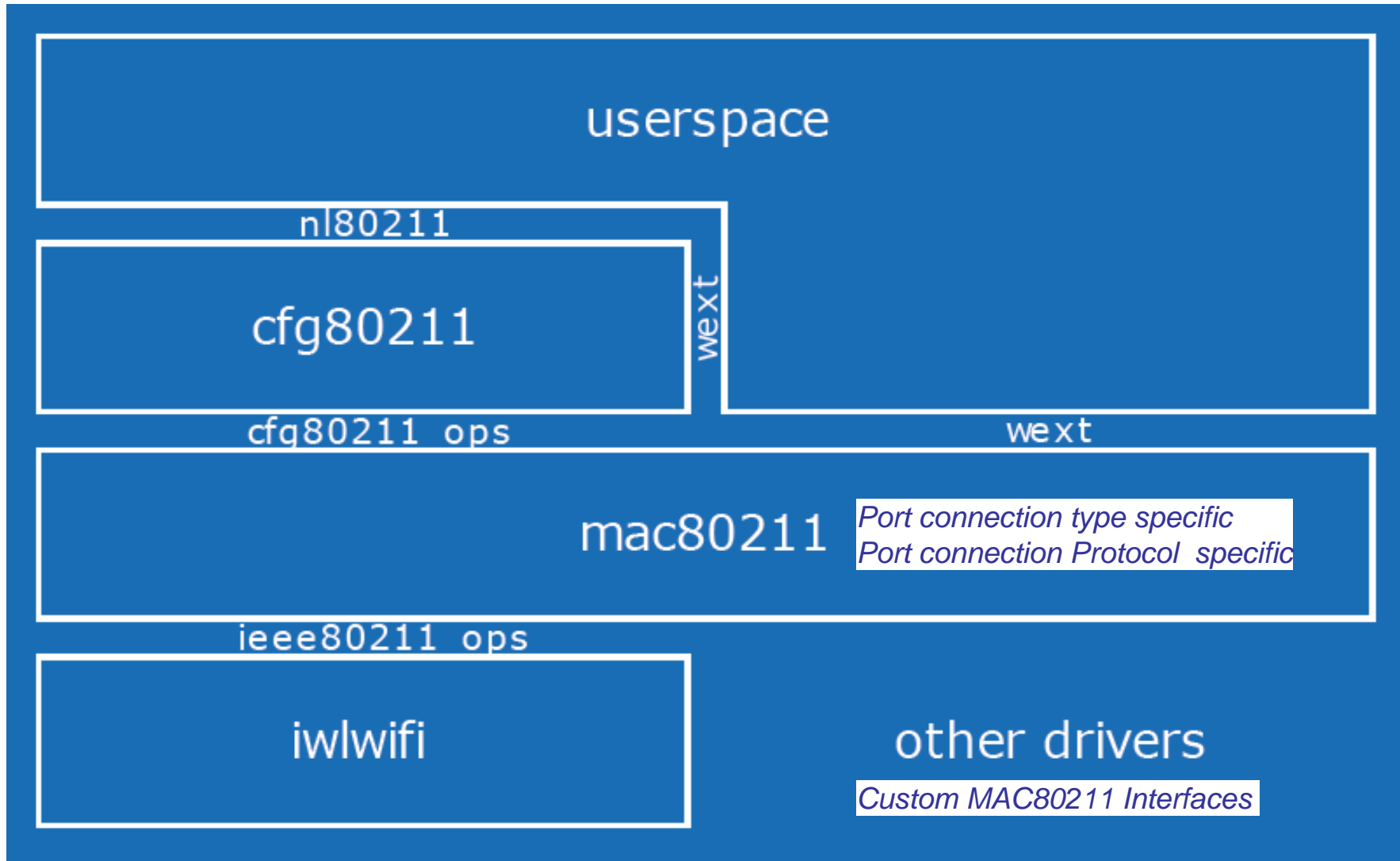
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