

International SpaceWire Conference 2011

NEXTAR: Small Satellite Bus Based on SpaceWire Deterministic Implementation

10 November 2011

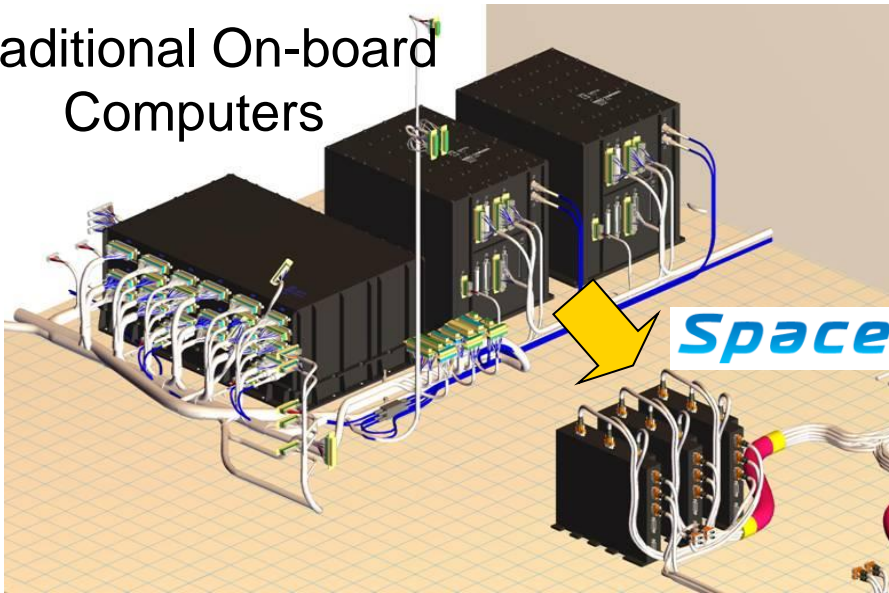
Hiroki Hihara
NEC TOSHIBA Space Systems, Ltd.

Toshiaki Ogawa, Kenji Kitade
NEC Corporation

NEXTAR: NEC Next-generation Star

What SpaceWire provides for small satellites are...

Traditional On-board Computers

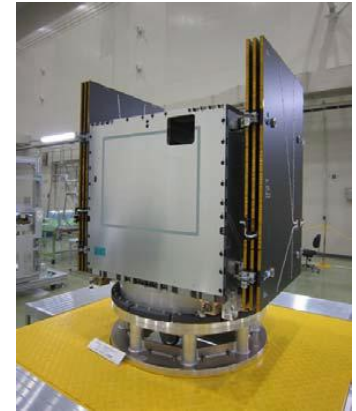


Space Cube 2

Small size, light weight



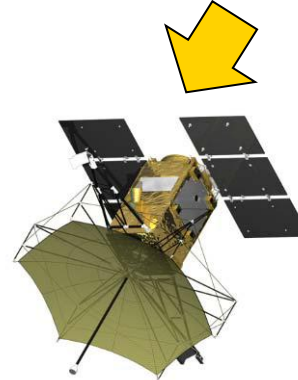
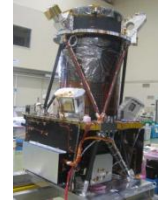
Modularity



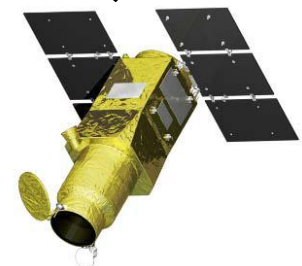
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SAR probe

