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Saratoga: scalable, speedy data delivery for sensor networks

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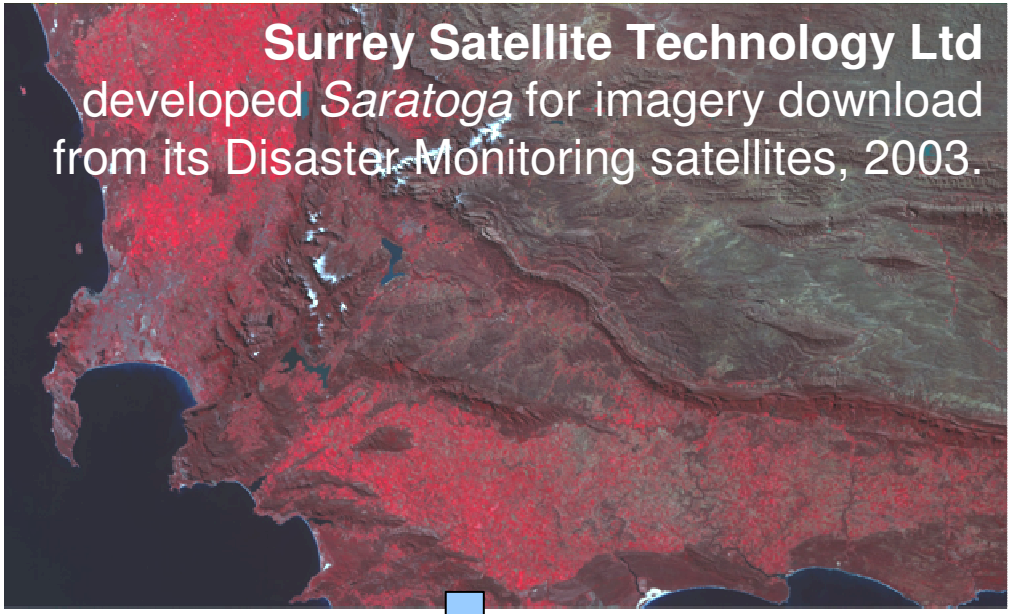
Private sensor networks

- Must deliver sensor data – very quickly.
- Want to use Internet technologies – cheap, reliable, robust.
- Want more speed than TCP can offer.
- Congestion is not a problem; private single-owner managed network with scheduled traffic, single flow per link with no competition. This is not the shared public Internet!
- Sensor capabilities are ever-increasing (side-effects of Moore's law). Need to scale for ever-growing data sizes.
- Support for streaming and simultaneous delivery to multiple receivers is also useful.
- ***Saratoga* protocol designed to meet these needs.**

Saratoga's development



Surrey Satellite Technology Ltd developed *Saratoga* for imagery download from its Disaster Monitoring satellites, 2003.

Saratoga redesigned, specified to the Internet Engineering Task Force, 2007.

NASA Glenn uses *Saratoga* to test DTN and Interplanetary Internet on UK-DMC, 2008.

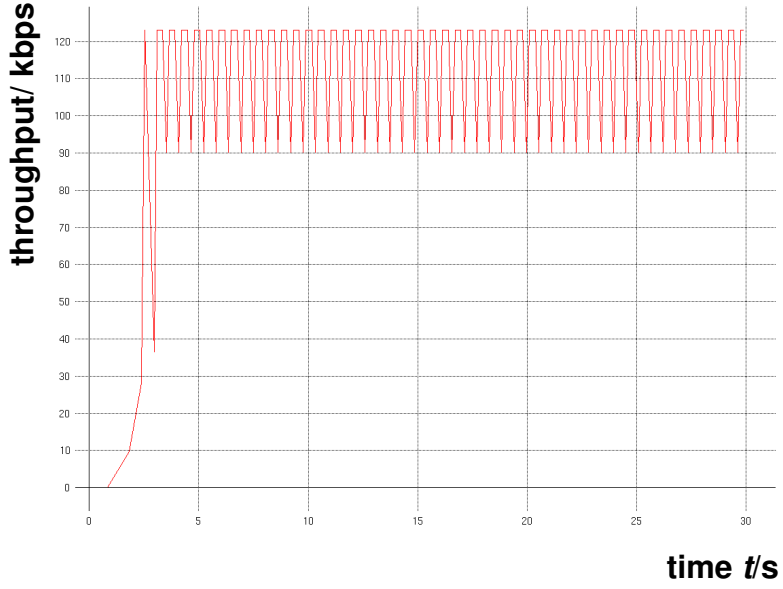
Multiple *Saratoga* implementations in progress with interoperability testing.