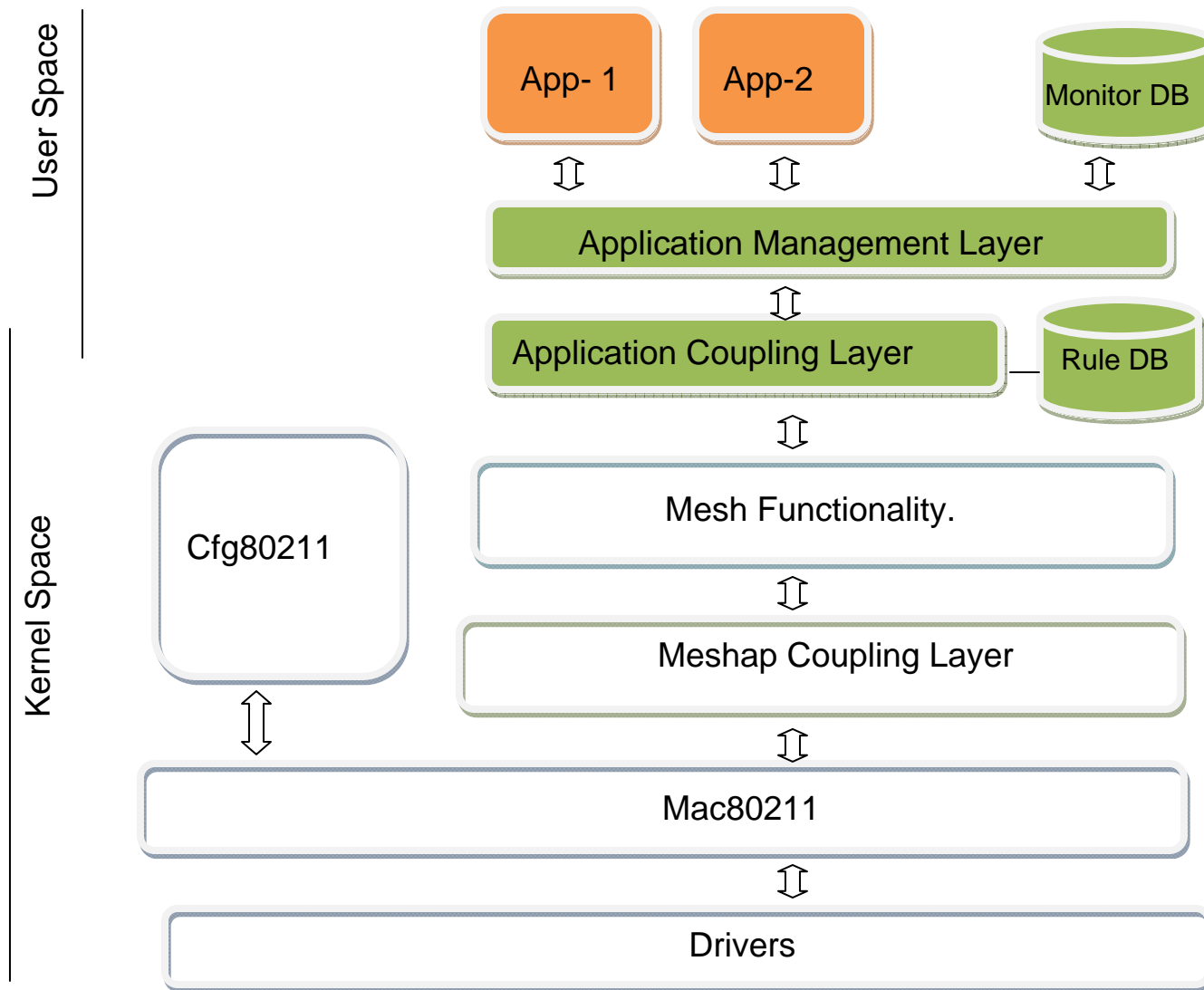


