

APPLICATION NOTE

Unmanned Aerial Vehicle (UAV) Back-haul –

Using the Metrodata AP3000 and HSSI CE DSU to transport Asymmetric Data from the Ground Data Terminal (GDT) over Fiber or ATM to the Mission Planning and Control Station (MPCS).

About Metrodata

Metrodata is a British company based near London Heathrow. We are leading designer, manufacturers and suppliers of high performance hardware to the Military Satcoms community.

A sound technical and commercial understanding of both the Data and Satellite Communications marketplaces enables Metrodata to provide innovative products to our clients.

Our products are designed to solve Wide Area communications problems for Federal Government Departments, Satellite Service Providers, ISPs, Corporates, Carriers and Global Network Operators.

Satellite Division



UAV Systems

In 2001 Metrodata became involved with Unmanned Aerial Vehicle (UAV) Systems. We are not concerned with the specific Payload of the UAV, rather we are concerned with the Data Link characteristics that the Payload enforces on the UAV System.

Typically a UAV System will have the following elements:

- Air Vehicle
- Data Link
- Payload
- Mission Planning and Control Station (MPCS)

Ground Data Terminals Attract Hostile Fire

The Ground Data Terminal (GDT) is the ground portion of the data link. The GDT communicates with the UAV typically via microwave antenna that can provide Line-Of-Sight communications. Where this is not possible, satellite can be used.

In the past, the GDT would be co-located with the MPCS. Decisions can be made at the MPCS, as video, command, and telemetry data are all processed and displayed there. However, the RF emissions from the GDT can attract hostile fire.

So, where applicable the MPCS can be located remotely from the GDT, ensuring the safety of the Decision Makers and Controllers of the UAV. Typically this would be via Fiber Optic Cables, or if it was on an Air Base via the Bases ATM/Secure Network.

UAV System Distinctive Data Characteristics

The distinctive characteristics of a UAV System in terms of Data Comms are that the data rates are typically "odd", non-carrier data rates and that the links are asymmetric. This isn't a problem if you are co-locating the GDT and MPCS. If you need to locate the GDT remotely from the MPCS, then you still have to transport the Asymmetric, Odd Data Rate across either Fiber that supports Symmetric Speeds or an ATM Network that Supports standard Carrier Rates.

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Metrodata UAV Applications

Metrodata see several Applications within UAV Systems where we can help solve problems such as:

- Clocking the "Odd" UAV Data Rate - ie 10.671Mbps Over OC-3 ATM
- Supporting your exact data rate - ie 9.312Mbps Receive 266.67Kbps Transmit
- Asymmetric Operation - Where you connect over Symmetric Fiber Links

These Applications are from Real World problems that have been encountered. They might be slightly different from your Application of a UAV System. Metrodata are working constantly to optimise our equipment for UAV Back-haul. If you are having problems transporting the UAV Data Link over Terrestrial or Fiber Networks, then please feel free to contact us and see if we can help.

There are 3 Applications that Metrodata can provide that we are aware of:

- Remotely Locating the GDT from the MCPS via a fiber optic Link
- Controlling the UAV from a central MCPS on an air base, where the GDT is located remotely at the edge of the base
- Controlling the UAV via Satellite and back-hauling communications from the satellite teleport to the MCPS

Typically these will involve taking a Serial Satellite Modem connection from the GDT and converting this to Fiber or ATM cells. In terms of Asymmetric Operation, the best interfaces to use on the Satellite Modems are EIA530, High Speed Serial Interface (HSSI) and V.35 as these all support Asymmetric Clocking.

UAV Data Link

Metrodata offer UAV Systems the flexibility and scalability to operate between 8k and 155.52Mbps in 1Bit increments. For example, on our EIA530 Module we support 20 million different data rates as we have a Max speed on EIA530 of 20Mbps. If you had 64k increments that would only be 312 different data rates.

We can match the data rates of the UAV Data Link.

