Briefing on Unmanned Aerial Vehicles (UAVs)

March 2011

Following our recent briefing on ***Spread Spectrum Technology***, Telesat has received requests from customers and business partners for a high level view on Unmanned Aerial Vehicles (UAVs) and the role that satellite communications play in their operation and control.

This paper has been developed in response. We hope you find it a useful overview and would welcome any feedback or questions you may have.

Introduction

UAVs have become an integral part of defense, peacekeeping, border patrol, drug interdiction and disaster management. With the advancement of technology, these vehicles can fly over increasingly greater distances and for longer periods.

UAVs are launched using a LOS (line-of-site) communications link; however, once the UAV reaches its intended altitude or loses the LOS communications, it switches to BLOS (beyond-line-of-site) communication, or a satellite link.

Telesat, as one of the largest satellite service providers in the world, operates a fleet of satellites strategically positioned to offer BLOS connectivity for UAVs.

Service overview

Typically, UAVs are controlled by ground pilots using a narrowband forward link, while the return link utilizes a broadband transmitted carrier from the vehicle. Possible data ranges are 200-256Kbps for the forward link and 1.5Mbps up to 48Mbps for the return link.

Antenna systems typically vary between 30'' and 47'' (76cm to 1.2m) and use various ModCod techniques, such as spread spectrum, to communicate[1].

In addition to offering standard multicarrier transponder leases, Telesat can provide single transponder configurations within its satellite fleet which can increase throughput and availability of services by adjusting transponder settings to suit a particular application.

Two Telesat Telstar Satellites Ideally Suited for Supporting UAV Operations

UAVs operating in the Middle East can be controlled from the United States on Telesat's Telstar 12 satellite with a single point-to-point solution. The operational environment on Telstar 12 located at 15 degrees West is ideal because of the satellite's coverage, connectivity and high power available over the Middle East.

As for North American UAV services, Telesat's new Telstar 14R satellite is expected to be operational at its orbital location of 63 degrees West by mid-2011[2]. The planned capabilities of Telstar 14R will provide a highly effective satellite resource for UAVs operating over CONUS and the coastal waters of North America including the Gulf of Mexico and the Caribbean. In addition, T14R will have outstanding capacity availability enabling Telesat to alter transponder configurations such as input/output back-off and gain step settings to drive maximum throughput and efficiency.

Example of UAV Services Using Telesat Telstar 14R CONUS and Telstar 12 Middle East coverage

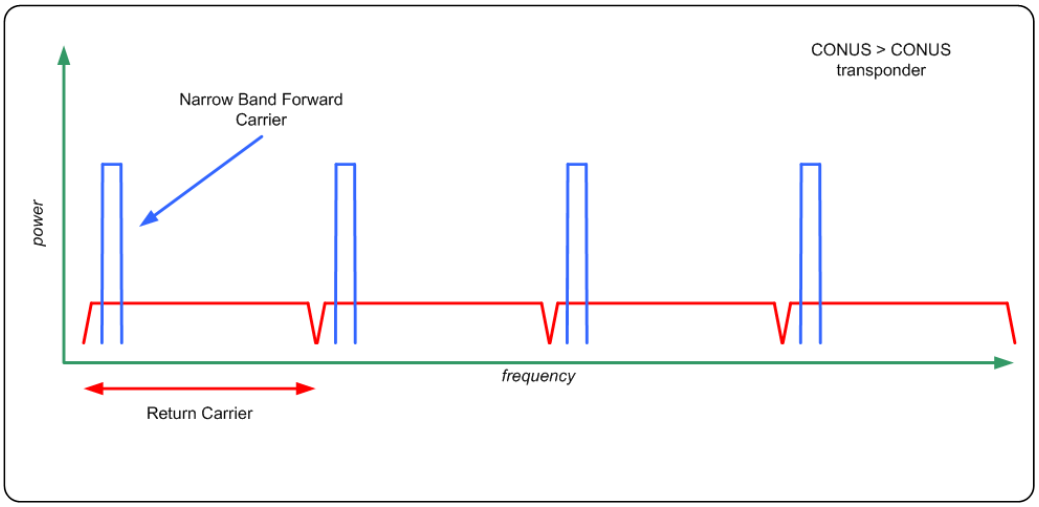
The following indicative link budget examples are based upon a UAV system running DVB-S2 modulation on Telesat's Telstar 14R and Telstar 12 satellites. They are based upon the 76cm Predator and 1.2m Global Hawk UAV Systems manufactured by L3 Communication Systems Ltd. The locations of the UAVs are US /Mexico border using Telstar 14R CONUS coverage, and Iraq for Telstar 12 Middle East coverage.