# OpenWRT + MAC80211 Network Stack

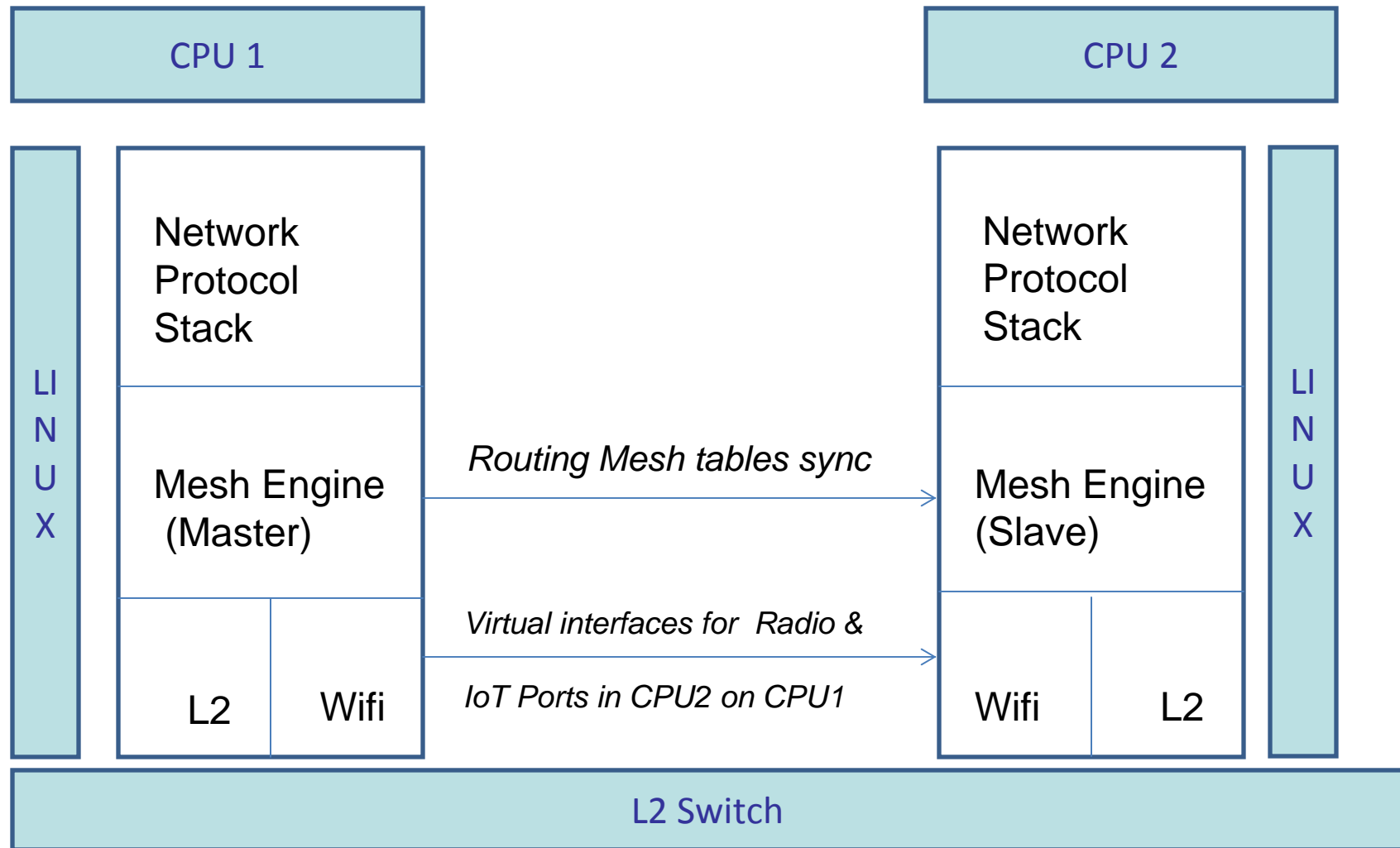


*Open Source Library of MAC80211 based drivers for 11abgn/bluetooth etc:*

# OpenWRT + MAC80211 + Applications Network Stack



# Dual Processors for Multiple High Performance Radios



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*Disruption Tolerant Networks and its relevance to IOT/M2M*

