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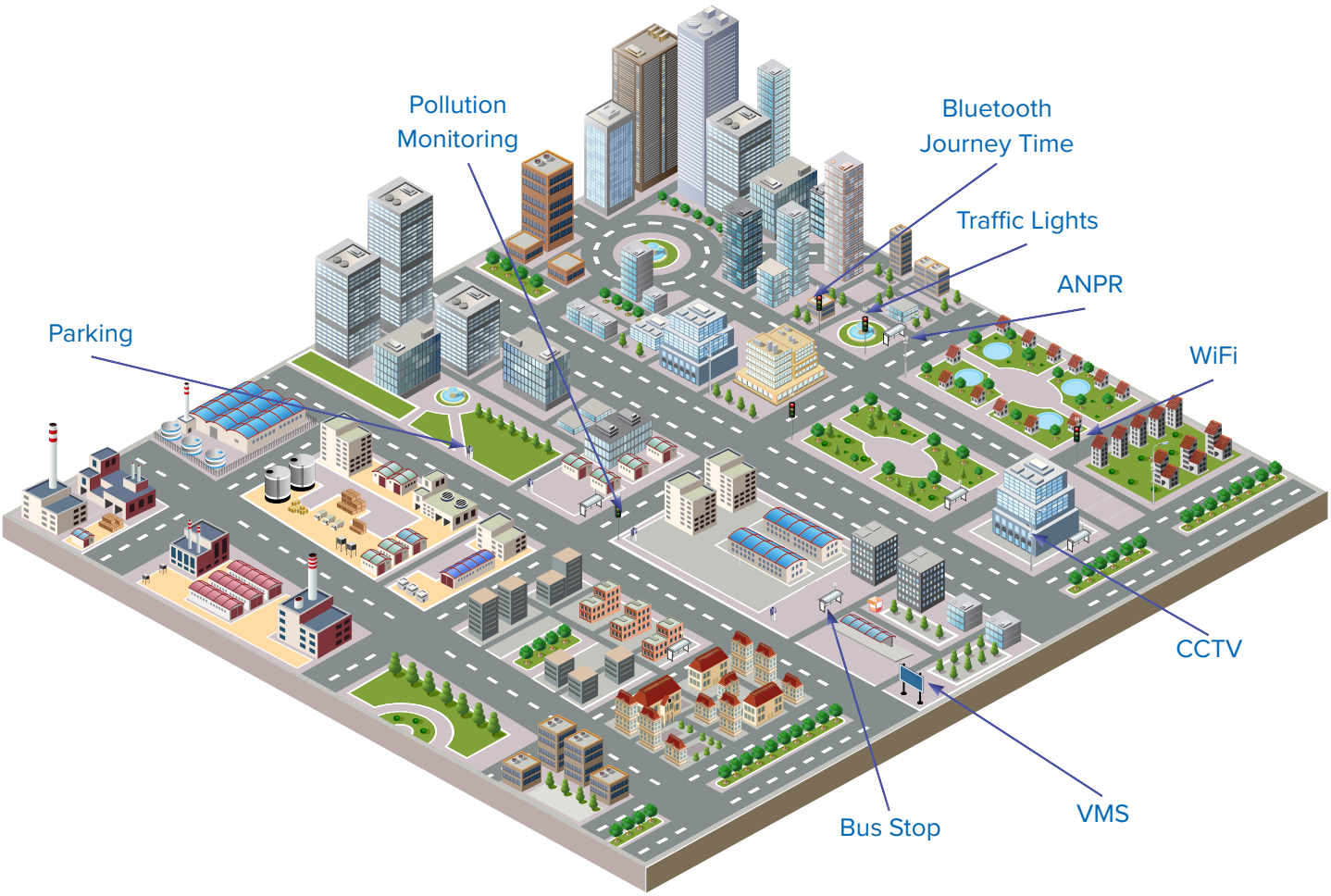
Smart City Infrastructure

AI driven pollution prevention, journey analysis and high-speed networking

Mesh4G – Smart City



Smart Cities require multiple devices to be installed on streets. By using a Mesh4G system for Traffic Lights and CCTV, any additional devices requiring communication on that road can plug into the Mesh4G system with no additional revenue cost.

Mesh4G uses a high-bandwidth link along a road to connect devices such as Traffic Lights, CCTV, Bluetooth Journey Time, ANPR, VMS, Parking Meters, Bus Stops, Pollution Monitors, Totems, Vehicle to Infrastructure and sensors. Normally each of these devices would take a separate communications link, but Mesh4G allows a street to be Illuminated with a radio signal that can be used by all devices on that street.

To finance these additional connections, as Traffic Lights and CCTV have existing connections, they can provide the cost base to cover all the other devices on street so new services such as congestion zones and toll roads can be implemented at minimum cost.

As the EU introduces more regulations for Pollution Monitoring and Co-Operative vehicles, the pressure is on City Councils to implement cost-effective and efficient Integrated Traffic Systems. Mesh4G provides just that.

Wi-Fi and other public networks can act as gateways onto the system using separate bandwidth-limited tunnels to provide both secure transport communications and public access over the spare bandwidth.

Mesh4G - Applications

Traffic Lights

Fully UTMC compliant, a Mesh Node can connect traffic lights up to 8 km distance.

CCTV

CCTV requires jitter-free transmission; the QCMR protocol of Mesh4G supports this.

VMS

VMS can be connected with a simple antenna connecting to any Mesh Node within view.

Pollution Monitoring

Pollution monitors are connected via any IoT protocol and tunnelled to servers. UTMC protocols are supported.

Bus Stop

Bus stops can be connected to any Mesh Node within view with a simple antenna.

Wifi & IoT

Wifi support and Wifi mesh support is built into the Mesh4G system. The network supports IoT devices using LoRa WiFi and Bluetooth.

ANPR

ANPR cameras can be directly interfaced to the Mesh4G system with processing local or central.

Bluetooth Journey Time

Standard Journey time works well on mesh as does real-time feed into UTMC type systems. UTMC protocols are supported.

802.11p

Mesh4G supports vehicle to road side infrastructure using 802.11p and Bluetooth.

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IA NO2 – Pollution Monitoring

The IA NO2 is a low-cost nitrogen dioxide sensor for pollution detection. It is a highly sensitive detector, designed for mounting on Traffic Lights and Lamp Columns. With alert functions and real-time data for traffic management, it provides the complete pollution solution.

