

Space Disaggregated Network Architectures

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What this Briefing is About

- Space networks can enable not only communication resiliency, but also provide a means of resource sharing in disaggregated architectures
- A common (open) set of protocols provides a modular and stable platform upon which to build an space-space-ground network: a scalable resource
- There are challenges presented in this architecture not encountered in conventional networks (scarcity)






Disaggregated Satellite Taxonomy

(Macro-Scale)

Satellite Type	Alternate Terms	Examples	
Monolithic	Satellite	GOES	
Monolithic + Hosted P/L	Networked Monolith	SES-2/CHIRP	
Disaggregated	Small Sats	Alternate MILSATCOM	
Disaggregated Constellation	Constellation	GPS	
Networked Disaggregated	Fractionated	?	

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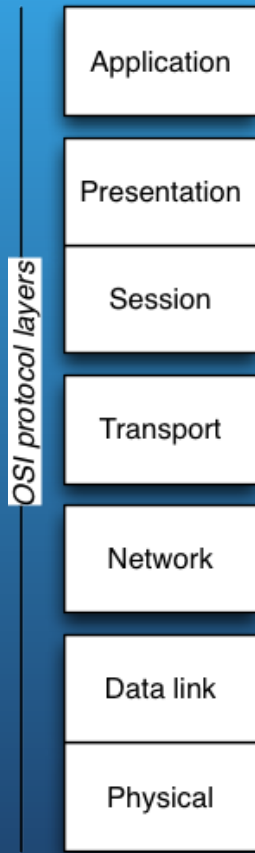
Hosted P/L and Networked Disaggregated Architectures



- Core common features
 - Share resources of a space-based network
 - e.g. Computing, PNT, Comm, Data Storage
 - Require network connectivity
 - Interoperable
 - Require arbitration of resources
 - Require varying degrees of information assurance
 - Ultimately lead to greater resiliency through diversification and flexibility

Disaggregated Satellite Taxonomy

(Micro-Scale)



- A common set of protocols enable (at a micro-scale) a virtual disaggregation of capabilities. “Applications” synonymous with resources and payloads
- Appeal to such an abstraction
 - Well defined interfaces for physical and data link layer communication elements (hence rapid substitution)
 - Modularization and transportability of applications
 - Enables highly adaptive and scalable application development, while maintaining stable lower stack configuration(s)
 - Protocols widely used and understood, many with “free” implementations
 - A path to system of system integration of payload-host, space-ground, and ultimately space-space nodes
 - Offers very scalable network architecture

Challenges of a space network architecture built on common protocols



- Good news adaptability and scalability - bad news adaptability and scalability
 - Scarcity of external resources that can not be readily scaled or evolved (high cost, spectrum constraints). f(orbital dynamics)
 - Scarcity of internal resources that have SWaP and mission constraints
 - Power, Mass
 - Antenna pointing
 - Latency and intermittency
 - Current (“chatty”) protocols not tuned to this environment

Future Directions - Research & Implementation



- Analyze protocol characteristics w.r.t. scarcity
 - IPv6 brings new complexities, limited experience
 - Understand interaction of protocols, options, and intermittency
- Develop a cross-layer QoS management approach
 - Define capacity needs And alternatives when needs cannot be met
 - Model and measure and respond to capacity availability
 - Handle disappointments reflected up to applications
- Problems not limited to space
 - Aircraft fleet communication (e.g., antenna orientation issues)
 - Power, weight, upgradability not quite as expensive
 - V2X

Summary



- Implementation of standard set of (open) protocols for resource sharing and communications for inter and intra spacecraft networking offer many benefits and opportunities
- Main issues are scarcity of resources
- Challenges offer a rich opportunity space for research investment and design implementation

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Credits

Satellite designed by misirlou
from the thenounproject.com



Faucet designed by Kenneth Von Alt
from the thenounproject.com



Satellite designed by Guillermo Vera
from the thenounproject.com



Local Education designed by Berkay Sargin
from the thenounproject.com



Satellite Orbit designed by Martin Vanco
from the thenounproject.com



Rocket designed by Cris Dobbins
from the thenounproject.com