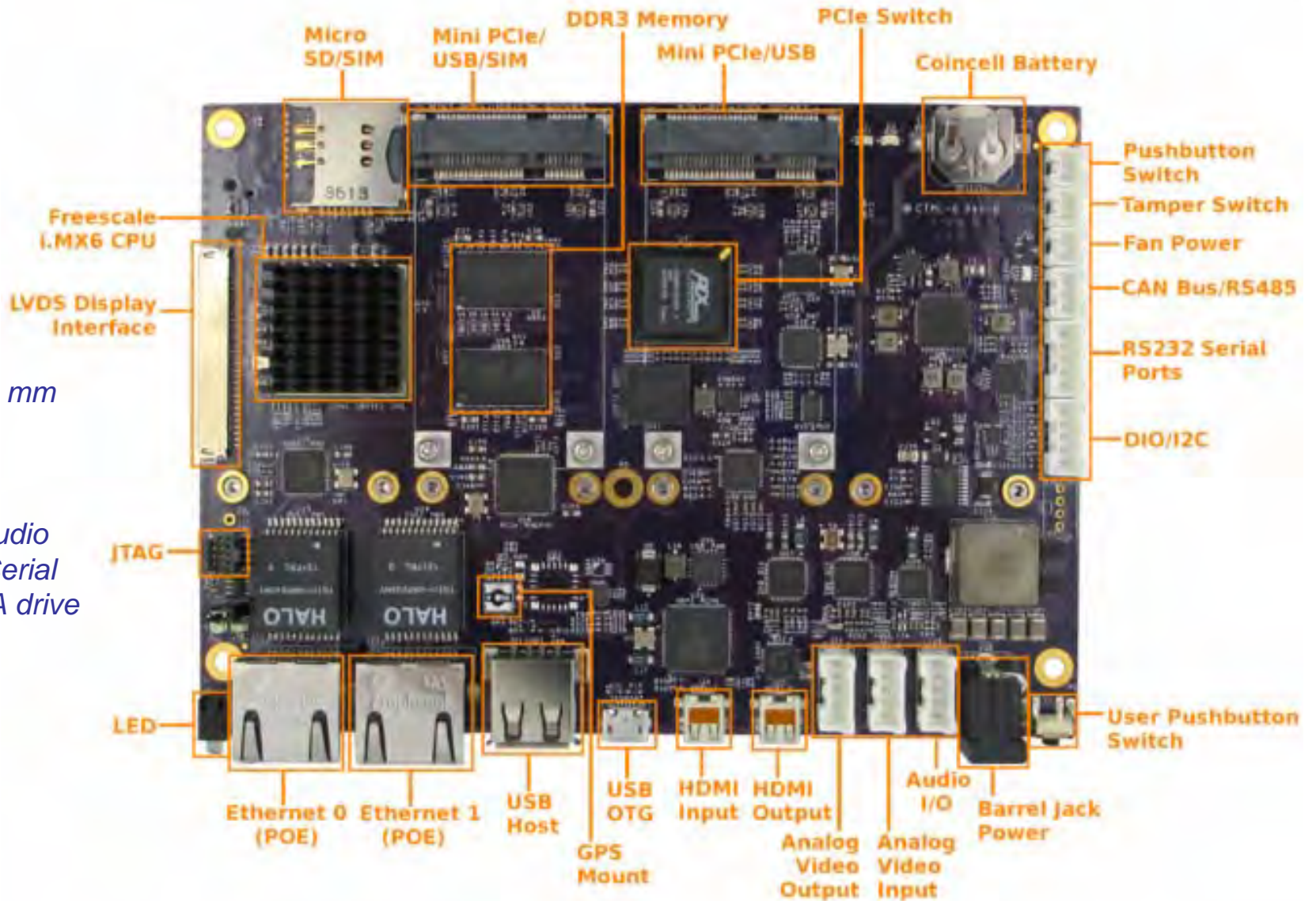
*Extensible NMS Support for DTN Mesh Networks + Applications*

