SOIS – SpaceWire Working Meeting

Estec 26-27 April 2007

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SOIS Presentation – Basic Flow

- Background, status and meeting Objectives (Chris Taylor, ESA TEC-EDS)
- SOIS Subnetwork services (Dai Stanton, Keltik UK)
- SOIS Application Support services (Stuart Fowell, SciSys UK)
- Prototyping plans (Massimiliano Ciccone, (ESA TEC-EDD)

- ***Interaction is encouraged and additional inputs welcome as appropriate***

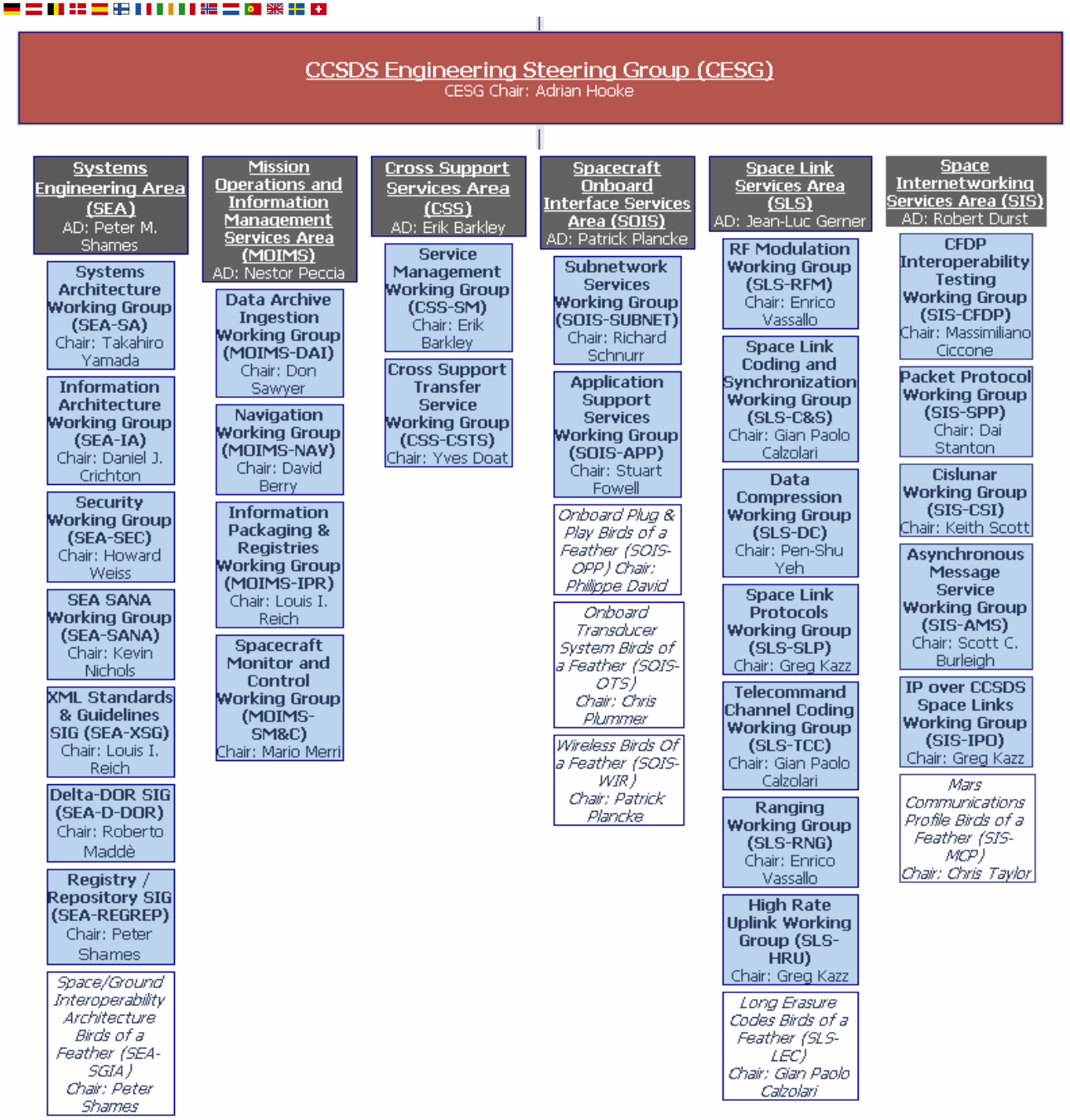
SOIS – Some Background

- The **S**tandard **O**nboard **I**nterface **S**ervices activity is part of ESA's contribution to CCSDS