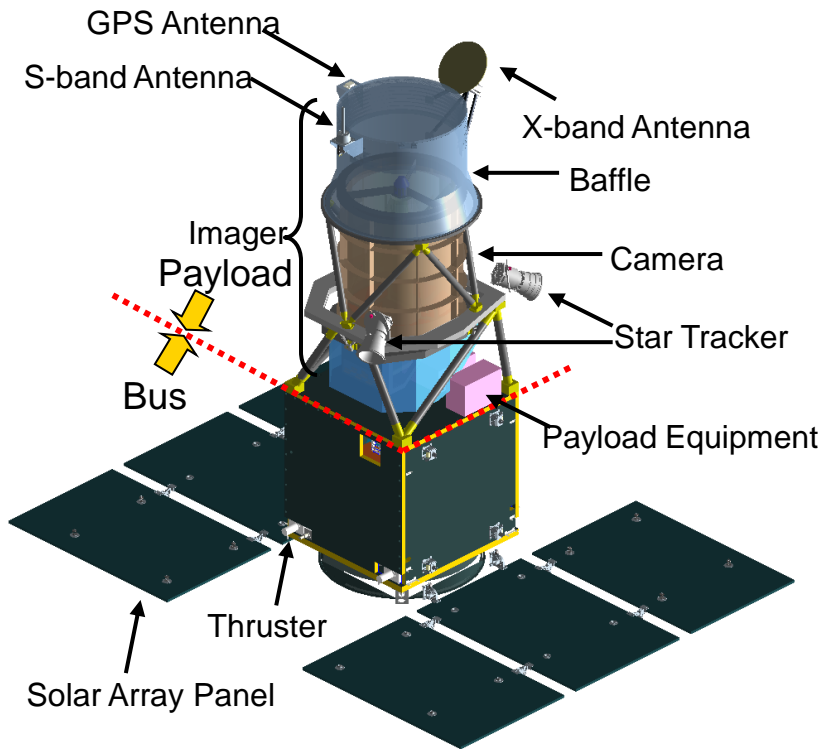


Optical probe

NEXTAR – the Earth Observation model

ASNARO (Advanced Satellite with New system Architecture for Observation)

- The first model with NEXTAR bus



Item	Description
Mission	
- Optical sensor	Pan / Multi (6-bands) GSD : < 0.5m/2m (Pan/Multi) Swath: 10km
- Data transmission	X-band, 16QAM, ~ 800Mbps
Pointing	Coverage: +/- 45deg x +/-45deg (cross x along track) Agility: 1deg / sec (average)
Launch Orbit	compatible with major launchers SSO ~ 500km altitude
Mass	Bus 295 kg (incl. 45kg fuel) Mission 200 kg <TOTAL> 495 kg
Power	Generation : > 1300 W (EOL) Payload : 400 W
Dimension	2.5 x 3.5 x 3.2m (in orbit)

Determinism Implementation exploiting SpW/RMAP

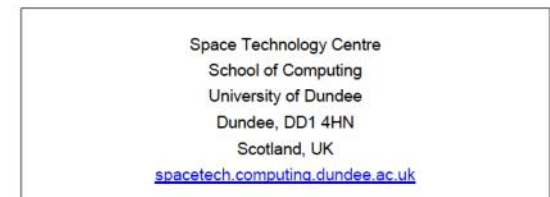
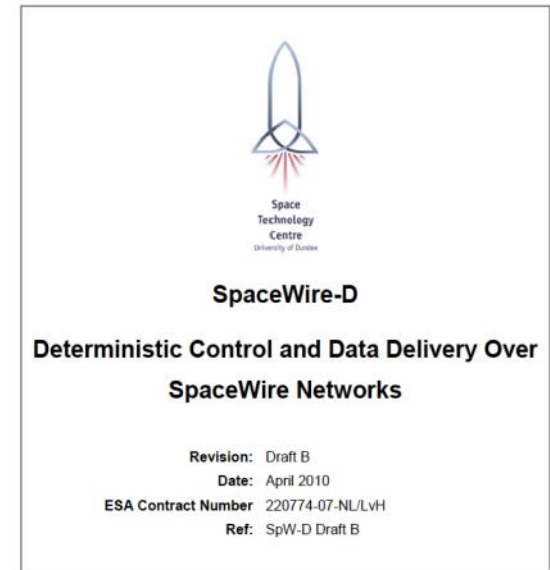
Determinism required for NEXTAR bus

- Every data must be delivered and collected on time.
- Re-transmission and ACK/NACK transaction are required.
- Shortening system test schedule without reducing reliability
- Integration with legacy interface
 - CAN, UART, MIL-STD-1553B, etc.

Inherent capability in SpW/RMAP

- RMAP
 - CRC, Status field, transaction sequence
- SpaceWire
 - EOP and EEP

Deterministic character is formalized in draft specification of SpaceWire-D.