The IA NO2 provides an accurate low-cost NO_2 gas sensor for the measurement of pollution. Pollution events take time from the event threshold to the NO_2 creation. By analysing traffic information, thresholds can be set in the UTMC system to avoid the pollution.

Additional information to help the detection of pollution events can be made by adding additional sensors. NO measurement is a lead indicator of pollution, as this is the gas that is converted to NO_2 by the action of NO with O_3 (Ozone).

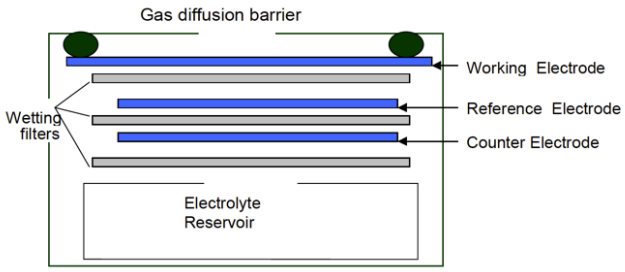
IA NO2 is part of a wide range of IOT devices to enable smart cities to operate at realistic costs. With a range of Gas Sensors, WiFi gateways, Bluetooth Gateways, Particle Sensors, ITS G5 (802.11p), Vehicle to Infrastructure, Bluetooth Journey time, low cost CCTV, ANPR and computing elements.

- Gas Sensor for NO2
- Range of Gas And Particle detectors
- 3 Electrode advanced Gas sensors
- Email alert and data
- SQL Database
- Real Time Feed
- UTMC database interface
- IoT interface

IA NO2 - Pollution Monitoring

IA NO2 GAS SENSOR SPECIFICATION

- Sensitivity 10 ppb, Calibration 2 years intervals
- Size 115mm x 60mm x170mm
- Temperature Compensated
- Response Time from zero to 2ppm <60s
- Alert Mode - Email, SMS, Web URL
- Power Passive PoE 12V to 24V
- Local or Cloud Storage SQL Server
- Temperature -30°C to 40°C
- Humidity 15 to 85 %rh
- Advanced Filtering
- Three electrode electrochemical cells
- Mounting options available
- 3G, 4G, WiFi, Bluetooth, LoRaWAN, ZigBee, Mesh



3 Electrode Gas Sensor

OPERATION

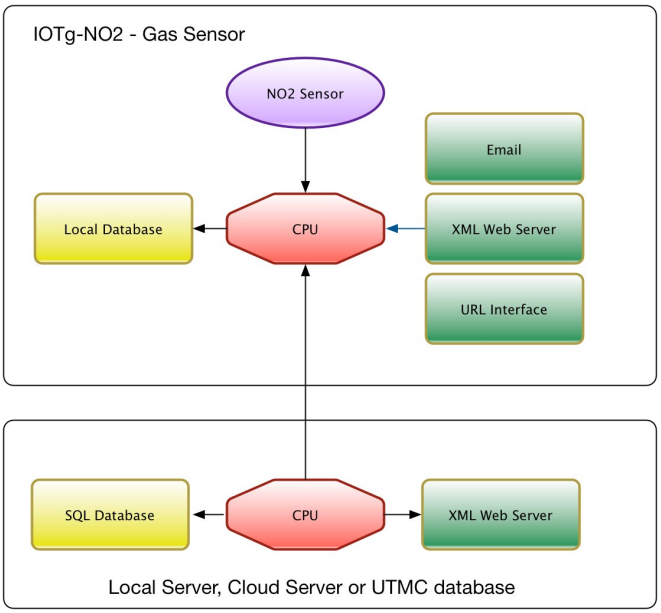
The IA NO2 operates as follows:-

- A powerful on-board computer samples the gas sensors every 60 seconds and records the data into a database.
- An average of the data is compared to preset values set on its web interface. If it detects a peak above a preset value (Web Interface setting), then it can send an email, trigger text messages or write to a URL with a data update. As a powerful Quad Core computer is included new algorithms can be added.
- A web server allows the data to be extracted by a central computer in an asynchronous operation. This process can be Cloud or WAN based.
- This information is then fed into an SQL database for analysis of Gas levels.
- A real-time XML data feed is prepared, allowing information about pollution to be used in traffic modification of timing of signals or VMS sign warnings.
- The data from the sensor is also available directly from the IA NO2 to the in-station or OTU via a simple web page on the IA NO2. This then bypasses the need for a central database server.
- An alternative to the central server option is for the detector to write directly to a UTMC server or provide a XML feed to be read by the UTMC server.

CUSTOM GAS SENSOR VERSIONS

- IA CO — Carbon Monoxide
- IA NO — Nitric Oxide
- IA SO2 — Sulphur Dioxide
- IA H2S — Hydrogen Sulfide
- A SO2 — Sulphur Dioxide
- IA O3 — Ozone
- IA O3NO2 — Ozone and NO_2
- IA CL2 — Chlorine
- IA OPM — Particulate

All of the above versions utilise identical format gas sensors. Each has different equations and temperature and humidity parameters. NO2 is in production, other units are for custom orders only at present. A particulate sensor is in development.



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IA Bluetooth M3

- Triple Bluetooth Radio
- Quad Core Processor
- Low Cost
- Journey Time Calculation
- Vehicle Communications Option UTMC and SQL Modes
- Real Time Feed
- Mesh4G, ADSL, 3G/4G