Usually the up-link is a few kHz, simply providing flight-path control information to the UAV and commands to the UAV's payload. The down-link consists of 2 channels. A low data rate channel to acknowledge commands to the UAV's payload, to acknowledge flight path control requests and to transmit information about the UAV. The high data rate channel usually transports either video or radar. This data rate is typically between 1Mhz and 10Mhz.

Several different elements combine here to give the odd data rate:

- Availability of Satellite/Microwave may not be constant or fixed.
- Capability of Satellite Modems used to take the RF from an Antenna on the GDT
- Weather may affect the usable Mhz
- Encryption Overhead, FEC, MPEG Framing on the Video

One thing to consider is that to most Data Comms Manufacturers 9.312Mbps is an "odd" data rate, but to Metrodata it is simply the Maximum Data Rate that some Satellite Modems run at (for example the Comtech EFDATA SLM8650).

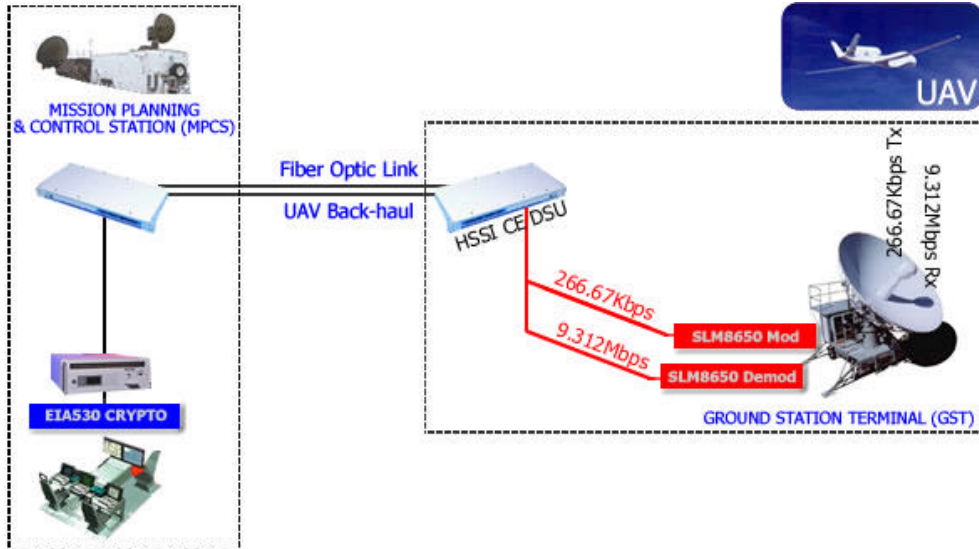
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Remotely Locating the GDT from the MCPS via a fiber optic Link

Fiber Optic Cable is widely used in the tactical environment, mainly due to the fact it does not suffer from Electromagnetic and Radio Frequency Interference (EMI & RFI). This can affect data integrity and cause corruption on non-fiber links.

Using the HSSI CE DSU we are able to drive the Asymmetric Data Rate from the Ground Station Terminal up to 70 Kilometres (dependent on fiber type). In this instance the data rates are 266.67Kbps Transmit of communication/payload controls signals and a Receive of 9.312Mbps which is the maximum bit-rate achievable on the SLM8650 Satellite Demodulator used.



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Controlling the UAV from a central MCPS on an air base, where the GDT is located remotely at the edge of the base

Within any airbase, there will be a given Transport Infrastructure for data. Typically this is ATM, due to the ability of this protocol to transport different traffic/application/service types. The ATM network may be extended by using Fiber Optic Cables, Microwave Radio etc. The ability to interconnect the UAV Control system into the Air Bases Secure network is important. This requires a connection from the Fiber Optic Devices to a Secure ATM Cell Crypto, which in turn connects into the ATM Switch. At this point, we connect the HSSI CE DSU to the Ground Station Terminal. The MCPS end of the link is identical.

In this application the data rates are slightly different. 266.67Kbps Transmit and 26.67Mbps receive. This can present a problem as the EIA530 Satellite Modems go up to only 9.312Mbps. As EIA530 only goes to 20Mbps, in this application we are going to use an EIA530 Satellite Modulator and a High Speed Serial Interface (HSSI) Demodulator.