- SOIS occupies it's own area within CCSDS and is led by Patrick Plancke (ESA TEC-EDD)

- The SOIS activity has it's roots in a previous ESA initiative (SOIF) to standardise the interfaces to onboard sensors and actuators, with the objective to reduce the number of interfaces needed for off-the-shelf components

- The activity has now evolved into the international arena and been redirected to standardise the communication system typically required on all spacecraft


CCSDS Engineering Steering Group (CESG)
CESG Chair: Adrian Hooke
Systems Engineering Area (SEA)
AD: Peter M. Shames
Systems Architecture Working Group (SEA-SA)
Chair: Takahiro Yamada
Information Architecture Working Group (SEA-IA)
Chair: Daniel J. Crichton
Security Working Group (SEA-SEC)
Chair: Howard Weiss
SEA SANA Working Group (SEA-SANA)
Chair: Kevin Nichols
XML Standards & Guidelines SIG (SEA-XSG)
Chair: Louis I. Reich
Delta-DOR SIG (SEA-D-DOR)
Chair: Roberto Maddè
Registry / Repository SIG (SEA-REGREP)
Chair: Peter Shames
Space/Ground Interoperability Architecture Birds of a Feather (SEA-SGIA)
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Service Management Working Group (CSS-SM)
Chair: Erik Barkley
Cross Support Transfer Service Working Group (CSS-CSTS)
Chair: Yves Doat
Spacecraft Onboard Interface Services Area (SOIS)
AD: Patrick Plancke
Subnetwork Services Working Group (SOIS-SUBNET)
Chair: Richard Schnurr
Application Support Services Working Group (SOIS-APP)
Chair: Stuart Fowell
Onboard Plug & Play Birds of a Feather (SOIS-OPP)
Chair: Philippe David
Onboard Transducer System Birds of a Feather (SOIS-OTS)
Chair: Chris Plummer
Wireless Birds Of a Feather (SOIS-WIR)
Chair: Patrick Plancke
Space Link Services Area (SLS)
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RF Modulation Working Group (SLS-RFM)
Chair: Enrico Vassallo
Space Link Coding and Synchronization Working Group (SLS-C&S)
Chair: Gian Paolo Calzolari
Data Compression Working Group (SLS-DC)
Chair: Pen-Shu Yeh
Space Link Protocols Working Group (SLS-SLP)
Chair: Greg Kazz
Telecommand Channel Coding Working Group (SLS-TCC)
Chair: Gian Paolo Calzolari
Ranging Working Group (SLS-RNG)
Chair: Enrico Vassallo
High Rate Uplink Working Group (SLS-HRU)
Chair: Greg Kazz
Long Erasure Codes Birds of a Feather (SLS-LEC)
Chair: Gian Paolo Calzolari
Space Internetworking Services Area (SIS)
AD: Robert Durst
CFDP Interoperability Testing Working Group (SIS-CFDP)
Chair: Massimiliano Ciccone
Packet Protocol Working Group (SIS-SPP)
Chair: Dai Stanton
Cislunar Working Group (SIS-CSI)
Chair: Keith Scott
Asynchronous Message Service Working Group (SIS-AMS)
Chair: Scott C. Burleigh
IP over CCSDS Space Links Working Group (SIS-IPO)
Chair: Greg Kazz
Mars Communications Profile Birds of a Feather (SIS-MCP)
Chair: Chris Taylor