Protocol Layer for Scheduling and Assured Transmission

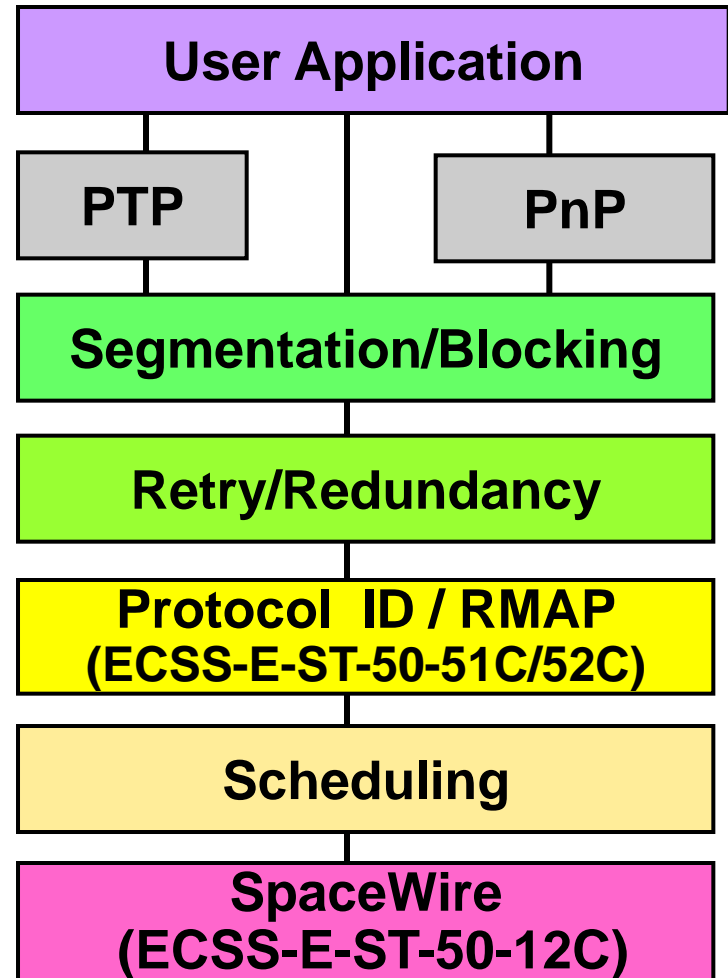
Documents established by JAXA and NEC

- Telemetry/Command Design Criteria / SMCP
- Annex for each project

- SpaceWire Network Design Criteria

Results of Analysis for the SpW-D Draft Specification
Takahiro Yamada (JAXA/ISAS)
18 October 2010
Fifteenth SpaceWire WG Meeting

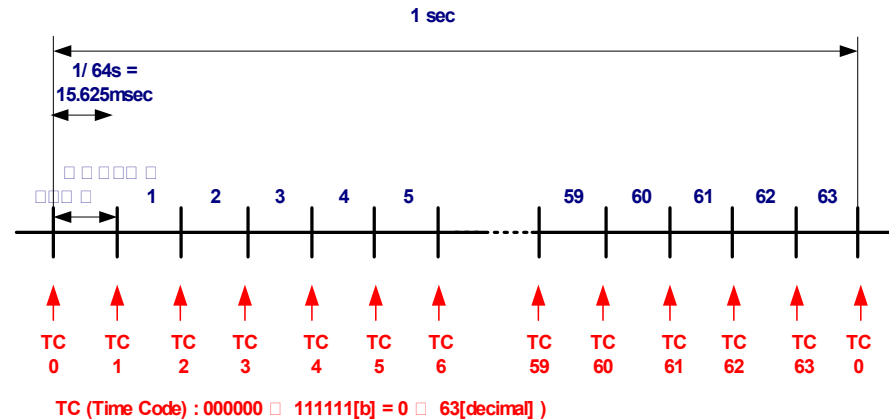
Reference Protocol Stack



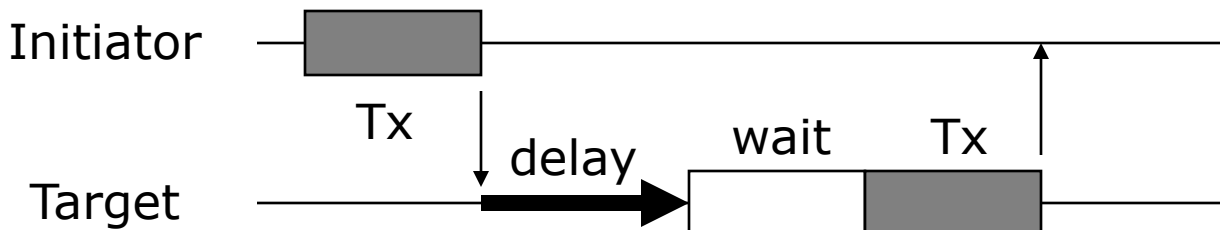
Deterministic Implementation for NEXSTAR (1/3)

