WHITE PAPER

RESILIENT WIRELESS ETHERNET ON AN FPSO

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Resilient Wireless Ethernet on an FPSO

The need to provide Ethernet connectivity to locations round production plant or other facilities is becoming more common place due to the fact that most modern control and instrumentation equipment is now supplied with an Ethernet interface as the primary means of communicating with the device. In many cases it is simply a matter of running an Ethernet cable from the switch to the device as this more often than not provides power as well using the 802.3af POE standard.

However in certain applications such as in the Oil and Gas industry, certain equipment must be temporarily installed as fast as possible so it is not practical to run Ethernet cables between each device to a central location such as a server where the application software is run. Another such case is on an FPSO (Floating Production Storage and Offloading vessel) where a permanent Ethernet link is required between the Turret equipment room where certain items of operational equipment are installed and the Main control room where the servers are located running the application software.

Fig.1

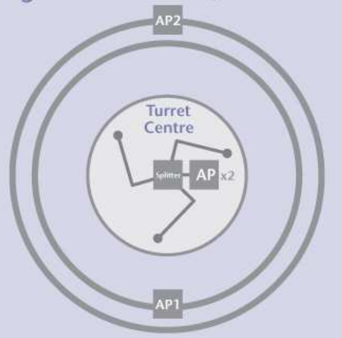
The issue here is not the inconvenience of running an Ethernet cable but the fact that the main vessel can rotate through 360 degrees around the Turret as part of the normal operation in order to maintain the most suitable position for drilling and production. The traditional way to overcome passing electrical signals over a rotating joint has been to use a slip ring device and in the case of the hazardous area industries this must be explosion proof. The existing FPSO's that have been in service for many years never envisaged having an Ethernet connection over the slip ring and more to the point the ones that have run Ethernet over slip rings have problems with the reliability of the connection as they are not really suitable for high speed communications links at 100Mbps and over. Even running Ethernet at a much lower speed such as 10Mbps can have severe reliability problems. Another problem we came across recently with a customer application was that the client's application could cope with a slow Ethernet speed, but had run out of ways on the slip ring meaning a larger one would need to be purchased and installed, which of course is quite feasible from a technical point of view but from a cost perspective it is very expensive. The cost of the hardware and installation is of course important but in this case the main cost issue of using a hardwired Ethernet over a new explosion proof slip ring was due to the amount of down time required to install and commission the device and all the while Oil or Gas would not be produced. A solution was therefore required!

The need to provide a redundant Ethernet from the main control room to the Turret switch room at an affordable price with no down time was the challenge presented to Extronics. The solution had to be highly reliable and provide a high speed link of more than 20 Mbps for layer 2 traffic. The solution must be highly resilient and if any element fails the network should be able to tolerate this and not lose connectivity. Of course with these requirements only wireless technology is able to offer a viable solution and coupled with suitably configured Ethernet switches running RSTP (Rapid Spanning Tree Protocol) a highly resilient system can be built.

There are many issues to resolve in order to design and install such a system;

One of the first is to resolve which wireless technology to use as there are a host of low cost wireless WiFi Access Points and Bridges that appear to be suitable. Applying WiFi 802.11abg devices is all well and good but they are only designed for point to point links and will not provide the best throughput and resilience.