SOIS - Why

- While all spacecraft essentially have the same basic communication requirements, implementations tend to be reinvented in each new project
- Any reuse between projects tends to be based on proprietary implementations that are not open, highly optimized, and generally targeted at a series of identical missions (may require significant adaptation for different mission types)
- Although physical interface types are generally limited, services and access are not standardised (e.g. typically each payload has it's own protocol flavour)
- The above translates in to *time, cost and risk*, and, in addition, it limits the opportunity for standard component development both in ESA and industry

SOIS – Objectives summary

- In general, reduce the cost and complexity of assembling the flight data handling system and associated payload integration process

- Achieve the above by developing a set of communication services and associated protocols which enable standardised access to onboard elements (subsystems, sensors, actuators, payloads and generic spacecraft functions)

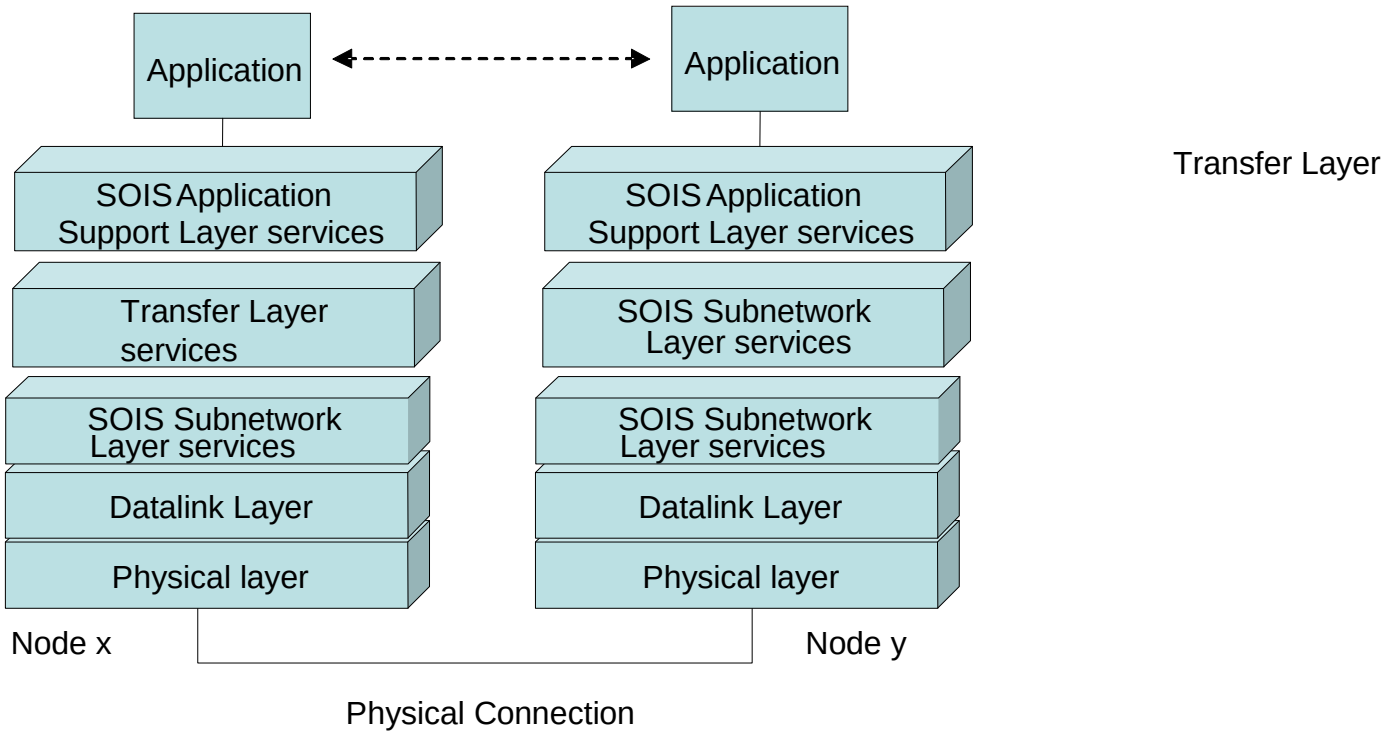
- In doing so:
  - Insulate application and core mission software from the differences in underlying hardware and thus foster reuse across missions
  - Provide a clear target for interface and component developers for product development