*MAC80211+OpenWRT Framework for Proprietary Devices*

***Representative SBC computers with OpenWRT BSP support***



# Representative SBC with OpenWRT BSP Support



140 mm x 100 mm

6-miniPCie,

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

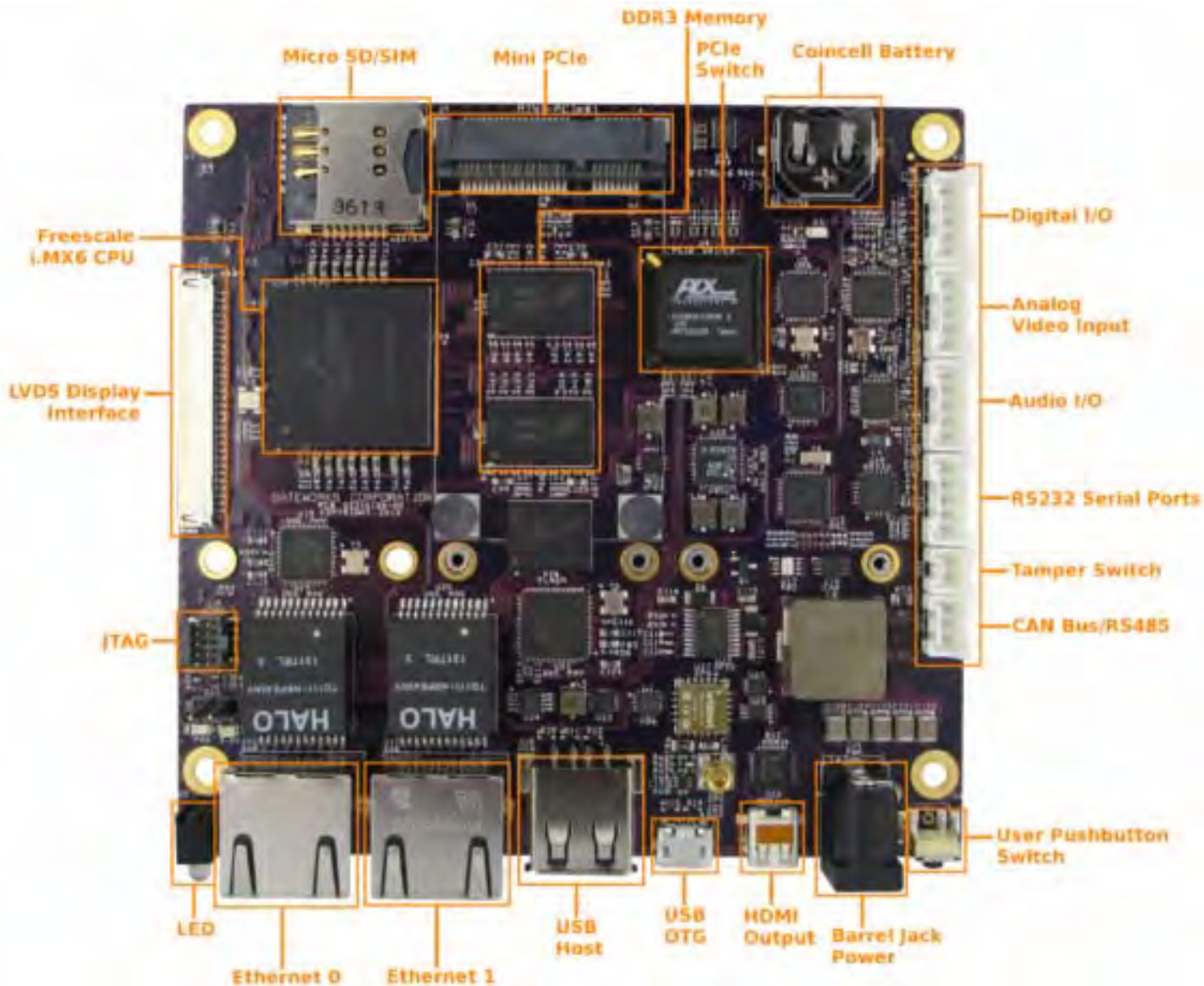
<http://www.gateworks.com/product/item/ventana-gw5400-network-processor>

