DTC

DTC Offers Enhanced MANET Mesh Networking

Rob Garth, Product Director, Domo Tactical Communications (DTC) talks to Soldier Modernisation about MANET Mesh Networks and the technology behind them

Tactical MANET Mesh networks have become a key part of the battlefield communications picture, most notably in solving the "Dismounted Situational Awareness" challenge - delivering media and data rich applications as well as video to and from the dismounted soldier. Mesh networks have many advantages over traditional military communications systems, not least in their ease of configuration, ease of deployment and in-built resilience.

But as Rob Garth, Product Director at Domo Tactical Communications (DTC) notes "Mesh networks are resilient and very tolerant to poor deployment, however to get the most out of the Mesh it is important to understand a little about the technology so that the right equipment can be chosen and sensible deployment decisions can be made."

MANET Mesh networks share some key characteristics: They are self-forming - Mesh radios or "Nodes" automatically connect or "Mesh" with surrounding units. And routing across the network should be seamless without the need for user intervention or setup. In the case of DTC's Mesh, this is achieved using Dijkstra's Algorithm - essentially a cost table routing approach, much like that in an automotive Satnav - but in this case based on the signal quality and supportable data rate for each "hop" rather than mileage or drive time.

MANET Mesh Networks are also seamlessly self-healing - if a node is removed or a link is broken, for example due to interference or the introduction of a large obstacle, then the Mesh will try and re-route via another path. For a dense cluster of nodes, this can provide significant redundancy and resilience. But Garth notes "This is not magic. The resilience achieved is dependant very much on network topology - if for example nodes are arranged in a long line, with each link operating at the extreme of its range, and the node in the middle is taken out then connectivity between the two ends of the line will be lost."

But when it comes to resilience, not all Mesh networks are the same - some are reliant on a central "Master Node" or "Mobility Controller" to disseminate routing and path quality information, which can lead to a single point of failure. DTC's mesh by contrast has no such master node and all nodes have access to the path quality information necessary to make routing decisions - "In DTC's Mesh," Garth jokes, "all nodes are created equal..."

At the air interface, most MANET Mesh systems use some form of COFDM modulation (see inset below.)

However, there are significant differences between the ways in which this is implemented by different vendors as Garth notes "some Mesh products use a WiFi derived waveform, even in some cases using the same 'chips' used in

domestic WiFi routers. In our experience, these waveforms, whilst very effective in a domestic environment, where very high data rates at very short ranges are the order of the day - are not well suited to long range links, nor operation in difficult conditions - such as under heavy interference or jamming." In contrast, DTC employs a proprietary Tactical COFDM mesh waveform designed specifically for long range and robustness in the presence of interference and multipath reflections. Moving away from Wi-Fi and other standards based technologies also has other advantages - in particular it means that DTC can offer numerous different channel bandwidth options to allow an optimum trade-off between data rate and range as well as making the best use of available spectrum.

One other way in which MANET Mesh implementations differ is in the channel access mechanism - the means by which each node is allowed access to the shared radio channel in order to transmit data. Most Mesh systems use "contention based" access - also known as CSMA - which essentially means that the Node radios listen to see if the channel appears to be free before transmitting their data. Contention-based access works pretty well when there is not much data traffic, but as the traffic level increases there is a higher and higher chance of collisions when two or more radios make a decision to transmit at the same time. The normal outcome of this is that all messages are lost and need to be sent again. "You can see that this becomes a self-feeding problem," Garth says, "the more traffic, the more chance of collisions and the more retries are required, increasing the traffic level further and leading to yet more collisions - and so on. Poorly designed networks can sometimes be brought down completely by this. Even if the network limps on, the latency and quality of service deteriorate rapidly as the number of nodes increase."

DTC takes a completely different approach to channel access, based instead around the use of an access "token" which is passed around all the mesh nodes in turn. Only when it has this token can a node transmit data, after which it passes the token on to the next node. "DTC's token-based access mechanism leads to much more efficient channel utilisation" says Garth "and also much more consistent latency - really important for low delay video applications."

DTC recently launched the SOL8SDR-H "Special Role Radio" a Mesh transceiver designed for Soldier-worn Tactical MANET networks. The SDR-H employs standard Military radio batteries and accessories and includes built in dual video encoders, Ethernet, USB and serial ports. ITAR-free and offering AES256 encryption, it also incorporates an inbuilt GPS receiver and provides a full 2 Watts of RF output power, as well as MiMo capability to support increased data rate in a given channel allocation.

Other DTC MANET Mesh radios are used in artillery applications, providing Mesh links between Fire Batteries and to the Fire Control Management System (FCMS) to allow for co-ordination of fires. Embedded DTC Mesh radios are also widely used in military UxV systems - on land, sea and in the air.

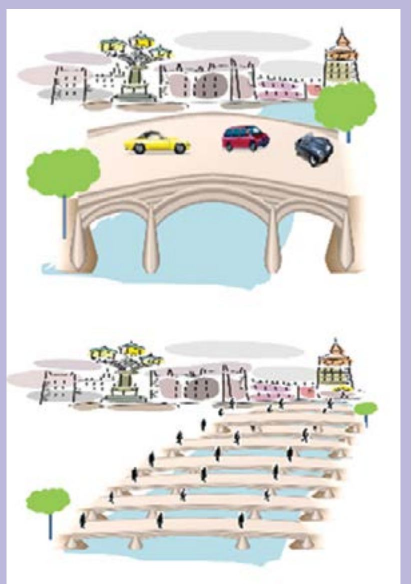
Garth concludes "We are excited to be able to offer this new 'soldier radio' form factor. But as well as offering industry leading performance, our strength is also in the breadth of our product range - for example we have a tiny 63g Mesh radio (Sol8SDR-C) which fits perfectly into small UAV and UGV applications. And at the other extreme, the highest power Mesh radios - 5 or even 10 Watts - which are great for long range maritime links. All of our Mesh products are available over a wide range of frequency bands to suit different countries and user groups." ■

COFDM Modulation

Coded Orthogonal Frequency Division Multiplexing - or COFDM for short - is today widely used in wireless mobile communications systems and for Digital Broadcasting, both Television (DVB-T) and Radio (DAB). It provides significant advantages in terms of robustness and multipath rejection over traditional "single carrier" communications systems. COFDM works by splitting the information to be transmitted over a large number of signals or "carriers," each transmitting at a very low data rate. These carriers are separated just enough to avoid interfering with each other - this is the "Orthogonal" bit in COFDM. This contrasts with traditional high speed communication links which use a single very high data rate carrier.

Garth explains "Traditional single carrier transmissions are like having a super wide bridge crossing a river. Lots of cars can cross at the same time, so if everything is ok the traffic flow can be very high. But if the bridge has to be closed due to, say cracks being found or a boat crashing into it, then no traffic at all can flow.

COFDM is like having a large number of narrow bridges across the river. Each bridge can only carry a small number of cars, but together the bridges provide an overall traffic flow just as high as the single super wide bridge. But now if a boat now hits one of these narrow bridges and maybe another one has to be closed due to cracks, yes some cars will be stopped but most of the traffic will still get across the river on the other bridges."



And COFDM systems can make up for some "bridges being closed" - carriers lost or corrupted- by employing redundant error correction coding - this is the "Coded" in COFDM.