

***Saratoga* update**

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Thoughts on the evolution
of IETF transport protocols

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TSVAREA – Evolution of IETF Transport Protocols
IETF 88 – Vancouver, November 2013

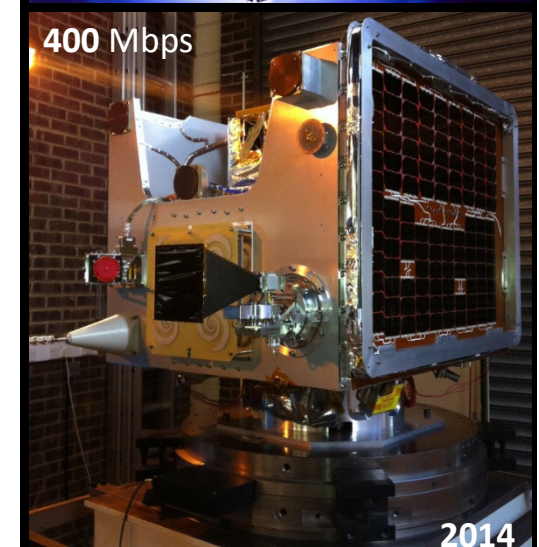
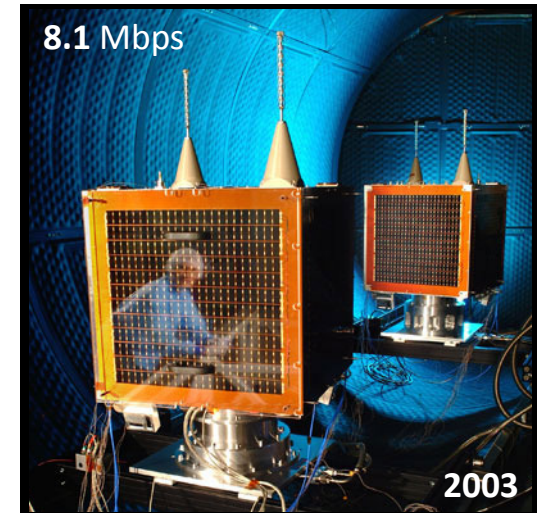
draft-wood-tsvwg-saratoga

- UDP/IP-based data delivery protocol. Draft now at version -14.
 - Initial -00 version of draft was May, 2007.
 - Related supporting drafts:
 - draft-wood-tsvwg-saratoga-congestion-control-04
 - draft-eddy-tsvwg-saratoga-tfrc-04
 - draft-wood-dtnrg-saratoga-13
- Discussed several times in DTNRG and TSVWG on lists and at group meetings, and at IETF69 TSVAREA, but have not yet asked for adoption.
 - Intent is to publish as experimental RFC matching the “flying code.”
- Development continues via the *Saratoga* mailing list:
saratoga-discussion@googlegroups.com
- Some code and related material is publically available:
<http://saratoga.sourceforge.net/>

Saratoga is in operational use

- Disaster Monitoring Constellation: <http://dmcii.com/>
- Surrey Satellite Technology Ltd (SSTL) has used *Saratoga* since 2004 to download Earth imagery from multiple satellites:
 - initially 8.1 Mbps downlink, 9600 bps uplink, running at line rates.
 - path asymmetry of 848:1
 - SSTL's TechDemoSat-1, launching in 2014, has:
 - 400 Mbps downlink, up from 210 Mbps downlink now in flight.
 - *Saratoga* code conforming to current Internet-Draft.
- Cisco Systems has:
 - *Saratoga* implementation created for Square Kilometre Array effort.
 - funded *Saratoga* congestion control research at Uni. of Oklahoma.
- NASA has contributed:
 - Perl “reference implementation” used in interoperability testing.
- Charles Smith has contributed:
 - Wireshark decoder module for debugging implementations.
 - progress on development of C++ implementation for 64-bit Linux.