Scheduling

- One second comprises 64 time slots.
 - Each time slot corresponds to SpaceWire Time-Code.



- RMAP is used for all transactions.
- Latency is defined as the maximum delay time of an RMAP reply.

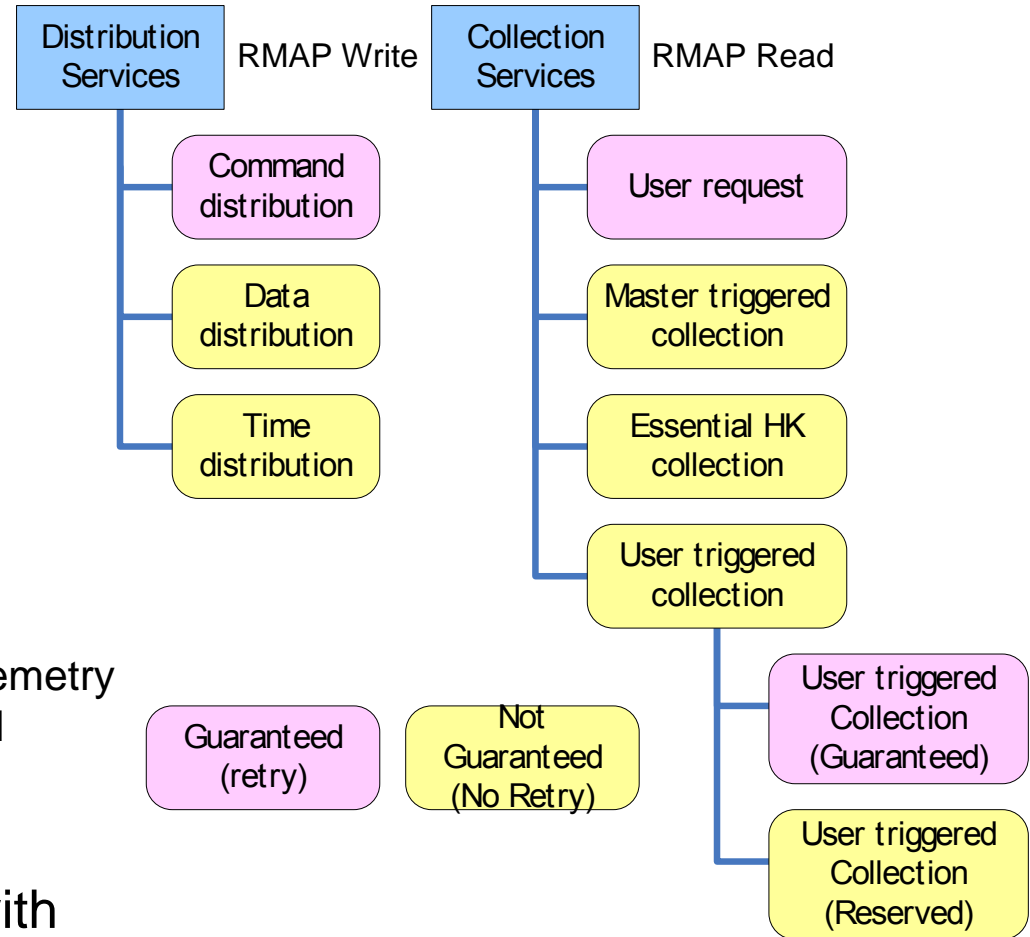


- Multiple transaction in one time slot is realized within the limitation of latency definition
 - No modification is required on SpaceWire/RMAP.

