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SPICE Testbed

A DTN Testbed for Satellite and Space Communications

Motivation

- A **prototype** DTN-based *-but not only-* experimental platform for developing, validating and evaluating new architectures and protocols for space

- Compliance with:
  - ESA standards
  - CCSDS standards

Relevant Projects

European Space Agency

- Extending Internet into Space project
  - Phase 2
  - Phase 3

European Commission

- FP7 Space Internetworking Center project
- FP7 Space Data Routers project

Key components

CORTEX CRT-XL

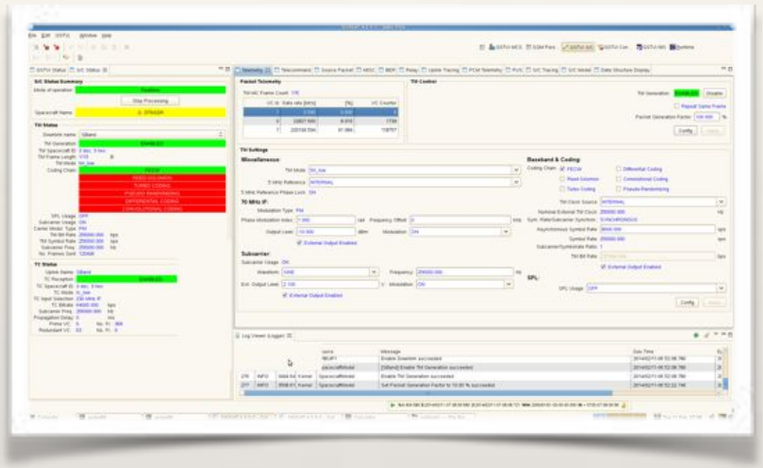
- COTS Telemetry, Tracking and Command (TT&C) processing system:
  A representative legacy system typically used in Ground Stations

- CCSDS Packet TM on the downlink
- CCSDS Packet TC on the uplink
- CCSDS SLE services