As this means we are supporting 2 different physical interfaces on the Satellite Modems, we need to support 2 Physical interfaces on the HSSI CE DSU. With its in-built functionality it is possible to present this as a single physical HSSI interface to the MCPS at the far end of the link. This single interface would support both rates and present a 26.67Mbps and 266.67Kbps data rate.

Controlling the UAV via Satellite and back-hauling communications from the satellite teleport to the MCPS

Metrodata offer UAV Systems the flexibility and scalability to operate between 8k and 155.52Mbps in 1Bit increments. For example, on our EIA530 Module we support 20 million different data rates as we have a Max speed on EIA530 of 20Mbps. If you had 64k increments that would only be 312 different data rates.

Use the HSSI CE DSU



HSSI CE DSU

In terms of transporting odd, asymmetric data rates Metrodata have had a solution for the past 3 years. The device we commonly use is the Metrodata Access Processor or AP. The AP comes in 3 slot, 4/5 slot and 8/9 slot Chassis. The HSSI CE DSU evolved from the AP3000, but has several features built into it that the AP does not have. The HSSI CE DSU is also evolving all the time. The HSSI CE DSU contains a lot of functionality, all in 1U of rack space.

For example, the HSSI CE DSU has the following features as standard:

- Single High Speed Serial Interface (HSSI) to 90Mbps
- Single Multi Standard Serial Interface to 20Mbps. This is EIA530, V.35, X.21, RS449, RS232
- Supports Asymmetric or Symmetric Clocking
- 1Bit data rate increments from 8k to 90Mbps
- Multi-mode SC, Single Mode Short Haul and Long Haul Fiber Interfaces
- E3, DS-3 and OC-3 ATM Port
- ATM or NON-ATM on the Serial Port
- Comprehensive Monitoring and Diagnostics
- SNMP Remote Management

Currently we are planning to add Inverse Multiplexing Over ATM of T1's and E1's to the HSSI CE DSU. This will allow the cost-effective back-haul of Sub E3 and DS-3 Asymmetric links.

Where the above applications require either a Redundant Power Supply Unit or Multiple UAV Connections Over a single link then we would specify the AP4000 or AP8000. We can also use WDM technology to transmit and receive on the same fiber link using the AP, and so could transport 4 x HSSI each at 51.84Mbps Over a Fiber Pair.

Reducing the Overall Satellite Terminal Cost

Because the Ground Station terminal (GST) can attract hostile fire, it needs to be as cost effective as possible. In some instances it may be destroyed, damaged beyond easy repair or left in the field. The use of commercial satcoms equipment can reduce the cost of terminals. Here at Metrodata we took this idea one step further. We looked at the exact requirements in terms of scalability, flexibility and functionality and made a device specifically for UAV System back-haul. We stripped out all the components that weren't required to do the job and made the device as cost-effective as possible.

This is the HSSI CE DSU. We hope to add greater functionality to it, as we receive requirements to do so. If you have a requirement/problem that is UAV specific or Military Satcoms specific let us try and solve it for you.

Satellite Division



UAV Systems and Current/Future Payloads

The use of UAV's and Unmanned Combat Aerial Vehicles (UCAV) is becoming more commonplace. The payloads are becoming more diverse, each with its own requirements in terms of data links. Some only require low data rate channels, and some require high data rate channels. These payloads might be:

- Video Cameras - Daylight or Night (Infrared) for reconnaissance
- Film Cameras - Taking stills
- Laser - For target designation
- Radar Sensors - Moving target indicator and synthetic aperture radar
- Electronic Warfare (EW) Systems - Signal Intelligence and jamming equipment
- Explosive/Lethal payloads

Because Metrodata support 1Bit data rate increments from 8k to 155.52Mbps we feel we have all the data link rates covered for the payloads above.

Contact Details

Listed here are both Metrodata contacts for your convenience:

Further Application Notes are published regularly on our website. Military Satcoms are available from here: www.metrodata.co.uk/federal

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