SOIS architectural drivers

- In preparing the SOIS architectures a number drivers were taken into account:
  - We typically have only one or two onboard subnets
  - Data transfer is extremely robust and typically error free
  - The vast majority of communication is planned with very little ad-hoc transfer
  - Memory and processing power is still limited
  - Some units may be very simple and not able to support full communication stacks (see next slides)
- This resulted in an architecture which assumes that the subnet normally contains all the necessary capabilities for addressing, data transfer and ancillary services
- Network and Transport layers are still possible if required, application support services normally directly access the Subnetwork services

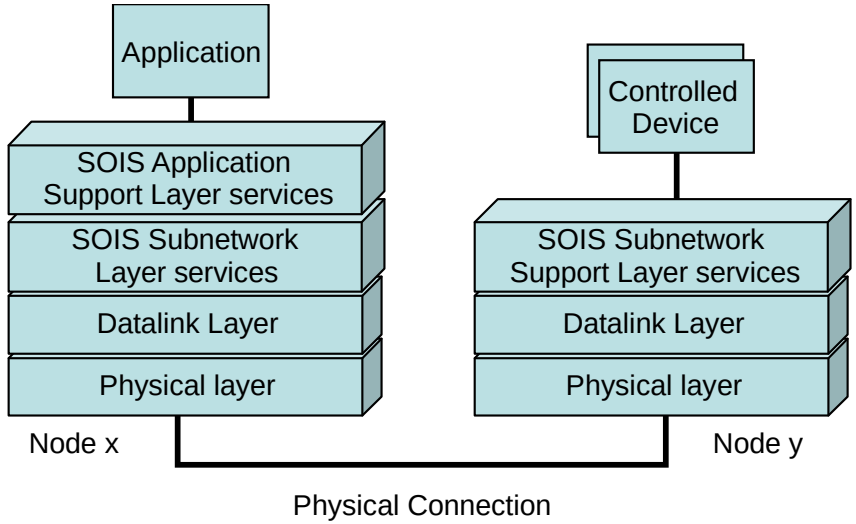
SOIS architectural drivers

- Symmetrical communication – e.g. computer to computer message exchange

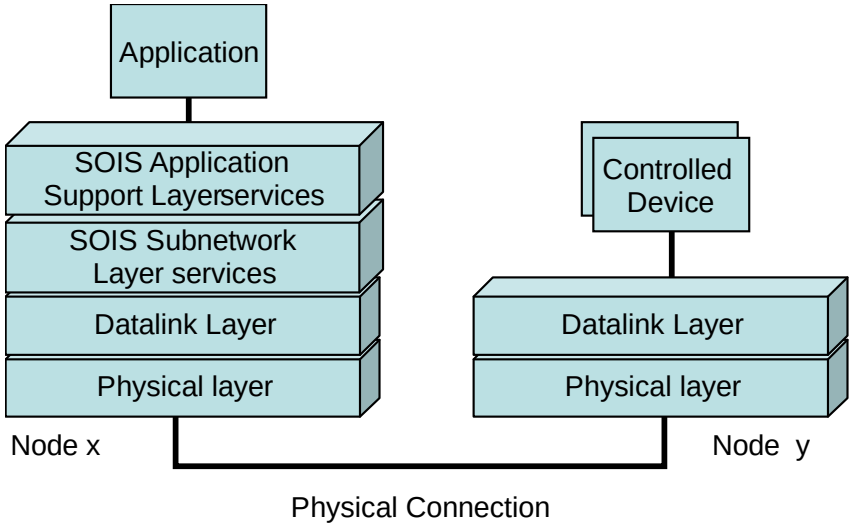


SOIS architectural drivers

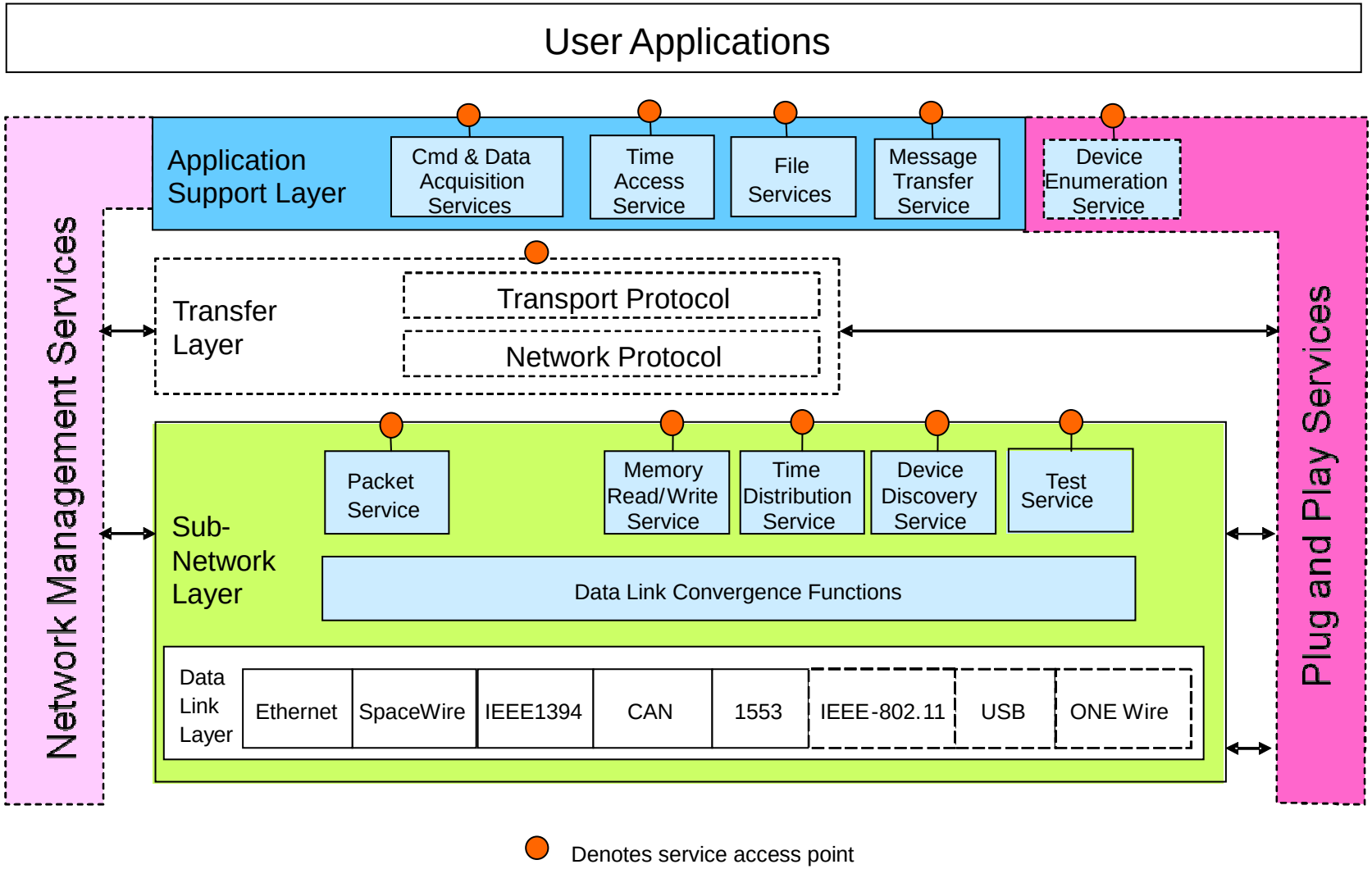
- Asymmetric Hosts – e.g. TM packet exchange with payload