Fully compatible with most well known satellites used by NASA, ESA

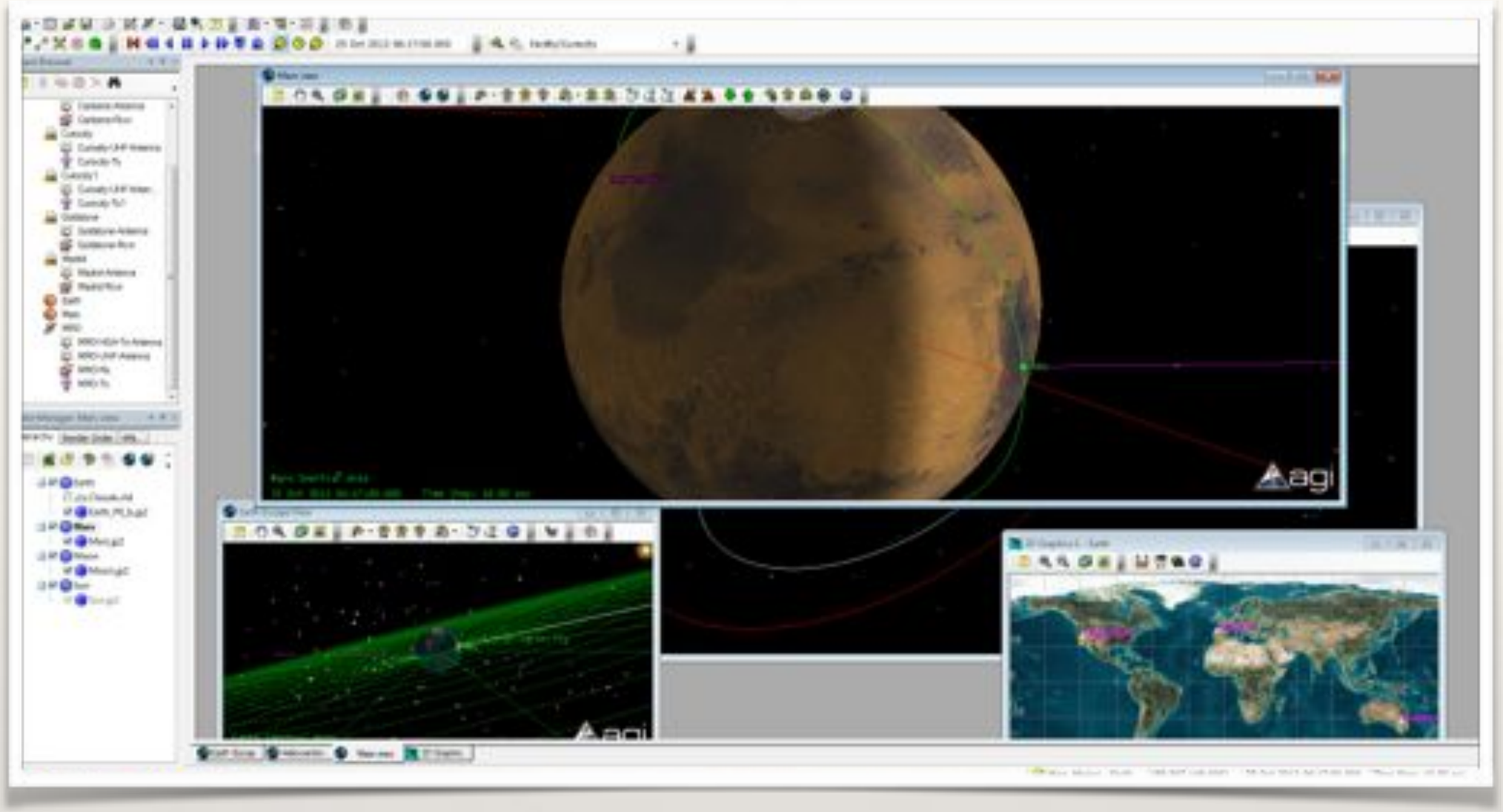
SIMSAT and PSS

- **SIMSAT:** A general purpose real-time simulation infrastructure developed for ESA



- **PSS:** A generic Linux-based system capable of:
  - Generating telemetry flows
  - Processing telecommands
  - Generating “bad” frames or inserting random BER

TM and TC data are exchanged between SIMSAT and PSS



General-purpose modelling and analysis application

Satellite Tool Kit (STK)

- Models real space missions
- Performs link-budget analysis
- Calculates LoS time window

STK Output

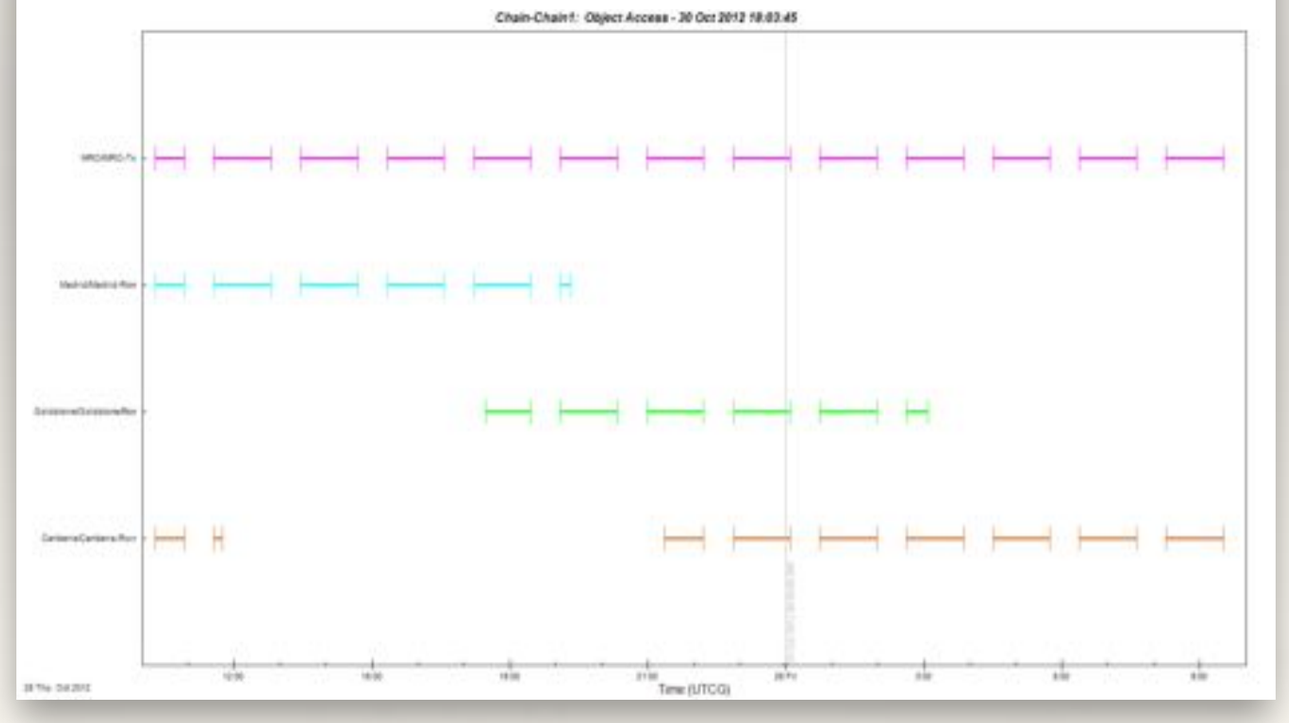
Facility-Madrid-To-Satellite-NRO: Access Summary Report