Forward Service + Return Service combination:

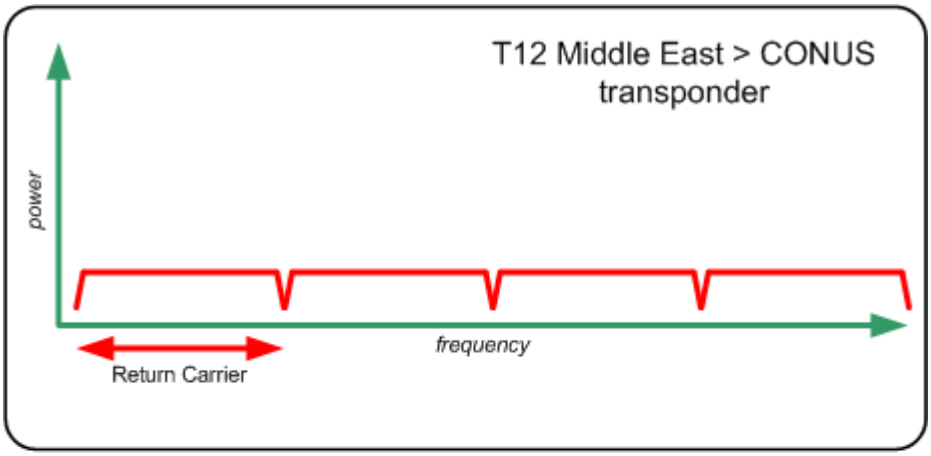
T14R CONUS – services can be run on same transponder, therefore it is possible to power balance the services across the transponder:

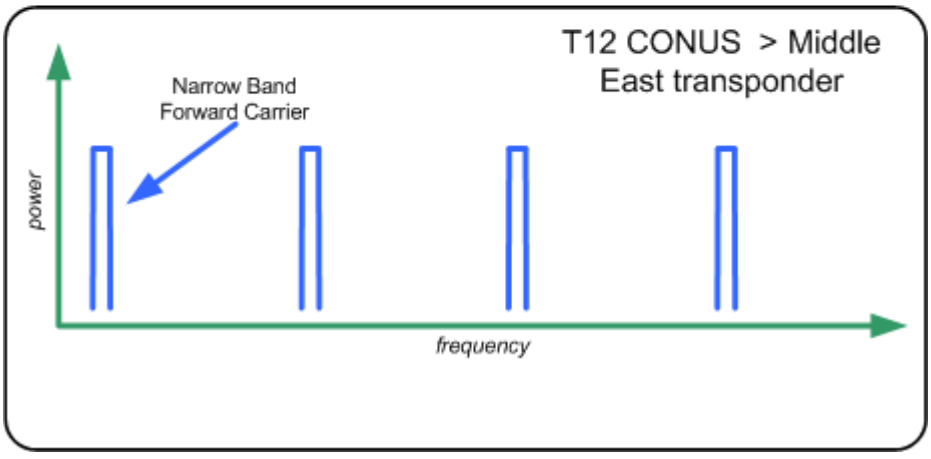
[1] For more information regarding spread spectrum, please see our prior briefing on spread spectrum technology.

[2] T14R is a high-powered Ku-band spacecraft that will provide additional capacity and expanded coverage over its predecessor, Telstar 14, along with continuity of service for existing T14 customers.



T12 CONUS<>Middle East services are operated on cross-strapped capacity. Therefore, forward and return carriers are allocated on different transponders:





Link Budget Examples

Forward Link from Mount Jackson Teleport (99.9% availability)

T14R CONUS BEAM

UAV	Forward Link (kbps)	DVB-S2 MODCOD	Link Availability (%)	Power Dominant BW (kHz)
Predator 0.76-meter Antenna	256	QPSK R1/2	99.9	700
GlobalHawk 1.2-meter Antenna	256	QPSK R1/2	99.9	400

Return Link from UAV (99.8% availability)

T14R CONUS BEAM

UAV	UAV EIRP @ 2dB OPBO (dBW)	Clear Weather BW to transmit 1 Mbps (MHz)	EIRP required to transmit 1 Mbps (dBW)	Maximum data that can be transmitted by the UAV (Mbps)	BW required to support Maximum Data Rate (MHz)
Predator 0.76-meter Antenna	53	2.0	43	10	20.5
GlobalHawk 1.2-meter Antenna	66	0.9	46.5	40	36

Forward Link from Mount Jackson Teleport (99.9% availability)

T12 CONUS>EUR BEAM

UAV	Forward Link (kbps)	DVB-S2 MODCOD	Link Availability (%)	Power Dominant BW (kHz)
Predator 0.76-meter Antenna	256	QPSK R1/2	99.9	1300
GlobalHawk 1.2-meter Antenna	256	QPSK R1/2	99.9	900

Return Link from UAV (99.8% availability)

T12 EUR>CONUS BEAM

UAV	UAV EIRP @ 2dB OPBO (dBW)	Clear Weather BW to transmit 1 Mbps (MHz)	EIRP required to transmit 1 Mbps (dBW)	Maximum data that can be transmitted by the UAV (Mbps)	BW required to support Maximum Data Rate (MHz)
Predator 0.76-meter Antenna	53	2.0	47	5	7
GlobalHawk 1.2-meter Antenna	66	0.9	48	40	36

Conclusion

The capabilities of Telstar 12 and Telstar 14R are ideal for UAV operations. Results can be further enhanced through customized transponder modifications in combination with adaptive coded modulation techniques.

Telesat would be happy to run further link budgets to show how UAV or other services can perform on any satellite in our fleet.