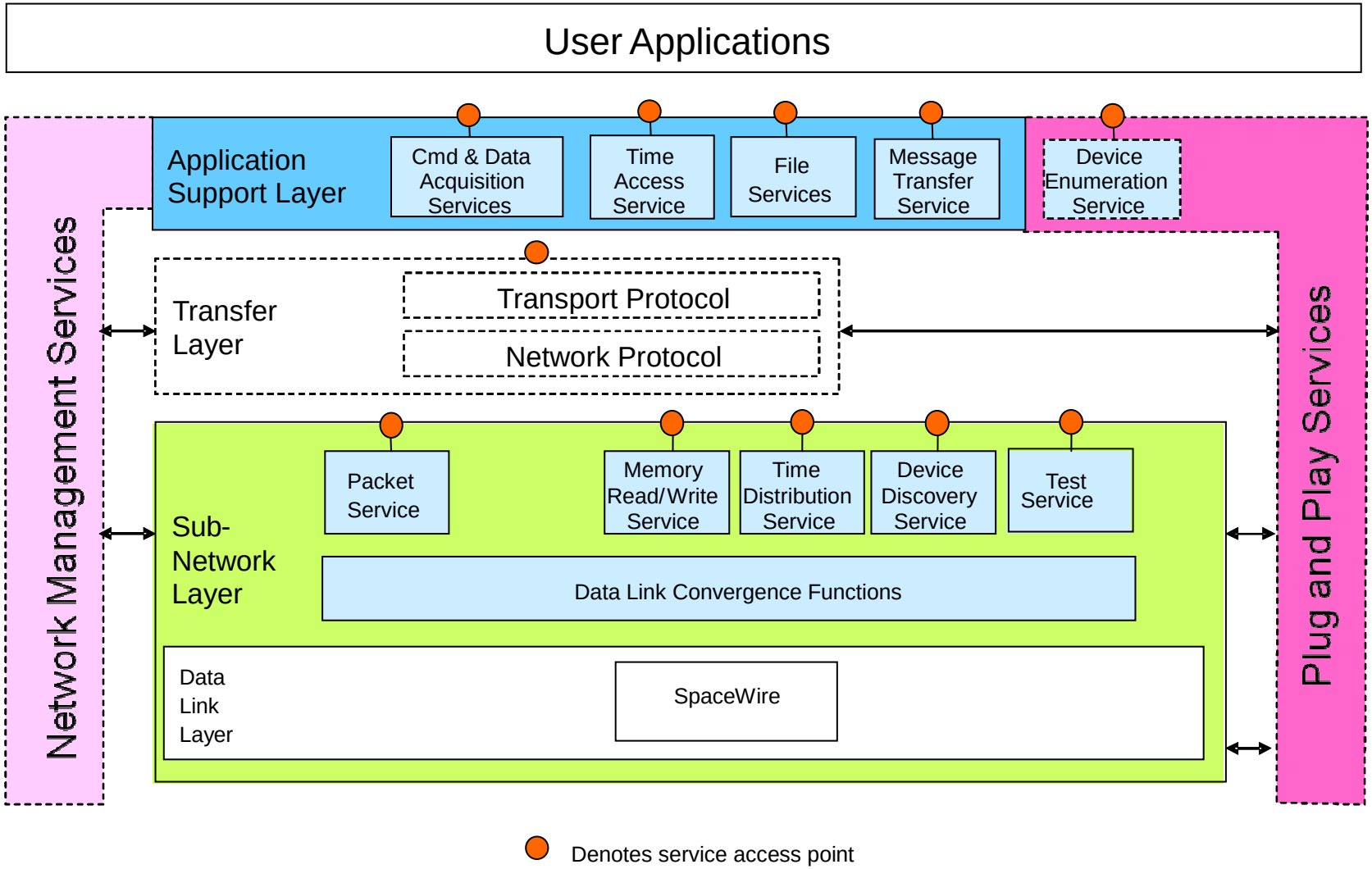
- Simple asymmetric Hosts – e.g. direct access to temperature sensor memory