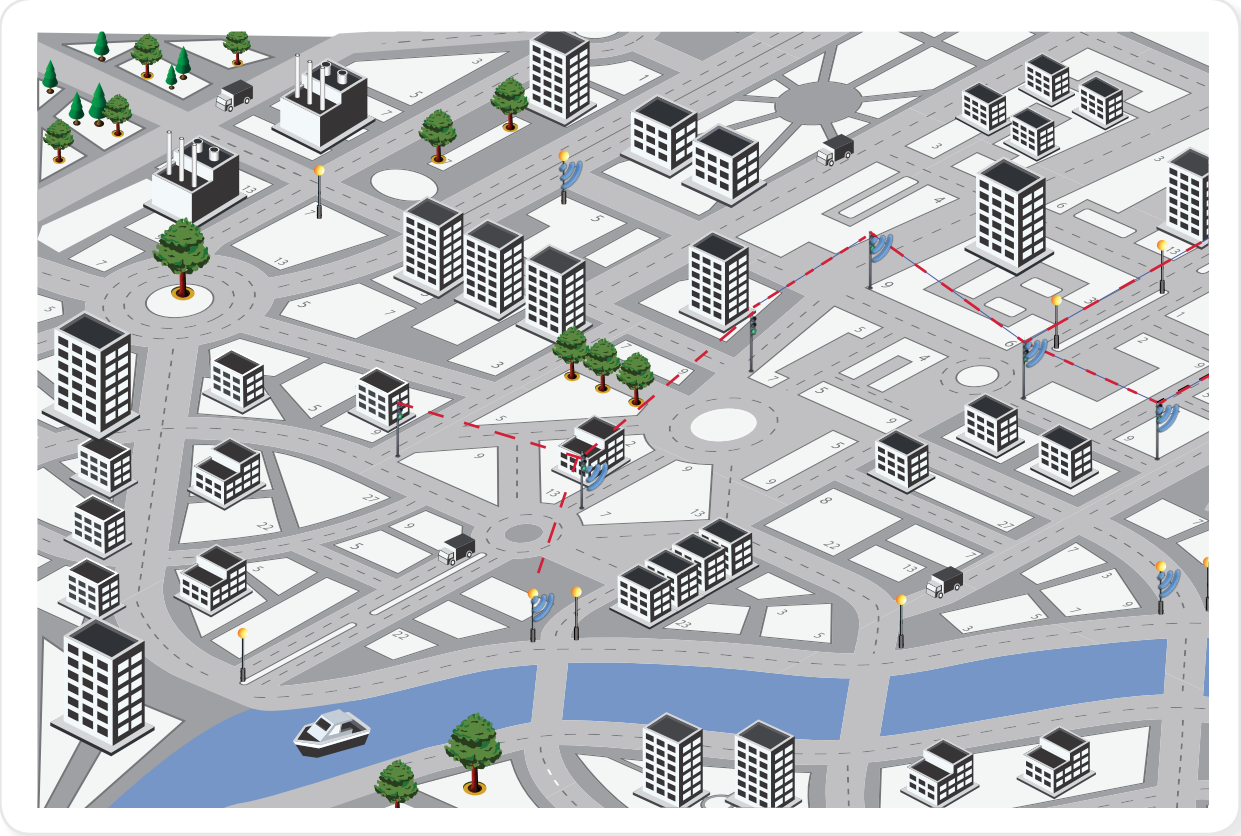
IA Bluetooth M4

- Dual Bluetooth Radio
- WiFi Radio
- Quad Core Processor
- Low Cost
- Journey Time Calculation
- Vehicle Communications Option UTMC and SQL Modes
- Real Time Feed
- Mesh4G, ADSL, 3G/4G

The results of four years of research with a leading University resulted in a 3rd generation Bluetooth radio detection system increasing the accuracy by a factor of ten over previous models. The R&D started after conducting trials with TfL for Pollution and Bluetooth Journey Time.

The Bluetooth M3 uses 3 radios to collect multiple types of Bluetooth signal; these signals are collated into Identity information and Signal Information. This is collated into an XML feed on the device which can be either forwarded to a UTMC server or collected from the XML Server in real-time. A server component is available to collect information from multiple devices and place these into an SQL server and a live journey time XML feed. This information can then be passed to local or external filtering to achieve accurate Journey Time figures.

IA Bluetooth - Journey Time



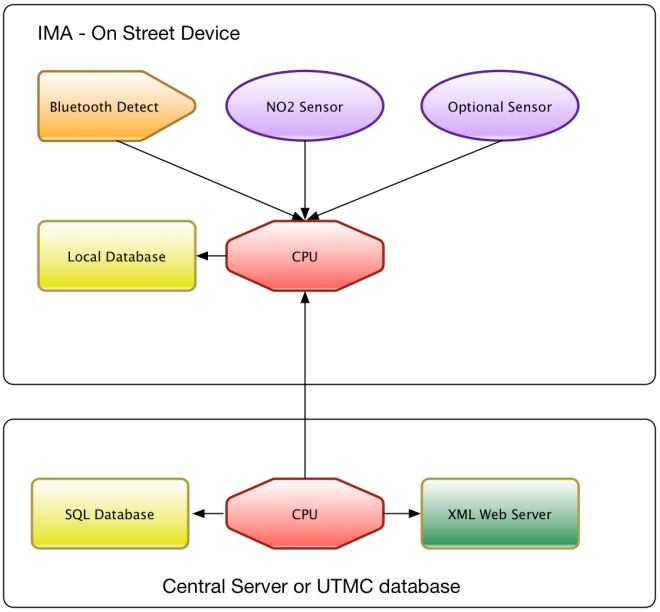
The M3/M4 Bluetooth has an ethernet interface that connects to an existing network or it can be connected to a 3G or 4G circuit. Clusters of devices can be joined by wireless Mesh to reduce the number of circuits and revenue cost, other devices can also be added such as pollution monitors and smart city traffic systems such as VMS and UTC functions.

SPECIFICATION

- Size 260mm x 140mm x 60mm
- 2 x Passive Bluetooth interfaces
- 1 x Active Bluetooth Interface or WiFi
- SQL Lite Store
- XML Web Interface
- Cloud or WAN Operation
- Post Processing Options
- Central Software Interface option

