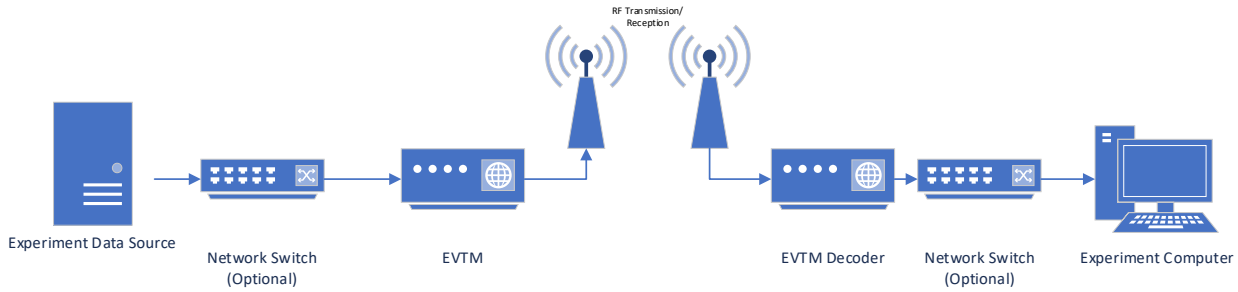
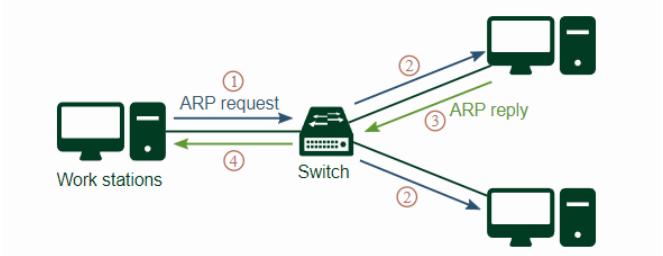
Ethernet Via Telemetry Introduction

The Nasa Sounding Rockets Program has recently acquired the ability to downlink real time data in the format of IP data packets over telemetry without any pesky reformatting on either end of the transmission. This is achieved via the Quasonix Ethernet Via Telemetry (EVTM) module. From a high-level standpoint, the EVTM and the ground-based decoder function as a transparent module that allows IP packets to flow in payload side and flow out on the ground.



Taking a slightly lower-level view than that what the EVTM is functionally doing is taking in IP data packets and converting them into RS-422 clock and data signals that can then be fed into a digital transmitter. After some RF magic that same clock and data signal is fed into the ground base decoder that reverts these signals back into the IP data packets and shoots them onto a network. There is a lot of nifty things at work at the lower levels here, the EVTM is basing its protocol on the High-level Data Link Control (HDLC) standard. But for the end user this is just nitty gritty that we no longer need to bother ourselves with.

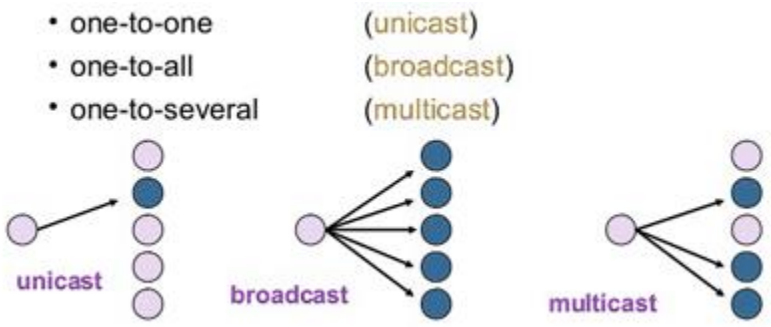
The EVTM has a max user data rate of 40Mbps and can be configured to suit the needs of the experimenter. There are some technical gotchas associated with using the EVTM and payload hardware. Given the current ability of NSROC we only offer a unidirectional capability of transmission with the ethernet packets. What this essentially means is that the TCP/IP or other connection-oriented protocols will not work in this configuration. It is highly suggested that the end user either use UDP or other connectionless style protocols. There are some gotchas that might be encountered that would normally be moot issues on a typical network. The most common is that even when using UDP some network interface cards (NIC) will send out Address Resolution Protocol (ARP) request to determine the Media Access Control (MAC) address of the NIC associated with the IP address that the datagram is intended to be sent to. Typically, this is done almost transparently because all the devices can communicate with each other on the network. With the EVTM the direction is true unidirectional, there is no way to satisfy this request and eventually the NIC might just stop attempting to send a message.



There are multiple ways around this issue. One of the most common methods is to either configure the flight device to send UDP packets to a specific MAC address thus bypassing the need for an ARP to used and resolved. This method is convoluted because most modern high level programming languages make this method difficult to send messages directly to a MAC address but hardware ethernet controllers shouldn't have the same issue since most controllers will allow a direct configuration of registers.

Another similar way is to do a broadcast message where the destination IP address is configured with the broadcast address of 255.255.255.255 which essentially sends the datagram to all the connections on the network. This is particularly easy but depending on your network topology this could cause unnecessary bandwidth. If we are working with a single source and destination, then this is adequate; you just need to keep aware that every node will be listening and will have to be programmed to handle each packet accordingly.

The final way, which is how NSROC is currently designs their on-board networks is we use a multicast group. Multicast works very similar to broadcast but only listeners that are configured to be apart of the group will receive the data. This is slightly more efficient than the broadcast method but the real gem of this is that it allows multiple multicast groups to be formed and can be configured independently of each other. This method comes in handy when functioning with an onboard ethernet switch and a more complex onboard IP network.



There are multiple ways of getting the data to the ground and it all depends on the end-user's requirements. Most sounding rocket telescope missions where there is a single source of experimental data with a single link typically could take advantage of the broadcast method. A good example would be to convert a high-rate parallel data channel into ethernet and send it down over EVTM. This would allow the transparency that the experiment community has gained with ethernet combined with the high data speeds available with modern technology. NSROC itself is working towards determining our own internal standards and with our own internal roadmap it's suggested that the experimenter work towards implementing a multicast protocol.