SOIS overall Architecture



SOIS overall Architecture



SOIS Conformance

- In preparing the SOIS recommendations we have taken account of the need to state conformance to the standards, this is required for two purposes:
  - SOIS contains options and we need a mechanism for stating which options have been included in a particular implementation
  - For interoperability between two SOIS compliant systems there must be a means to state implementation details
- These aspects are required for the service specification but more important (and involved) for the protocol specifications implementing the service

SOIS – much work remains

- SOIS is presently is in it's infancy. The specification of services and a communications architectural is an important step forward as is provides an overall framework in which other may focus their efforts, but to achieve the SOIS long term objectives of interoperability and software reuse, we need more:
  - For interoperability, we need protocols for the underlying datalinks
  - For software reuse we will eventually require software APIs

- This situation is fully appreciated by the SOIS development team and it was a conscious decision to leave the protocol and API development to expert working groups

- We are now looking to the SpaceWire working group to compliment the SOIS services by SOIS SpaceWire specific datalink protocol specifications. Other groups, e.g. the ECSS Milbus WG will provide similar specifications

- Once datalink specifications are completed, the intention is to propose them for adoption by the CCSDS/ECSS. Where no dedicate group exists the SOIS team may consider providing the required datalink protocol specification

SOIS – Evolution to meet final objectives (subnet example)

Step 1 SOIS Service Specification

SOIS Subnet Service Spec

We are Here

Step 2 Datalink protocol specs

SOIS Subnet Service Spec

Datalink specific Protocol Spec (e.g. SpaceWire)

Input required from SpaceWire working group

Step 3 Actual implementation

API

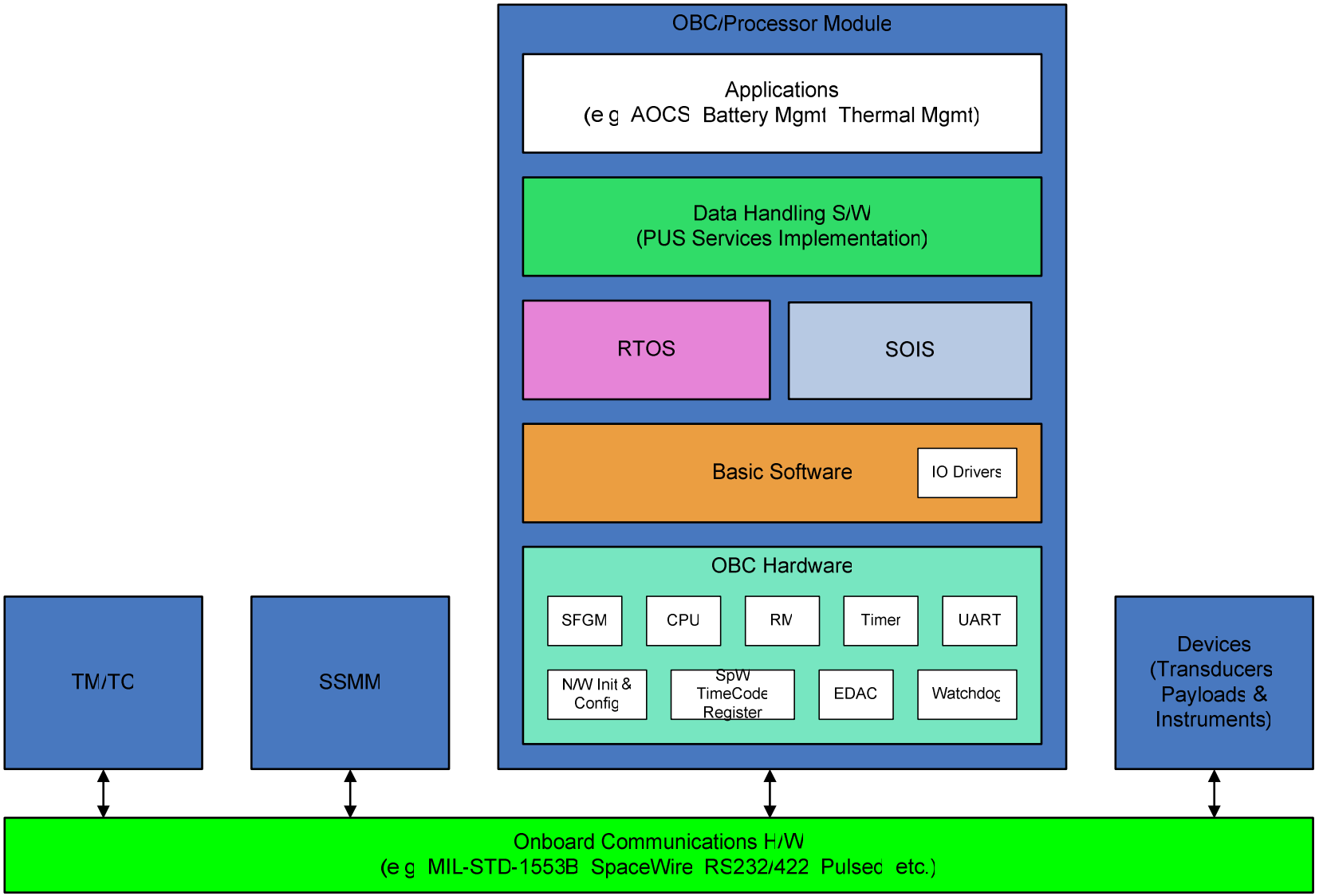
Datalink specific Protocol Spec (e.g. SpaceWire)