Madrid-To-NRO

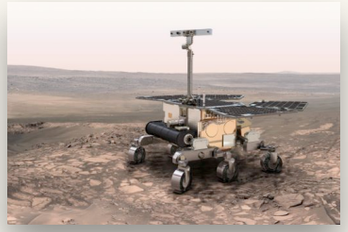
Access	Start Time (UTCG)	Stop Time (UTCG)	Duration (sec)
1	25 Oct 2012 10:13:00.987	25 Oct 2012 10:21:28.603	507.616
2	25 Oct 2012 11:00:28.712	25 Oct 2012 12:14:23.764	4435.052
3	25 Oct 2012 12:53:23.184	25 Oct 2012 14:07:18.922	4435.738
4	25 Oct 2012 14:46:17.652	25 Oct 2012 16:00:14.073	4436.421
5	25 Oct 2012 16:39:12.115	25 Oct 2012 17:53:09.218	4437.103
6	25 Oct 2012 18:32:06.567	25 Oct 2012 19:19:42.776	2856.209

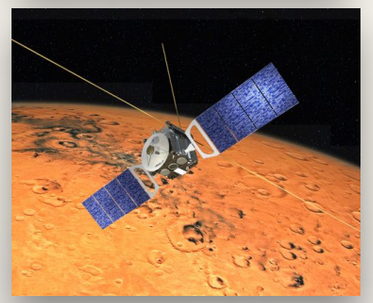
Global Statistics

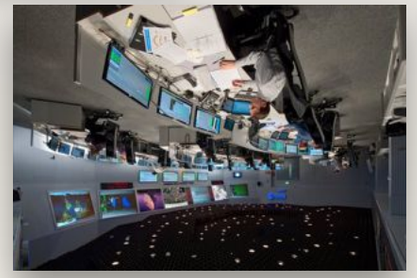
Min Duration	1	25 Oct 2012 10:13:00.987	25 Oct 2012 10:21:28.603	507.616
Max Duration	5	25 Oct 2012 16:39:12.115	25 Oct 2012 17:53:09.218	4437.103
Mean Duration				3518.033
Total Duration				21108.139