Deterministic Implementation for NEXTAR (2/3)

Communication Services

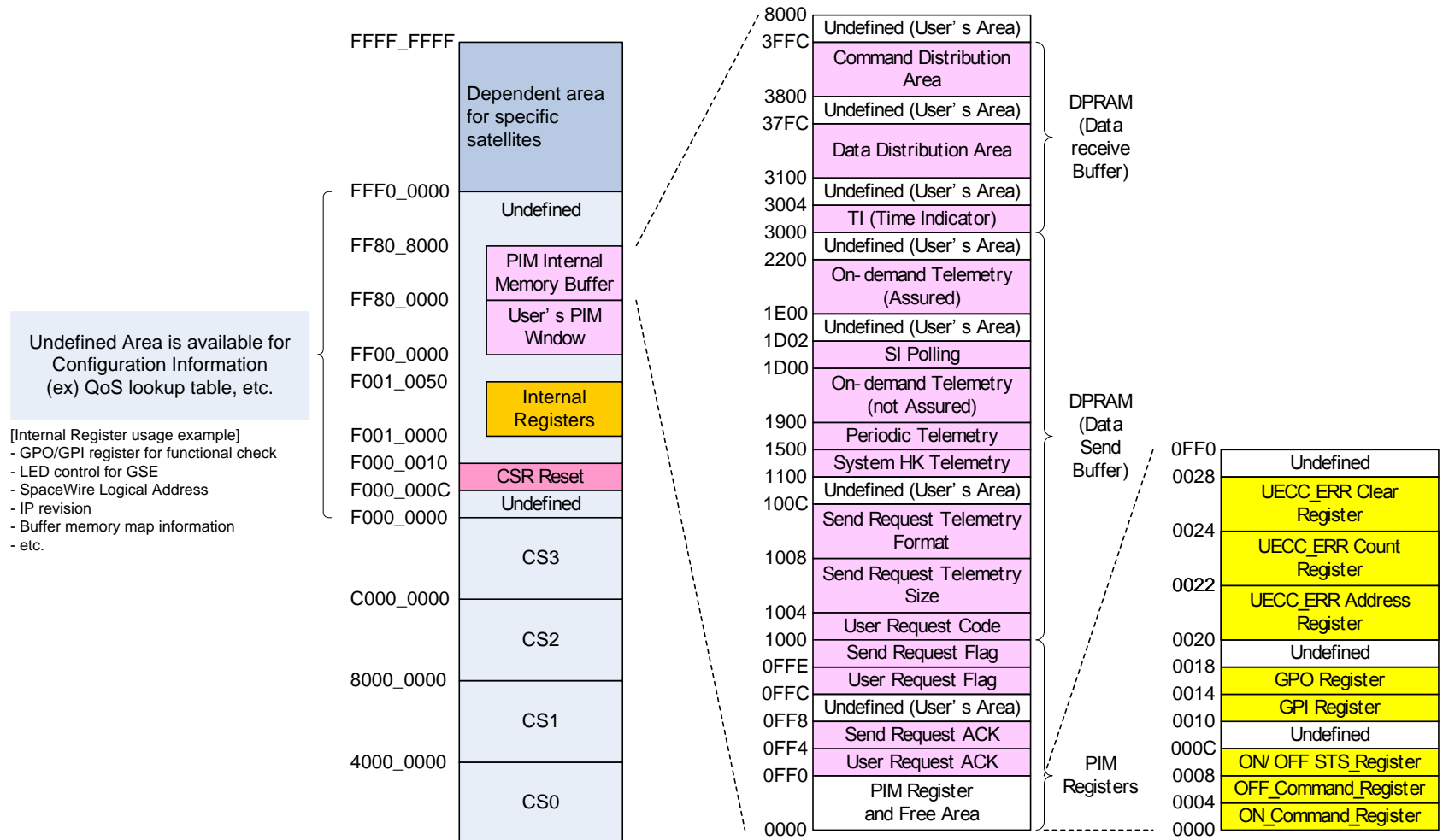
- Implicit services
 - Re-transmission
 - Re-transmission through alternative paths
- Explicit services
 - Distribution Services
 - Collection Services
 - Polling for additional telemetry collection and command delivery request
- Guaranteed transactions with ACK /NACK are implemented on RMAP.



Deterministic Implementation for NEXTAR (3/3)

Services are distinguished through addresses

- Exploiting RMAP inherent characteristics for Plug & Play capability



Road map of NEXTAR

