Subnetwork services

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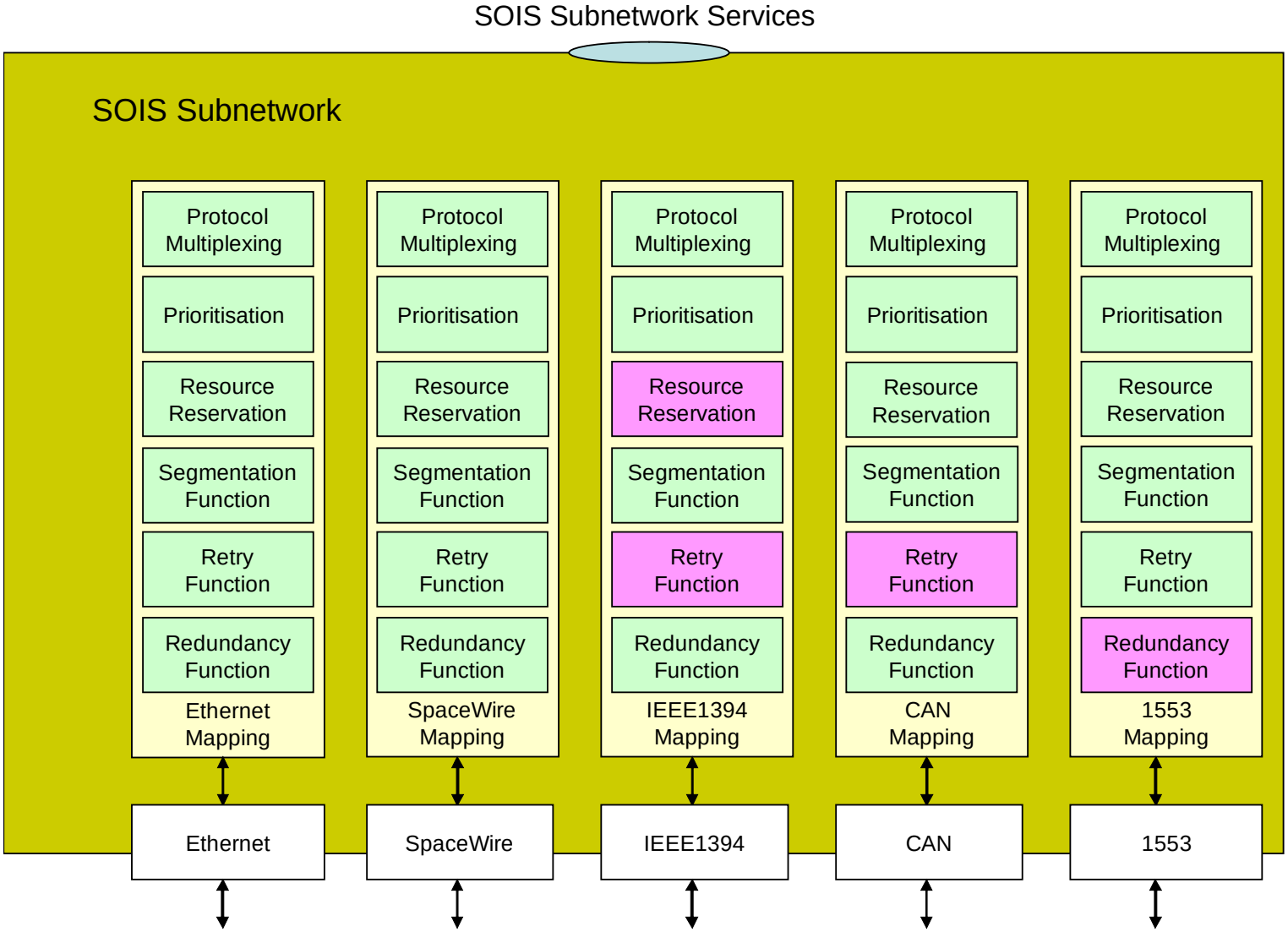
Overview of SOIS Subnetwork services