SPECIFICATION PROCESSOR

- ARM 1.5Ghz quad core CPU
- 2 Gbyte SDRAM
- Gigabit Ethernet



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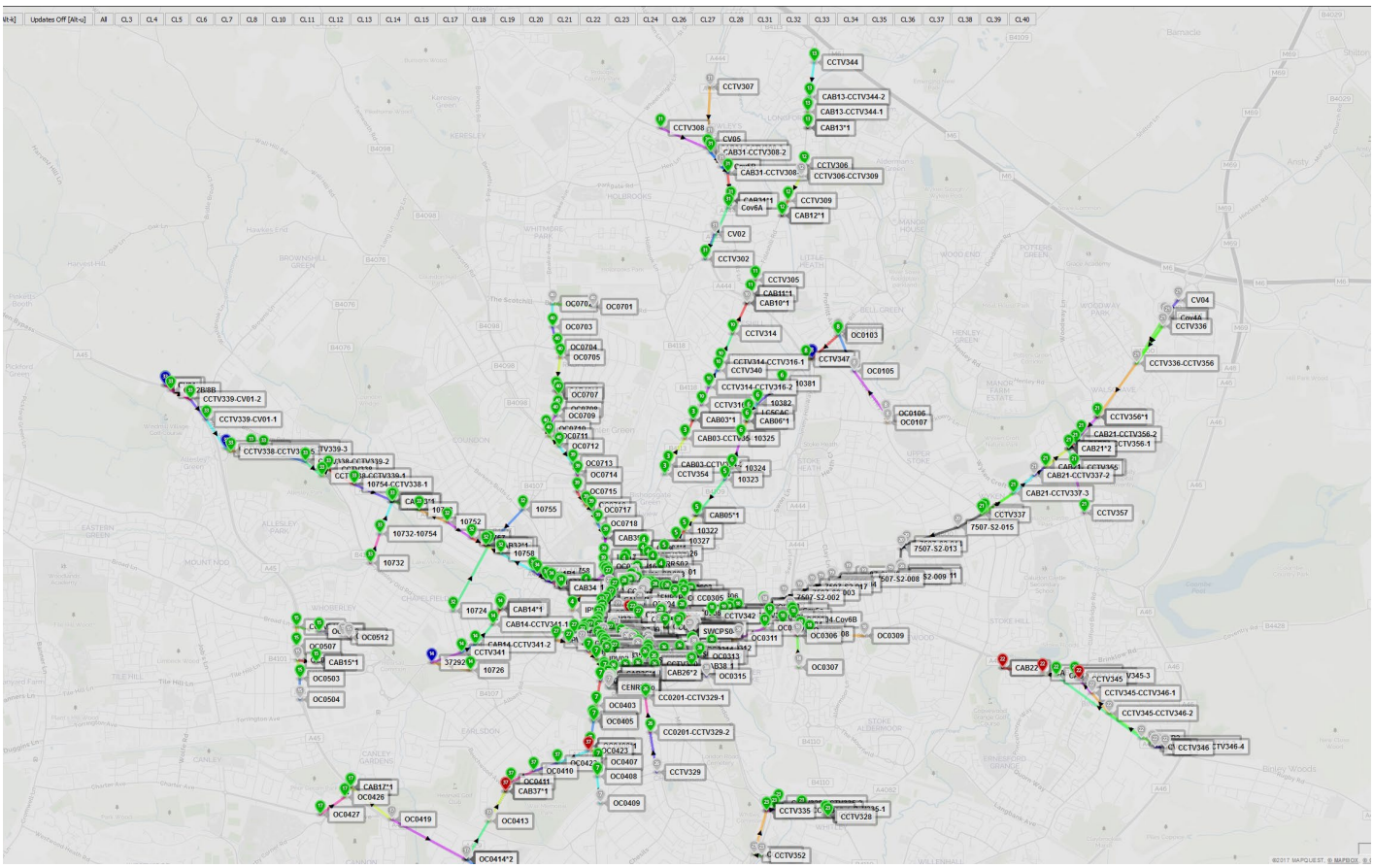
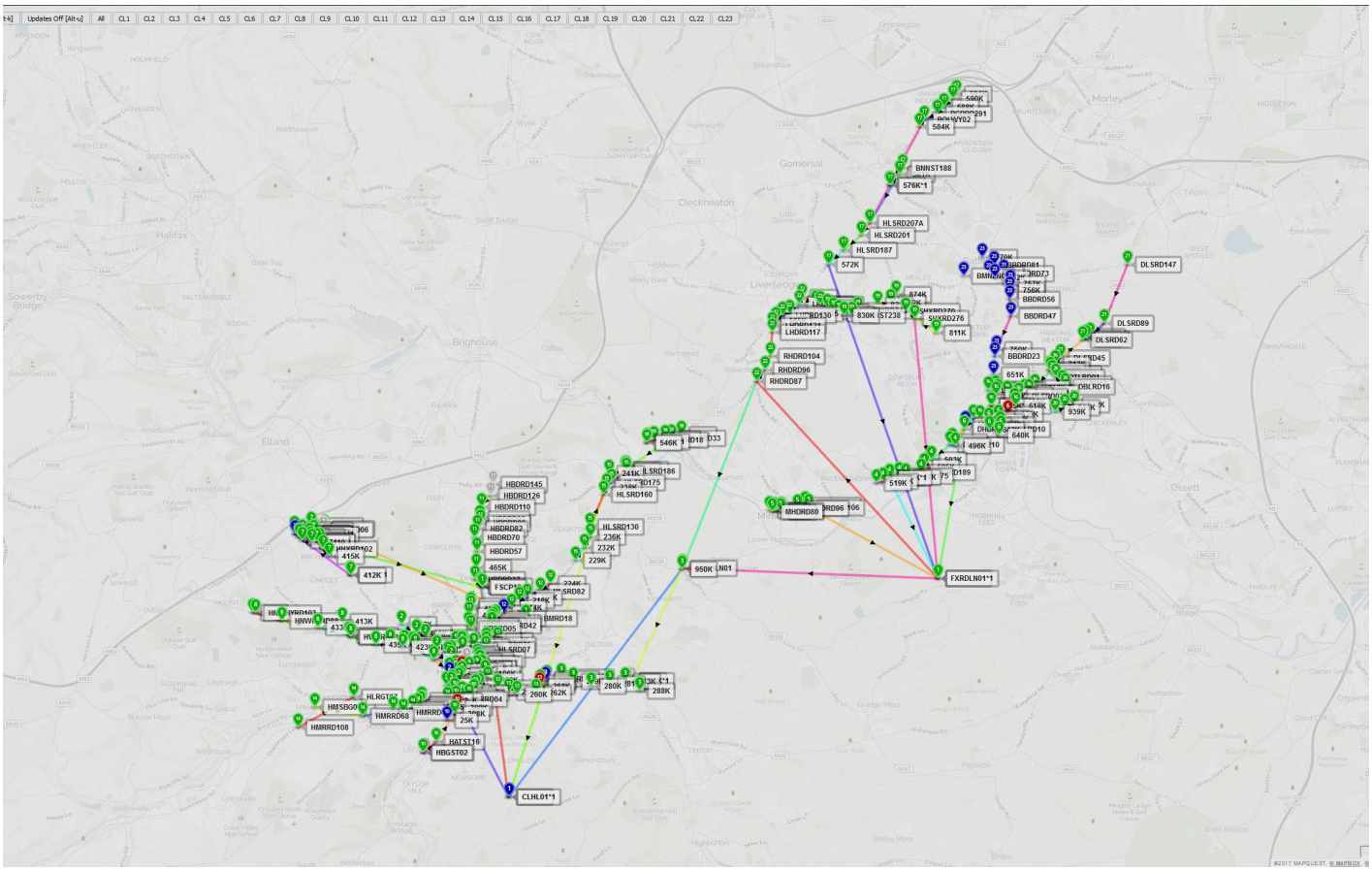
Mesh4G – Live Availability Maps