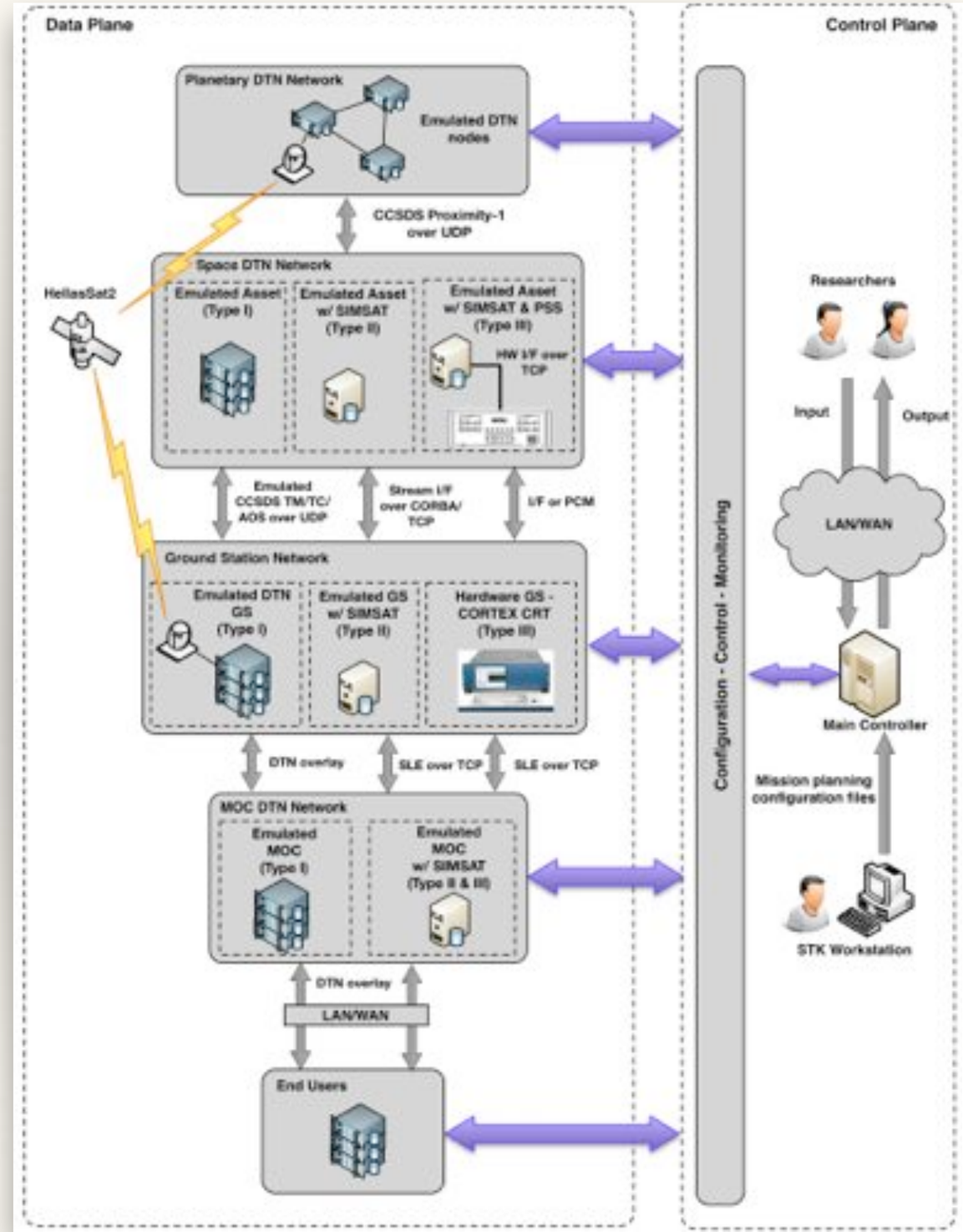


Testbed Architecture



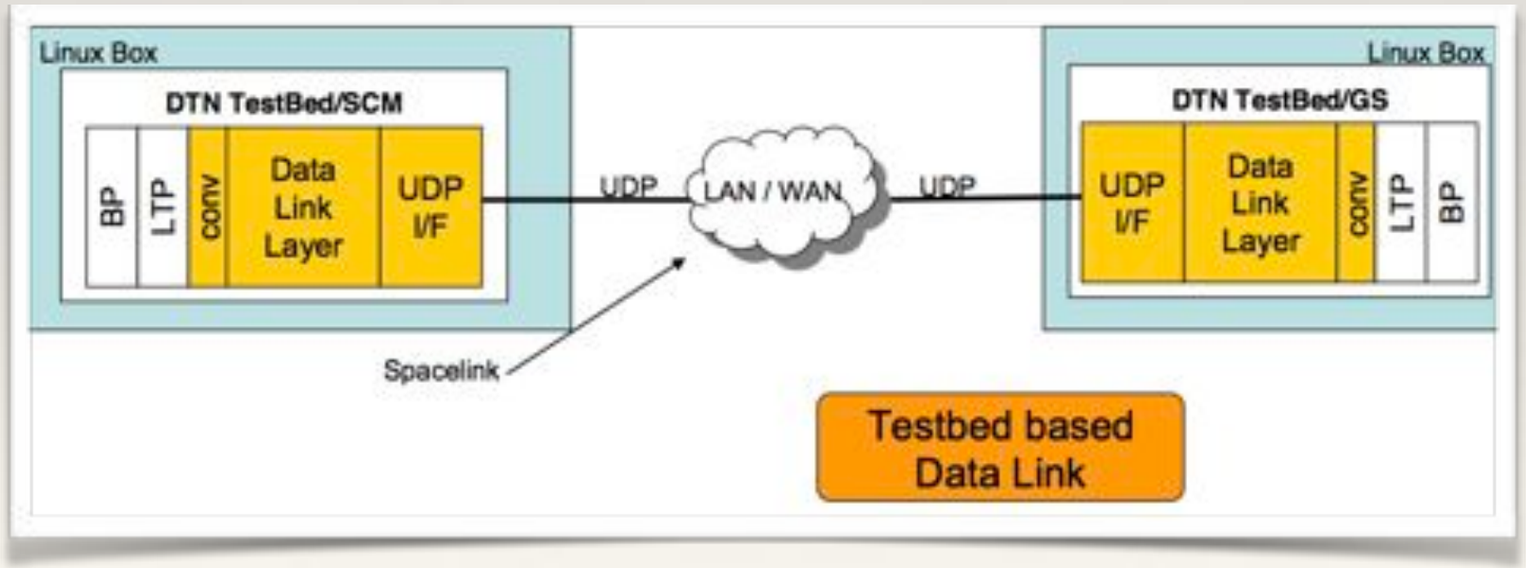