<http://saratoga.sourceforge.net/>



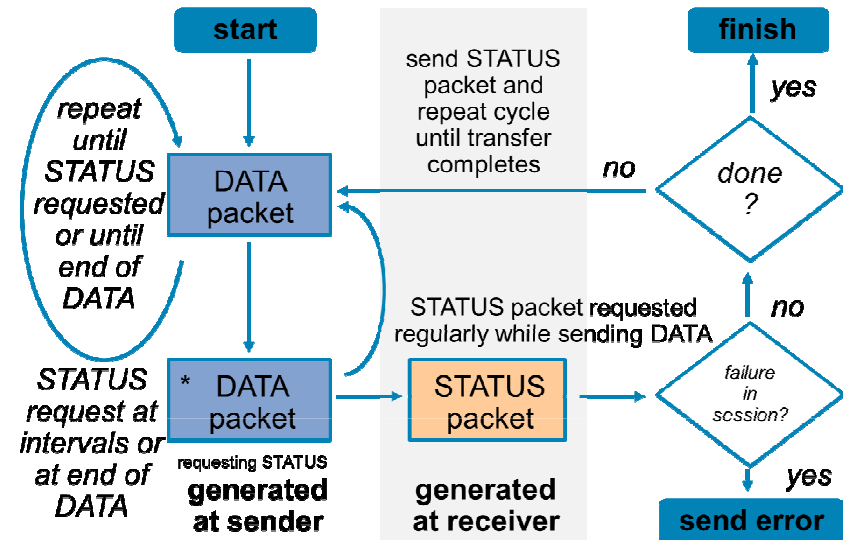
Background to *Saratoga*

- Reaction to size and slowness of an implementation of the CCSDS File Delivery Protocol (CFDP) being used for delivering images from first DMC satellite.
 - “CFDP Lite” later used on *Messenger* mission to Mercury.
- *Saratoga* version 0 developed at Surrey Satellite Technology Ltd (SSTL) by Chris Jackson, after scuba-diving the wreck of the *USS Saratoga* in Bikini Atoll.
 - Now used on Disaster Monitoring Constellation satellites.
- New version 1 created as a collaboration between SSTL, NASA, and Cisco Systems:
 - Originally thinking of IP-based bundle convergence layer for Delay/Disruption Tolerant Networking (DTN).
 - Now onboard SSTL’s TechDemoSat-1.
- ***Saratoga* in daily operation from space since 2004.**



Saratoga characteristics relevant to evolution of IETF transport protocols

- **High performance over very high delays**
 - Bufferbloat measurements show cable delays are now similar to lunar RF propagation delay.
- **Works with high bandwidth asymmetry**
 - Uses SNACKs – Selective Negative ACKs
 - Feedback can be paced by explicit requests
 - TCP breaks with path rate asymmetry above 50:1 ratio. *Saratoga* can operate at orders of magnitude higher than that.
- **Flexible congestion control**
 - Current options: fixed-rate, TCP-Friendly.
 - Many other possibilities.
- **Runs over UDP for portability**
 - Implemented in “user space” or as tasks in a real-time operating system.
- **Has feature profiles for lightweight embedded implementations**
 - Example target is **small flight computers**.
 - Very relevant to **Internet of Things (IOT)**.
- **Scales to yottabyte-size files for Big Data**



Evolving IETF Transport Protocols

- Can't keep defining "transport" as only TCP or UDP...
 - ...or even as the Gang of Four: TCP, UDP, SCTP, DCCP.
- Transport protocols are where we implement end-to-end capabilities that are too difficult or too expensive to reproduce across N apps
 - Path MTU Discovery, transmission control, reliability, etc.
 - *Saratoga* is more a transport protocol than it is an application protocol...
 - ...but contains notion of methods (GET, PUT, etc.) and data objects that are generally not associated with transport protocols.
 - CoAP, RELOAD are IETF APP and RAI protocols that contain a lot of typical transport functionality.
- **New IETF transports for the Internet** should **scale to high delays and throughput**, should **ACK efficiently**, should **support multiple congestion control algorithms**, and should be **runnable over UDP** for deployability through NATs in the real world.
 - ***Saratoga* shows that this is achievable.**

<http://saratoga.sourceforge.net/>