Mesh4G Smart Cities



Coventry



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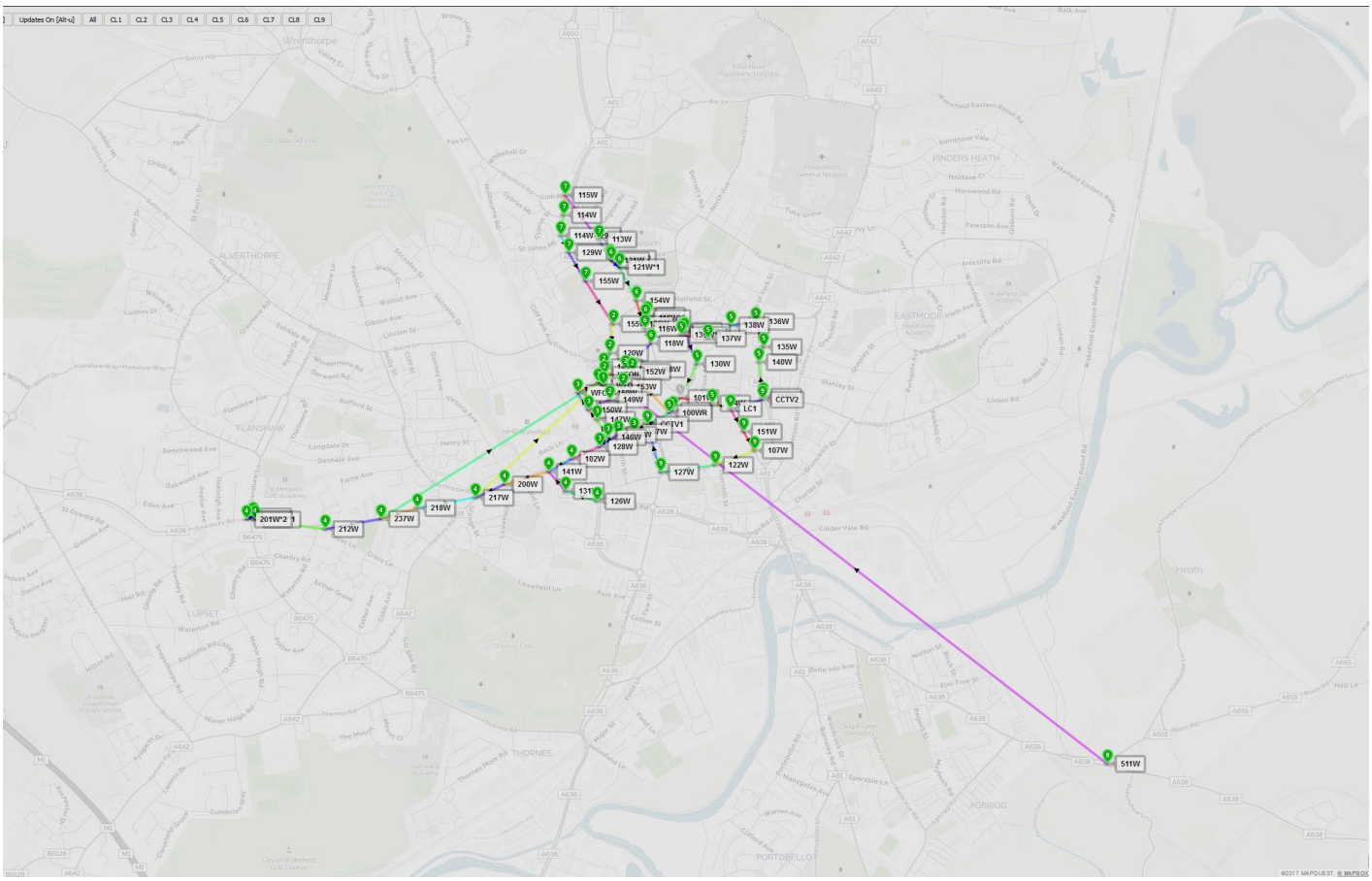
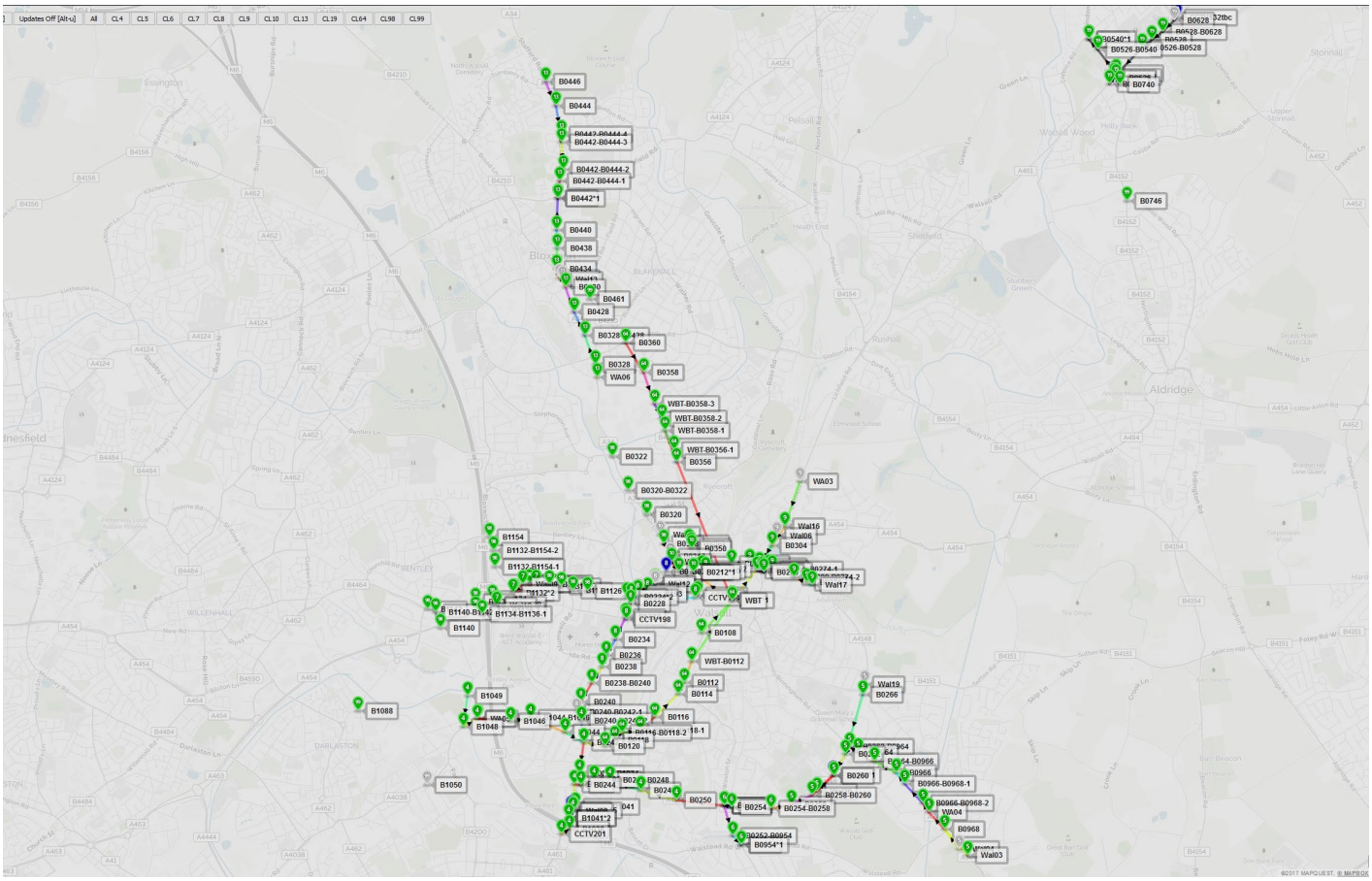
Mesh4G - Live Availability Maps