# Representative SBC with OpenWRT BSP Support

105 mm x 100 mm

4-miniPCie, (3 Back)

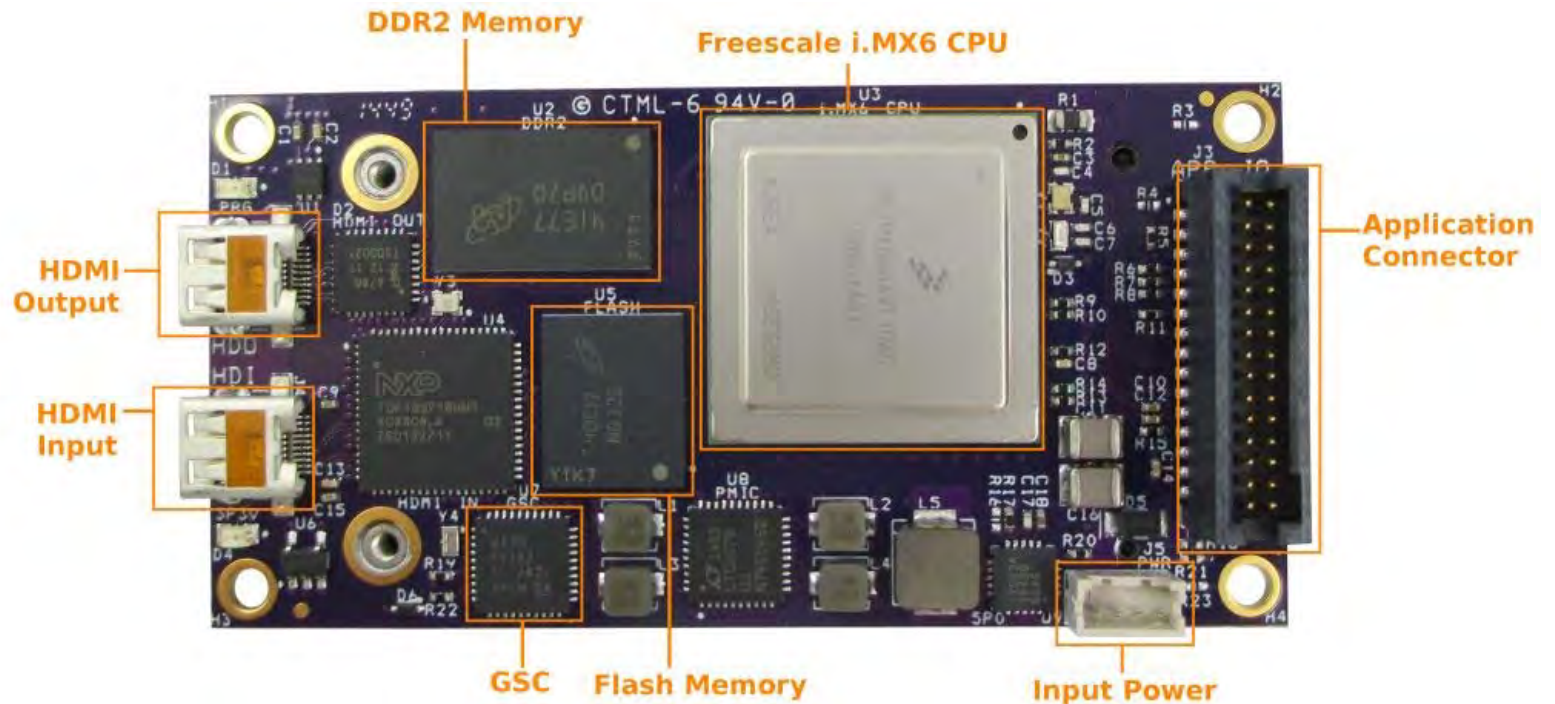
Ana. Video, Audio  
Dig. IO USB Serial  
Optional SATA drive



<http://www.gateworks.com/product/1611/veritana-gw5500-network-processor/>



# 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*

<https://wireless.wiki.kernel.org/en/users/drivers>

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