Satellite Control Networks: Trends and Prospects for Interoperability – a CCSDS View

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Everyone wants interoperability between satellite control networks, but what will it take to get?

Are there standards and architectures that can meet both military and civil space needs?

Will they emerge through the invisible hand of the market place, or do we need government planning and direction to achieve interoperability?

Will it bring cost savings or cost increase?
Potential Space Mission Interoperability Points

- Spacecraft-Spacecraft Interface Services
- Space Internetworking Services
- Space Mission Operations Services
- Space Link Access Services
- Commodity Space Communications Systems
- Commodity Space Navigation Systems
- Payload-Spacecraft Interface Services
- Space-Ground Interface Services
The Current "Hot Three"

Space-Ground Interface Services
- CCSDS Packet
- CCSDS TLM/TC Link
- CCSDS Modulation

Space Link Access Services
- CCSDS Packet
- CCSDS TLM/TC Link
- CCSDS Modulation

Space Internetworking Services
- FTP (Native, SCPS-FP)
- CFDP
- TCP (Vegas, SCPS-Tranquility, Reno...)
- SCPS-SP
- IPSec
- SCPS-NP
- IP
- CCSDS TLM/TC Link
- CCSDS Modulation

SLE SLE Management
- CCSDS Packet
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Internet
204 Missions using CCSDS Space Link Protocols, and counting
http://ccsds.gst.com/implementations

~ 20 spacecraft vendors
~ 25 space component vendors
~ 50 vendors
2 commercial networks
102 copies currently in the field
(Version 1.1.73 now shipping)

1.1.73 SCPS TP (in end system mode) : ran 93.6 Mbps user data throughput over a 100 Mbps crossover cable.

Thrower was 600MHz Celeron and Catcher was a 1GHz Celeron. File size: 2.4GB. Linux 2.2.16, Raw IP encapsulation.
Current testing of the SCPS-RI for the Canadian Public School System

- SCPS Gateway combined with Squid (Web cache)
- Test supported over 1 million connections at $\lambda = 15$ connections per second
- Deployment currently underway
Xiphos SCPS-TP: Maximize your bandwidth.

Internet Protocols do not cope well with the high loss rates and latency of wireless and satellite communication links. Xiphos SCPS-TP is the solution, outperforming the best of other TCP stacks hands down. Derived from the most reliable IP stack in the world, Xiphos SCPS-TP delivers increased throughput, response time and efficiency through stressed communications links.

Bandwidth is expensive. Make the most of it. Transport with Xiphos SCPS-TP.

- Introduction to the technology of SCPS-TP
- Xiphos SCPS-TP DataSheet

Why Xiphos SCPS-TP?

You want to transport your data quickly and efficiently.

On terrestrial networks, network congestion is most often the problem, and normal TCP/IP is optimized to deal fairly with congestion. This often isn’t the case in wireless or space linked networks, where normal TCP becomes tricked into believing that the network is congested, even when it’s not. To solve the problem, new algorithms have been developed and implemented that optimize transport over stressed communications links but still interoperate with TCP/IP: that’s Xiphos SCPS-TP.

For example, don’t shipping companies use advanced models to optimize the shipping of their parcels? Of course they do! They make the most of the available trucks, minimize cost and maximize results. It only makes sense to do the same with bandwidth.
NETWORK
Star Topology: 32,000 remote stations
Protocols: TCP/IP, OSI lower layers
TCP Acceleration: Integrated transport using SCPS Performance Enhancing Proxy

FORWARD CHANNEL
- DVB-S Broadcast: A/5, E1500, 4/32
- Data Rate: 2.45 Mbps
- Modulation: GPSK
- FEC Coding: Reed Solomon with convolutional rates 1/2, 2/3, 3/4, 5/6, 7/8

RETURN CHANNEL
- Multi Access Code: Direct Sequence Spread Spectrum
- User Data Rates: 30 kbps, 64 kbps, 128 kbps, 256 kbps, 512 kbps
- Spreading Rates: 204 up to 30 MHz
- Modulations: QAMK
- FEC Coding: Rate 1/3 Parallel Convolutional Code

HUB STATION
- IP Encapsulation using DVB-S MPE
- DVB-S compliant Forward Channel Modulator
- Modulator: extendable Return Channel modem
- SNMP-based Network Management System with user friendly Graphical User Interface
- Power from BPSK with antivalve and AC power supply

VSAT TERMINAL
OUTDOOR UNIT
- Antenna: 0.9 to 1.0 m KuBand, feed horn
- LNBs: Standard YRO: 11 V 400 mA DC supplied from D/N receiver
- TXBs: Proprietary 2W Ku TXB, or commercial standard 1.8W or 1.0W TXB

MODULATOR
- Dimensions: 34 x 26 x 76 mm (13.5 x 10.2 x 3"
- RF Interfaces: 75 MHz female connector
- User Interfaces: 100BaseT Ethernet/LAN, RS/232
- Terminal Console Ports: Serial port for configuration & monitoring; local equipment via DB-9F connector
- User Network Services: DHCP Server, Network Address Translation (NAT)
- Operating Temperatures: 0 to 40°C
- AC Power: 55 to 265 VAC, 50/60 Hz

OPTIONAL FEATURES
- Web Configuration (Site and/or remote)
- Conditional Access
SnapGear SE – SkipWare™ Enhanced

Why SnapGear?

Security
Protection from hackers through a world class firewall is only the start. Your privacy extends to your own private network of locations that are seamlessly and safely interconnected using VPN (Virtual Private Networking).

Simplicity
SnapGear products take the complexity out of choosing the right product at the right place – no more hidden extras. Set up is a snap with a web-based administration tool that you’ll probably only ever need once. Ask your ISP if they’re using SnapGear; if so their chances are you’ll only need to plug in and turn on.

Affordability
With comparable features to any similar product on the market, yet usually at half the price, you’re suddenly able to use the same advanced technology that’s normally only available to large corporations.

Why SnapGear SE?

Introduction
Security and access to the Internet has never been simpler than with the powerful SnapGear family of home and
The Bottom Line

- Space Link interoperability between military and civilian spacecraft and their satellite control networks is here now using international standards with widespread flight pedigree and commercial support:
  - CCSDS Space Link protocols
  - CCSDS Space Link Extension

- “Internet-in-Space” operations are ready to go using international standards with widespread commercial support:
  - Native Internet protocols, running over CCSDS Space Links
  - CCSDS-SCPS extensions of the native protocols to handle the stressed communications environment of space