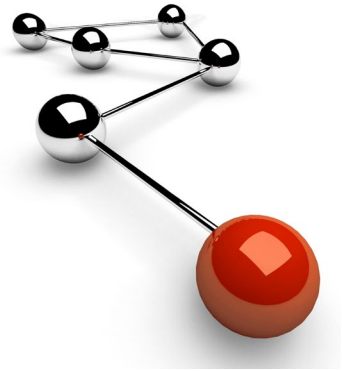
Wakefield



Walsall

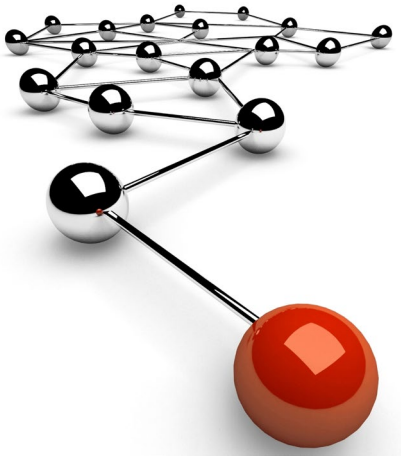
Mesh4G Wireless Network

- Mesh4G is a way of creating a communications system that reaches all the points in a campus or city with the minimum of expensive backhaul technology.
- Mesh4G creates a network of Mesh nodes and routes them over the back-haul to anywhere they are needed.
- Mesh4G can also route data between different devices on-street.



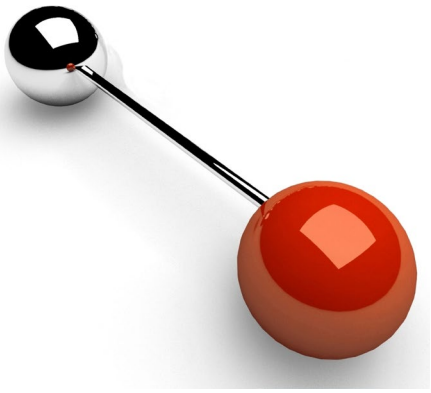
Mesh4G Operation

- Mesh4G creates a series of wireless links from the back-haul point.
- The backhaul point is connected to the Central Router that directs all external data access to the Mesh4G network; a Central Mesh Manager provides information on the network in real-time as well as management of the network.
- The wireless links connect the Mesh nodes and their connected street devices together to form a single network.



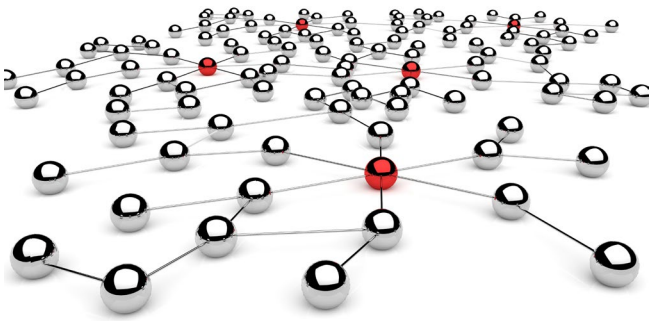
Mesh4G Basic

- A mesh starts by having a backhaul and adding another device.
- This allows two devices to share a single circuit.
- This is the simplest Mesh4G network, connecting two devices together.
- Just connecting two Mesh nodes together halves the communications cost.



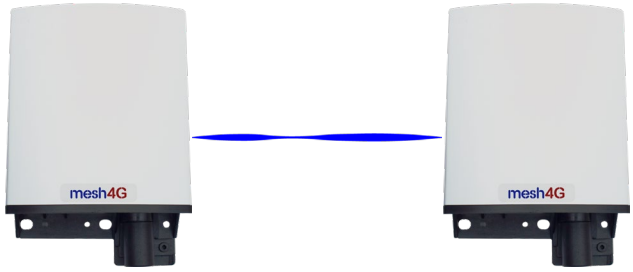
Mesh4G City Wireless

- A wireless city is created as more nodes are added to the backhaul and more backhauls created.
- Mesh nodes connect between backhauls providing resilience.
- New Mesh nodes can be added into an existing network between existing nodes or at the end of the current Mesh nodes.