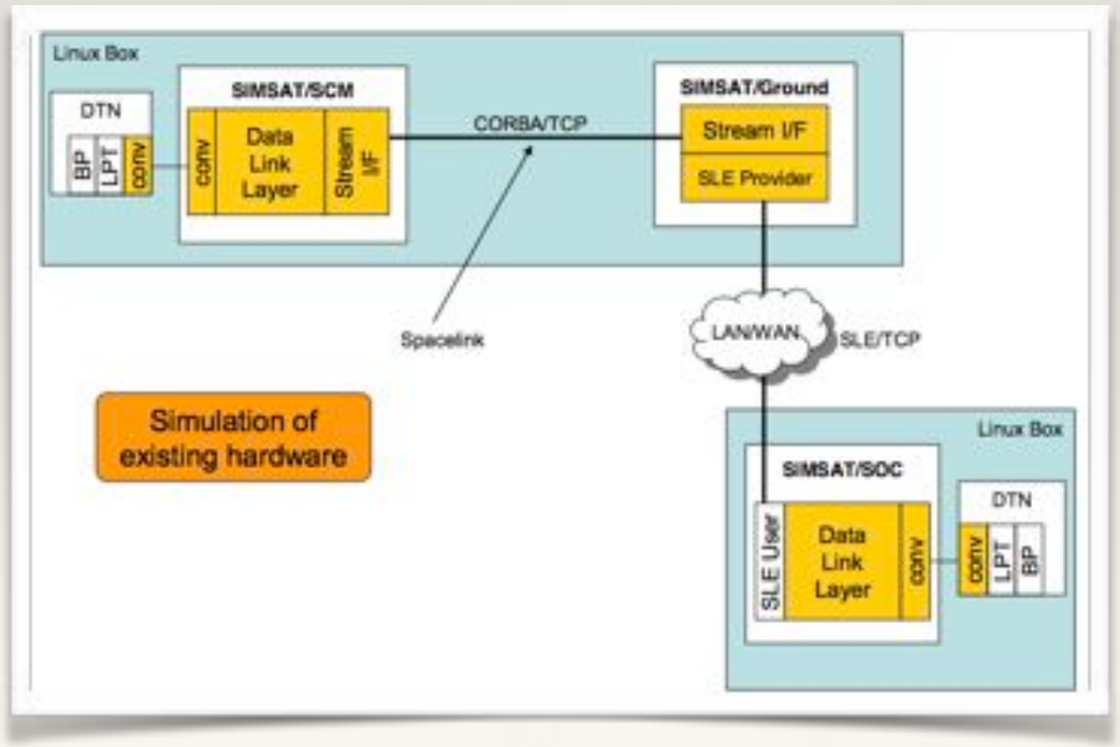
Type I: Simulated Space Data Link Protocols