Fig.2



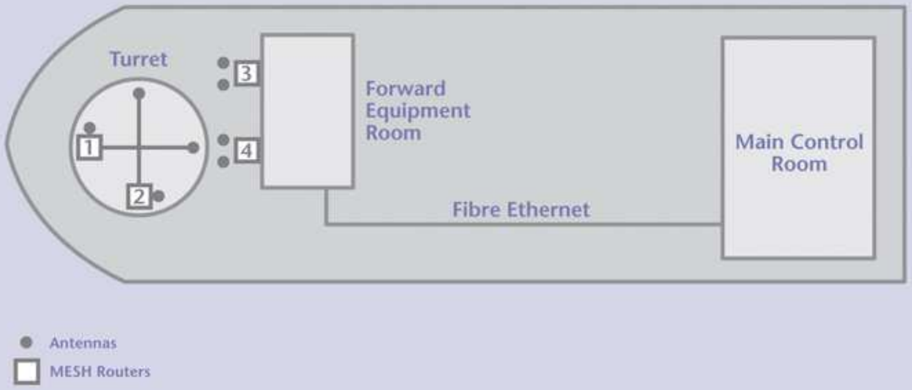
How will the radio signal propagate from the centre of the Turret from the Turret wireless nodes to the Control Room nodes due to the fact that there are many obstacles in the way at certain positions of the Vessel and the Turret. By using leaky feeder antenna technology it is possible to run a ring antenna around the complete Turret with wireless nodes in the centre with omni directional antennas so that at all times there is a wireless line of sight connection between the two.

The main issues here are that the loses in a leaky feeder cable at the regulatory powers allowed for 2.4 GHz can be a problem also at higher frequencies the distance is limited and for applications in zone 1 areas the feed to the leaky feeder must be intrinsically safe due to the cables not meeting the requirements of EN60079-14 (Electrical installations in hazardous areas) for cable construction for non intrinsically safe signals.

Interference is also major concern in such an environment. Multipath RF effects caused by the reflective metal surfaces from the vessel and pipes and background RF noise caused by large electrical machinery such as DC motors etc needs to be taken into account, otherwise a reliable connection will not be possible. The 5 GHz band was chosen as there is normally less background noise in this spectrum and it also leaves the 2.4GHz band free for a WiFi network to be installed at a later date.

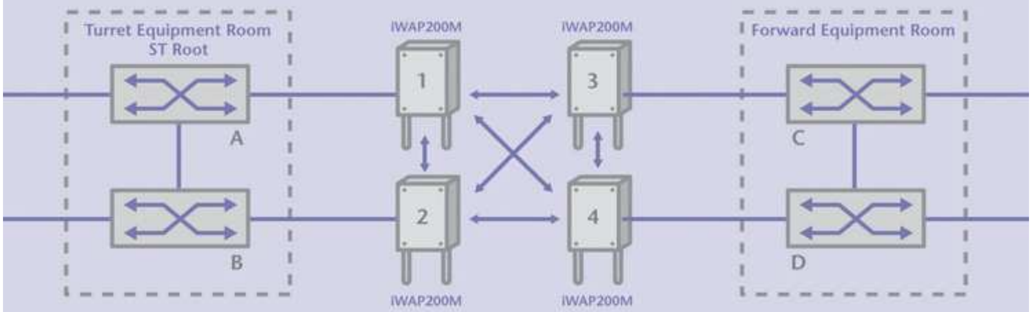
Extronics solution to these issues is to use a MESH Ethernet architecture with two dual radio nodes on the Turret with each radio configured to a different frequency and with antennas installed 180 degrees opposite each other.
Two other dual radio nodes are installed on a nearby wall of a local equipment room with antennas facing the Turret. With this configuration at least one antenna on the Turret will always have line of sight to the wall mounted nodes and with a self organising MESH the optimal signal paths are used when available and can be aggregated together offering up to 48Mbit/Sec layer 3 data throughput. In this configuration any one MESH node can fail as there is always another to carry the data, although at reduced rates.

Fig.3



The connection to the Ethernet network is via 4 industrial switches running RSTP (Rapid Spanning Tree Protocol 802.11w) for providing redundancy in the Ethernet switches. It was decided to use standards based protocols rather than proprietary for the ease of integration and familiarisation with IT support personnel. If there is a failure in a switch it will find a new path to route the data in less than 2 seconds meaning little data is lost.

Fig.4



Choosing a MESH network architecture for this application also has another advantage in that it forms the basis of a backbone to allow other nodes to be connected around the vessel for other applications where an Ethernet device is to be connected, such as an IP camera for instance.