Mesh4G Intelligent Antennas

- Intelligent Antennas are shipped ready-configured for immediate installation.
- They are shipped in secure matched pairs that ensure they will only communicate with each other.
- Each Intelligent Antenna is powered and managed by a Mesh Appliance called a VMAe which reconfigures Intelligent Antennas dynamically. It also provides management of the IA unit.



Mesh4G Mesh Appliance

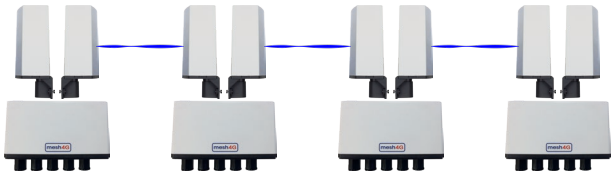
- A VMAe mesh appliance manages the links to other nodes and works through action plans to optimise transmission.
- A VMAe creates routes and secure tunnels for on-street devices to connect to their destination.
- Each VMAe provides up to four powered Ethernet ports which can drive Intelligent Antennas as well as Cameras, Bluetooth, Journey Time and Pollution Monitors and so on.

Mesh4G Mesh Node

- A VMAe is a Mesh appliance that controls the Mesh node; it has the ability to run action plans for different conditions that appear on the mesh.
- These rules are set by the Central Mesh Manager and increase in complexity as the network grows.
- A VMAe performs complex activities and there are several different software versions. These can vary from a simple mesh node to Unix-based applications server.

Mesh4G Network

- Each link is on a different frequency and can change on detection of interference.
- A VMAe creates a Mesh of the nodes in its cluster providing resilience and routing via other nodes.
- A VMAe starts at a basic level 0 software when shipped for rapid deployment. When installed and configured it becomes a level 1 or level 2 network; these levels are selected depending on the complexity of the network.



Mesh4G – Intelligent Antennas

IA 71

- 15 dBi Dual Polarised Antenna
- TDMA/QCMR Protocol
- Beam width 20/20°
- Range up to 4 km
- Throughput 200 Mbps Max
- Full mChannel support
- Power Supply Passive PoE 24V
- Frequency 5.1 GHz to 5.9 GHz

IA 72

- 18 dBi Dual Polarised Antenna
- TDMA/QCMR Protocol
- Beam width 15/14°
- Range up to 6 km
- Throughput 200 Mbps Max
- Full mChannel support
- Power Supply Passive PoE 24V
- Frequency 5.45 GHz to 5.85 GHz

IA 73

- 24 dBi Dual Polarised Antenna
- TDMA/QCMR Protocol
- Beam width 7/7°
- Range up to 8 km
- Throughput 200 Mbps Max
- Full mChannel support
- Power Supply Passive PoE 24V

IA 82 WiFi

- Omni and Directional
- 2.4 GHz and 5.4 GHz
- Multiple Billing Options
- Authentication
- Content Filtering
- Bandwidth Limiting
- Secure Tunnelling over Mesh
- Plug in to existing Mesh

IA 4G

- 3G and 4G operation
- Mesh Backhaul or Standalone
- Supports Standby Backhaul
- Single or Dual Antenna
- Bandwidth 100 Mbps down Max
- Bandwidth 50 Mbps up Max
- Power Supply Passive PoE 24V

IA Bluetooth M3

- Triple Custom Bluetooth Radio
- Journey Time
- Vehicle Communications option
- Real time operation
- UTMC and SQL modes
- Mesh, ADSL, 3G/4G operation
- Real-Time feed

IA Bluetooth M3

- Dual Custom Bluetooth Radio
- WiFi Detection
- Journey Time
- Vehicle Communications option
- Real time operation
- UTMC and SQL modes
- Mesh, ADSL, 3G/4G operation
- Real-Time feed

IA 802.11p

- Roadside and Vehicle Version
- Linux Application server
- 2 Channel 802.11p radio
- 1 or 2 Antenna Diversity
- Single Channel mode
- 10 MHz bandwidth modes
- 5.18 GHz to 5.93 GHz
- Dual 5 GHZ RF paths

IA LoRaWAN

- 8-Channel LoRa Basestation
- LoRaWAN and custom protocols
- 863-870 MHz
- Simultaneously decodes all spreading factors
- 0,3 to 40 Kbps
- Client and basestation
- FSK and LoRa

IA NO2

- 10 ppb Calibration 2 years
- Alert Mode email, SMS, Web
- Local or Cloud based
- Realtime every minute or batch
- 3G, 4G, WiFi, LoRa, Mesh, ADSL
- 3 Electrode electromchemical cell
- Integrates with Bluetooth

Mesh4G - Mesh Nodes

VMAeS

- 5 Port 100 Mbps Mesh node
- 4 Powered 100 Mbps port PoE
- Power 802,3at or 24V PoE
- Throughput 450 Mbps Max
- Temp Range -30° to 60°C
- Mesh Control Protocol (MCP)
- UTMC Compliant, CCTV stream

VMAeG

- 5 Port Gigabit Mesh Node
- 4 Powered Gigabit ports PoE
- Input Power 802.3at or 24V PoE
- MCP functions, mChannel
- Throughput 1.9 Gbps Max
- Temp Range -30° to 70°C
- MCP functions, mChannel
- UTMC Compliant, CCTV stream

VMAeA

- 4 Port PoE Mesh Node
- 2 powered 100 Mbps ports PoE
- 1 802.3af port for CCTV
- Power 802.3at or 24V PoE
- MCP functions, mChannel
- Throughput 450 Mbps Max
- Temp Range -30° to 60°C
- UTMC Compliant, CCTV stream

VMD

- UTMC & IoT Data Compatible
- VMD to VMD I/O mirroring
- UTMC XML interface for I/O
- Loop and Overhead Detectors
- Supports Siemens Heimdall
- Sensor Packages
- Allows remote serial to controller

VMAe3G/4G

- 3G/4G 2 Port Mesh Node
- 2 Powered 100 Mbps ports
- NOW Connection Software
- Dual Antenna connections
- Supports 2 cameras
- Power 802,3at or 24V PoE
- MCP functions,mChannel

LMSg/f/a/v

- Local Mesh Switch
- 5 Gigabit ports
- MCP Functions, mChannel
- Throughput 1.2 Gbps Max
- Temp Range -40° to 70°C
- Mains Power Supply
- Support ADSL/VDSL Modems
- Fibre Version (LMSf)