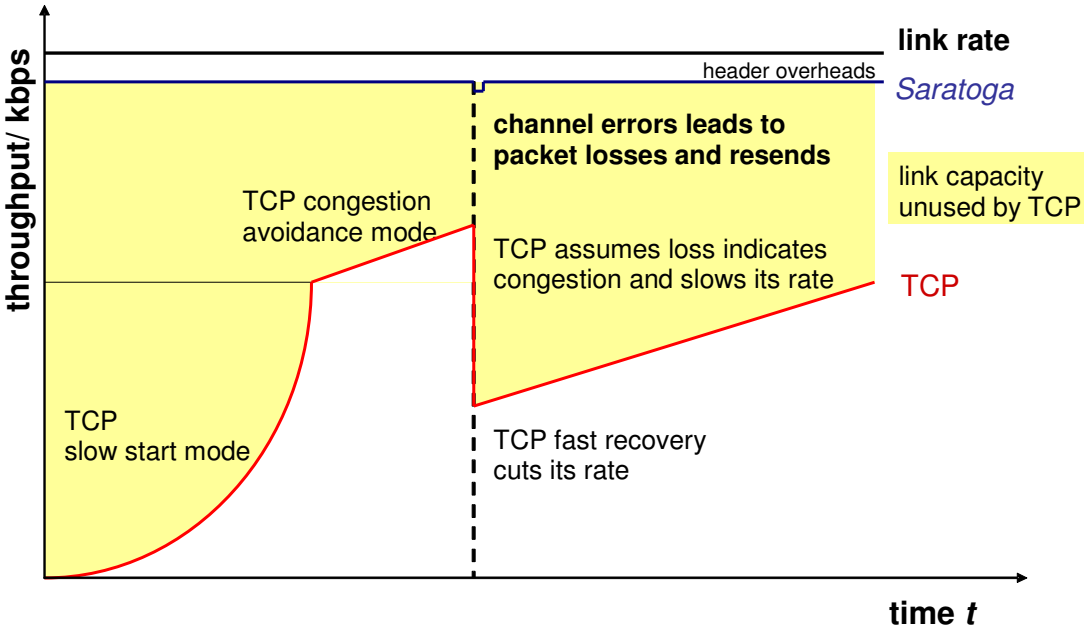
NASA Glenn Research Center
Saratoga for sensors on UAVs

CSIRO
Saratoga for radio astronomy

Saratoga's approach

Run as fast as possible, at maximum possible rate over a private dedicated link. Deliberately **don't** emulate TCP's cautious congestion-control behaviour.
('TCP friendly' behaviour can be added without changing packets.)





A single TCP flow can't fill a link – reaches capacity, then backs off.

A single *Saratoga* flow can take advantage of all the available capacity.

Research led to new use

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- SSTL remote-sensing images grew to cross 4GiB file size, needing >32-bit pointers.
- How to design a *scalable* file transfer protocol able to handle any size file, without requiring separate incompatible implementations for big files?
- Solved this problem with 16/32/64/128-bit pointers and advertising capabilities.

not needed - yet!

- Support for scalability and streaming introduced new users – high-speed networking for radio astronomy in Very Long Baseline Interferometers.

Implementations underway

The public *Saratoga* specification has led to:

- **a mature internet-draft**, aiming for IETF RFC.
- **multiple independent implementations** (SSTL, NASA Glenn, CSIRO and Cisco Systems) with interoperability testing underway.
- a simulator showing that TCP friendliness can be supported (University of Oklahoma)

Identified uses for *Saratoga* data delivery:

- **remote-sensing Earth data** from satellites (SSTL) and UAVs (NASA Glenn)
- high-end **radio astronomy sensor data** and processed data cubes (Square Kilometre Array)
- other applications in private networks and in supercomputing.
- could even replace TFTP for fast network booting of Cisco routers and phones...

Currently shortlisted for a Sir Arthur Clarke 'Monolith' award for achievement in space research, to be decided at the UK Space Conference next week.