- Integrated within DTN protocol stack (over UDP/IP)
- Insertion of propagation delay and PER through NetEm
- Support of CCSDS Proximity-1
- Complex scenarios



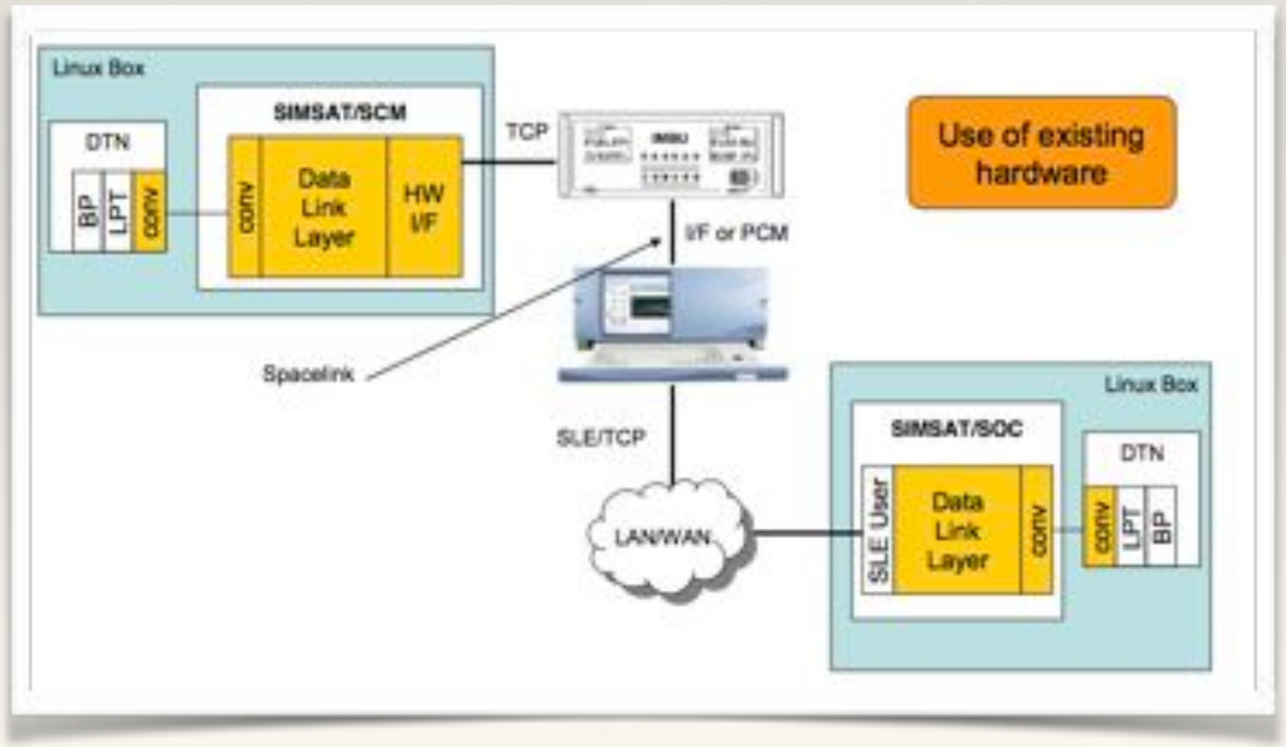
Type II: SIMSAT-based emulation

- Implementation of a simulated spacelink (over CORBA/TCP)
- Realistic models for earth and space assets
- Alleviates the need for special hardware
- Requires more effort on configuration