LMSav

- ADSL/VDSL High speed Internet
- 4 Ethernet Ports 1 VDSL port
- 80 Mbps down, 40 Mbps up
- Temp Range -30° to 70°C
- MCP functions, mChannel
- 19" Rack Mounting
- Local Mesh Switch

SMC

- Satellite Mesh Controller
- External or Internal Mounting
- mChannel Controller
- Remotely Manages Cluster
- Offloads CMC on busy circuits
- Cloud Computing Support
- Large or Cloud-based systems

CMR

- Central Routing of all Mesh Data
- Single or Dual operation (failover)
- VM Linux Router with HW router
- Cloud-based Version
- Data Centre version
- Firewall, VPN Router, Mesh Router
- Dynamic Mesh Routing Devices
- LMS Controller

CMC

- Central Mesh Controller
- Mesh Control Program (MCP)
- Actions Matrix on faults
- Real-time Configuration of Mesh nodes
- Second-by-second mesh polling
- Availability reports and maps
- Cloud-based with SMC
- VM runs on CMR

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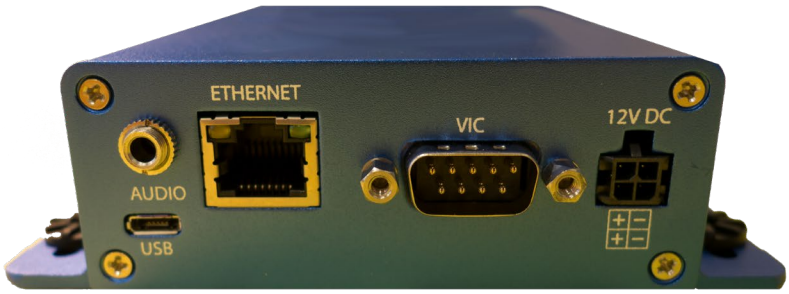
IA 802.11p - Vehicle to Infrastructure

IA 802.11P

- Roadside Device three antenna
- Linux Application server
- 2 Channel 802.11p radio
- 1 or 2 Antenna Diversity
- Single Channel mode
- 10 MHz bandwidth modes
- 5.18 GHz to 5.93 GHz
- Dual 5 GHZ RF paths



VMM 802.11p

- Vehicle Device three antenna
- Linux Application server
- 2 Channel 802.11p radio
- 1 or 2 Antenna Diversity
- Single Channel mode
- 10 MHz bandwidth modes
- 5.18 GHz to 5.93 GHz
- Dual 5 GHZ RF paths

The IA 802.11p is an Interface Series device for the Mesh4G system. It connects to an existing VMAe device and is powered from that device enabling its data to be back-hauled across the Mesh to a central or remote server. The device may also be connected locally to the VMAp 40 series processors allowing for fast processing across the local Mesh.

The IA 802.11p provides a gateway to 802.11p devices in vehicles. There are multiple operational uses for the radio: it can tunnel the information through to a application server either on street or in a central location. This tunnel would then manage the application layer from the radio connection. It can also preprocess the data by using the built-in Linux processor to provide telematic type process management. Depending on the antenna, it has the ability to use the whole 5 GHz spectrum providing a valuable connection to moving vehicles as well as the connection for Vehicle-to-Vehicle and Vehicle-to-Infrastructure. The IA 802.11p also works with the VMM 802.11p; this specialist device is designed for the vehicle and allows input of various information be transmitted over the 802.11p protocol.

C4.1003

- Interface: any VMAe
- Lens: EFL 3.6 mm f1.8
- Temperature: -30 to 70 C
- Night mode
- Optional IR LED
- High quality microphones
- 24V Passive PoE
- 1/3” 4 Megapixel HDR
- Weight: 300 g
- Size: 75 x 75 x 140 mm
- VMAeS supports 4 cameras

C4.5515

- Supported by VMAeA
- 360° pan with Auto Flip
- Day/Night H.264, Motion JPEG
- Colour 0.7 lux, B/W 0.08 Lux
- 12 x Optical Zoom
- 10 x Digital (x120 combined)
- Resolution:1080p
- Temp: -20° to 50°C
- Weight: 1.3 kg

C4.NVR

- Channels: 20 Cameras
- Storage: 500GB
- Custom Views Multiple Camera
- Browser Interface
- Media: MP4 (H.264/AAC)
- Mains Powered
- Size: 135 x 190 x 25 mm

Mesh4G is designed from the start to stream CCTV; the TDMA protocol used by Mesh4G is fast enough to support multiple cameras. The VMAe supports 24v Passive PoE cameras such as the C4.1003 fixed camera. The VMAeA supports 802.3af cameras including the C4.5515.

The CCTV solutions are generally installed on purpose built CCTV columns; however, the camera above can be mounted on Traffic Lights and Lamp Columns rapidly using the existing Mesh poles and power. They can also be moved with minimal effort to other columns to allow for flexible CCTV deployment. Both cameras are H.264 with 1080p resolution. The C4.NVR sits in the cabinet and allows it to be situated on-street to allow storage of high speed images and creation of multi-screen images without requiring all the CCTV to be back-hauled with the subsequent costs involved.

Mesh4G Smart Cities

Mesh4G is a technology that allows large on-street networks to be created and managed, easily and cost-effectively. Traffic Lights, CCTV, VMS, Totems, Bus Stops, 802.11p, pollution, ANPR, blue-tooth, Sensors, WiFi and IoT are all supported. Mesh4G is installed in 40 cities with more than 7000 nodes; it is designed for growth from 2 nodes to more than 100,000 nodes.

Mesh4G Traffic Systems

Mesh4G provides a state-of-the-art Wireless Network proven and in its 7th Generation. Capable of streaming Traffic Light data as well as providing connectivity for CCTV, VMS signs, UTMC database access, ANPR and Pollution with Journey time, both ANPR and Bluetooth. Interfaces for Traffic Counters and overhead detectors as well as the interface for the Vehicle-to-Infrastructure of 802.11p.

Mesh4G IoT

As Mesh4G is a communications transport system it can pass other protocols transparently across its network and deliver them to servers anywhere. It supports LoRa, 3G, 4G , SMS, MMS and WiFi

Mesh4G WiFi

Mesh4G uses a streamed protocol for the transfer of WiFi data across the network; it can use multiple backhaul points for Internet access or a WAN access. It supports user verification and billing as well as full Content Filtering. Support for Walled Gardens and Caching Proxies is also included.

All Specifications are subject to change without notice. E&OE