API and protocol implementation by industry

SOIS – Wider context

- It is temping to believe that the SOIS architecture defines the architecture for the onboard system, this is not case
- Rather, SOIS defines the communications architecture which must be seen in the context of the overall software architecture (next slide)
- This context is important as to be successful SOIS must be incorporated into other development activities
- In addition, for ESA spacecraft we must map the Packet utilisation standard into SOIS

SOIS – Software Context



SOIS – Where are we today

- The following books have been submitted to the CCSDS CESG for final review, they are all available in the SOIS public area at WWW.CCSDS.org

Green Book (informative)

- SOIS Green Book

Application Support Services

- Device Access Service (part of Cmd & Data Acquisition)
- Device Data Pooling Service (part of Cmd & Data Acquisition)
- Time Access Service
- File Services

Subnetwork Services

- Packet Service
- Memory Access Service
- Time distribution Service
- Test Service

SOIS – Where are we today?

- The following books are still under preparation and review

Green Book (informative)

- SOIS QOS Green Book (discussing need, inclusion of FDIR aspects)

Application Support Services

- Device enumeration service (associated with P&P)
- Device virtualisation (associated with P&P)

Subnetwork Services

- Device discovery (associated with P&P)

SOIS – Where are we today?

- Of course we still have a few known issues:
  - While we have solid support in CCSDS from all European Agencies, the support from NASA (initially very high) has dwindled. The result may be that the SOIS recommendations are released as Magenta instead of Blue books. (Magenta is a recommended practise rather than a standard)

- A possible strategy to alleviate the above is directly generate dedicated ECSS standards rather than adopt those coming from the CCSDS

- We have not yet finalised the QOS green book and there is still discussion within the group as to whether we need it and if it should contain information relevant to FDIR

- The precise meaning of Plug and Play and what it infers within SOIS is not yet clear. We need to develop requirements in order to derive a final approach and subsequent services

Meeting Objectives (SOIS Viewpoint)

- Present the SOIS activity and development status to the SpaceWire community
- Gain feedback from the SpaceWire implementers on the SOIS services with a view to updating the SOIS Recommendations in the next release
- Identify any open issues and explore solutions with respect to a SpaceWire specific implementation (e.g. Plug& Play, QOS)
- Review the possibilities for prototyping and ensure a coordinated approach to maximize return
- Identify the way forward for a SpaceWire protocol specification complying with the SOS Subnetwork services