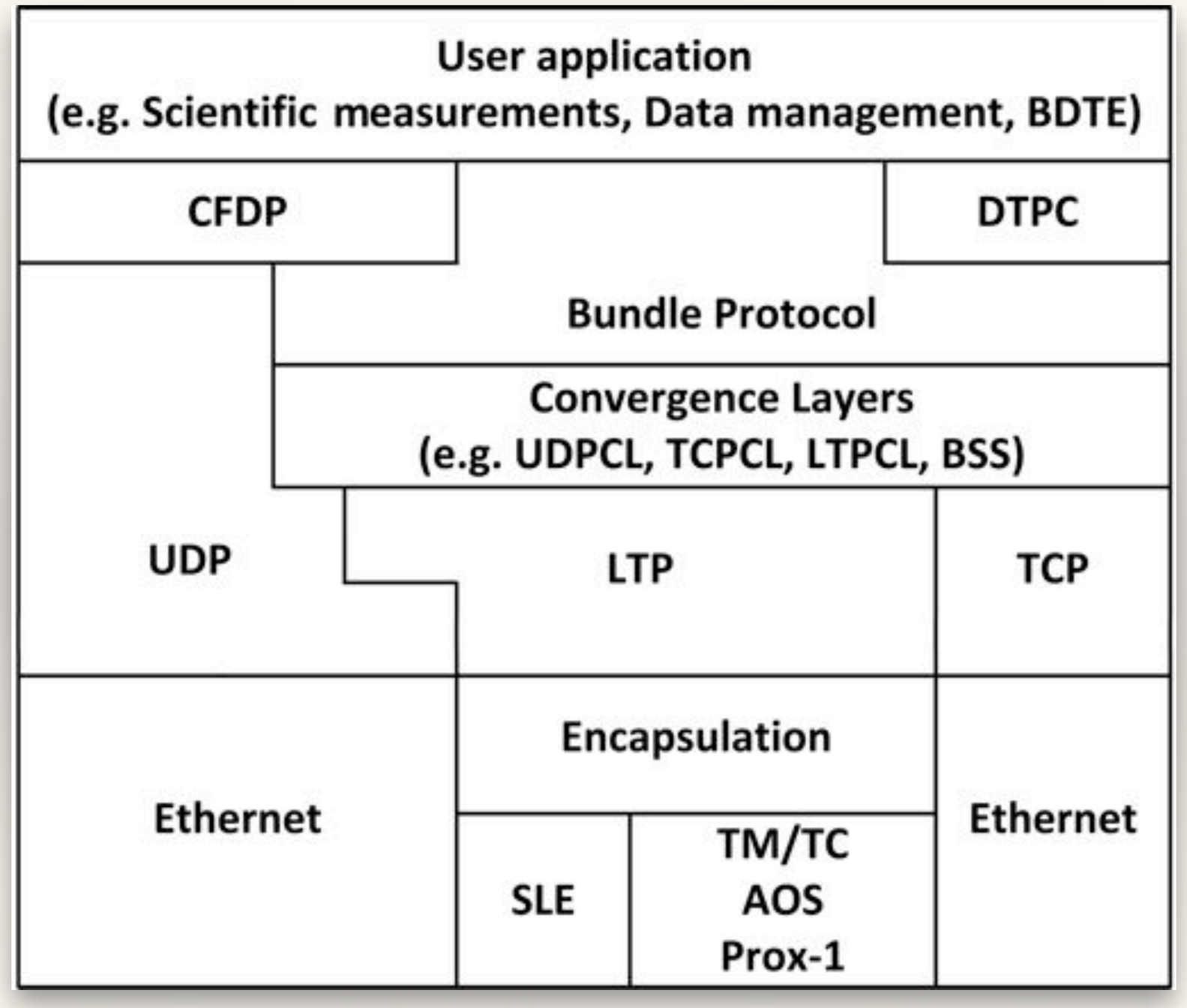


Type III: Hardware-based emulation

- Single emulated space link
- SLE-based communication between G/S and MOC
- Performance evaluation over contemporary implementations of space data link protocols



Protocol Stack



Protocols and Mechanisms

DTPC

- Delay Tolerant Payload Conditioning

BSS

- Bundle Streaming Service

BDTE

- Bundle Delivery Time Estimation

SPICE Testbed offers an ideal platform to evaluate space internetworking protocols, applications and services

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(Project title: Space Internetworking Center - SPICE).

www.spice-center.org

–Any questions?

Thank you!

Component Summary

Component	Quantity
Rack-mounted emulation nodes	15
High performance rack-optimized server	1
STK workstation	1
CORTEX CRT	1
PSS (SIMSAT & IMBU)	1
CISCO router 3900 series	1
Cisco switches 2960 series	4
CISCO ASA 5505 firewall	1
Hellas Sat 2 equipment	1