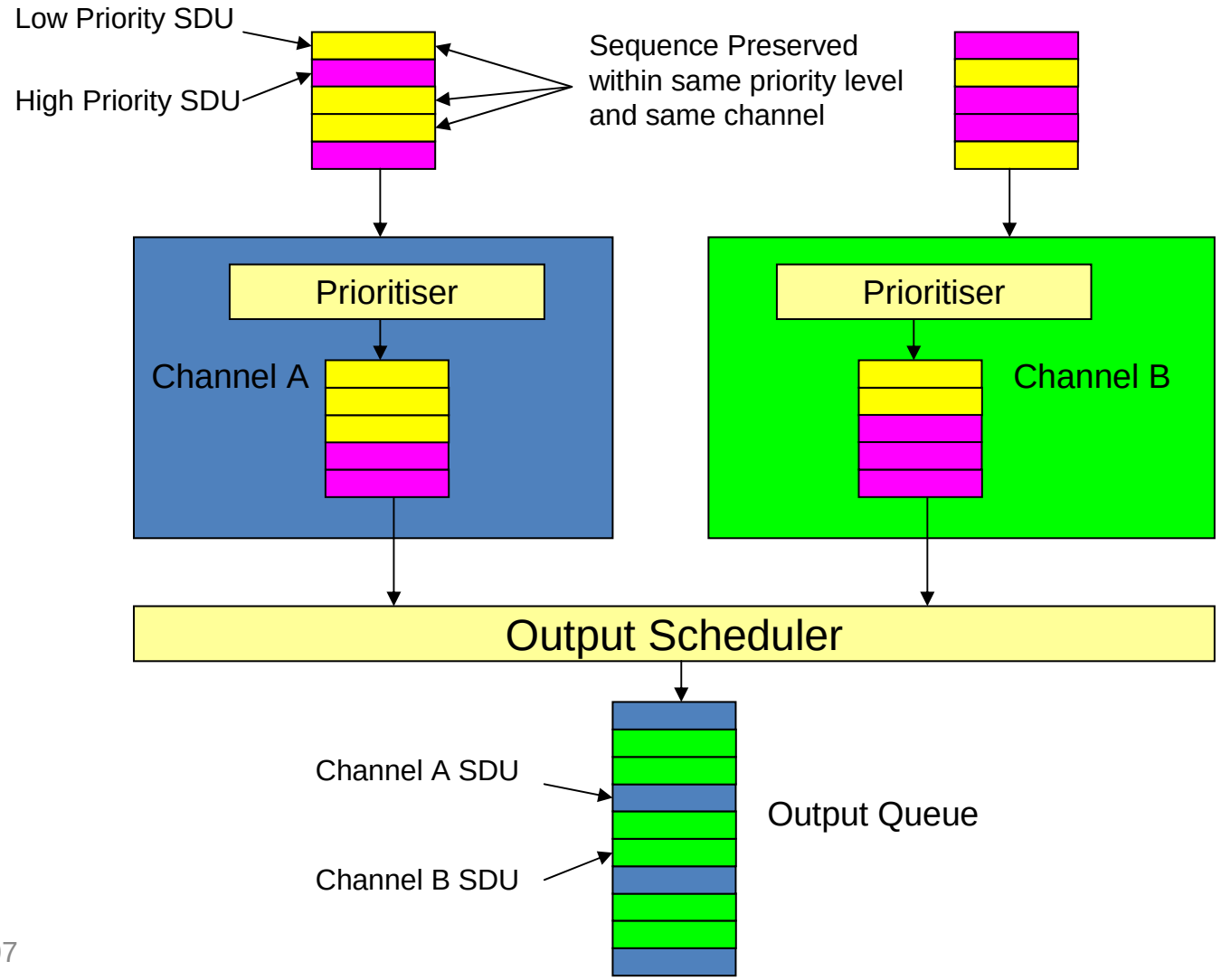
- The SOIS Subnetwork provides a set of SOIS-defined services which support upper-layer Application-Support and Transfer-layer entities.
- Services are independent of the underlying Data Link in that the service primitives and associated parameters are the same regardless of the actual link in operation
- Convergence functions are used to add the necessary functionality to that inherently provided by the Data Link
- For each SOIS-compliant Data Link there will need to be a mapping of subnetwork services to the actual Data Link implementation, including the provision of convergence functions where required.
- Mapping is left to dedicated groups (e.g. Spacewire or ECSS) and possibly SOIS (where no dedicated group is available).
- SOIS/CCSDS may adopt as Recommendations the mappings performed by dedicated groups.

Examples of SOIS Subnetwork Functions



indicates that the function is, to a substantial extent, already included in the specific Data Link.

Quality of Service Model



Quality of Service Classes

- Best-Effort Service Class:
  - makes a single attempt to deliver data but cannot ensure that it will be delivered successfully;
  - provides data in sequence (within a priority value), without errors, and without duplication;
  - uses a priority parameter to signal the importance of the data to the service.
- Assured Service Class:
  - ensures delivery of data to its destination;
  - indicates to the sending entity if it is not possible to provide the assured service;
  - provides data in sequence (within a priority value), complete, without errors, and without duplication;
  - uses a priority parameter to signal the importance of the data to the service.
- Reserved Service Class:
  - makes a single attempt to deliver data to its destination but cannot ensure that it will be delivered successfully;
  - provides data in sequence (within the channel and within a priority value), without errors, and without duplication;
  - uses a channel that defines the resources that are used to transmit the SDU;
  - uses a priority parameter to signal the importance of the data to the service.

Quality of Service Classes (continued)

- Guaranteed Service Class:
  - ensures delivery of data to its destination.
  - indicates to the sending entity if it is not possible to provide the guaranteed service;
  - provides data in sequence (within the channel and within a priority value), complete, without errors, and without duplication;
  - uses a channel that defines the resources that are used to transmit the SDU;
  - uses a priority parameter to signal the importance of the data to the service.

Quality of Service Principles

- Priority defines the priority of a communication within the resource reservation, i.e., within a channel.

- Priority is arbitrated across the best effort and assured service classes and across the reserved and guaranteed service classes where both classes are provided within a channel.

- All service classes are sequence preserving only within a channel and at a priority level.
  - No service-wide sequence preservation unless all users operate with no channelisation and at a single priority.
  - Sequence preservation will cause out-of-sequence data units in the best-effort and resource-reserved Qualities of Service to be deleted and not delivered to the user. It is therefore recommended that underlying data links be themselves inherently sequence preserving.

Subnetwork Management

- SOIS conforms to the established consensus within CCSDS regarding management concepts.
- A Protocol Conformance Statement (PICS) Proforma and accompanying Management Information Base (MIB) description mandatory for inclusion in any protocol specification claiming to implement SOIS Services
- Should include parameters, databases and actions necessary to inform operation of the protocols.
- Method of access to the MIB by the management system is undefined and may be a combination of preconfigured code, local configuration, or remote management via management protocol and local agent.

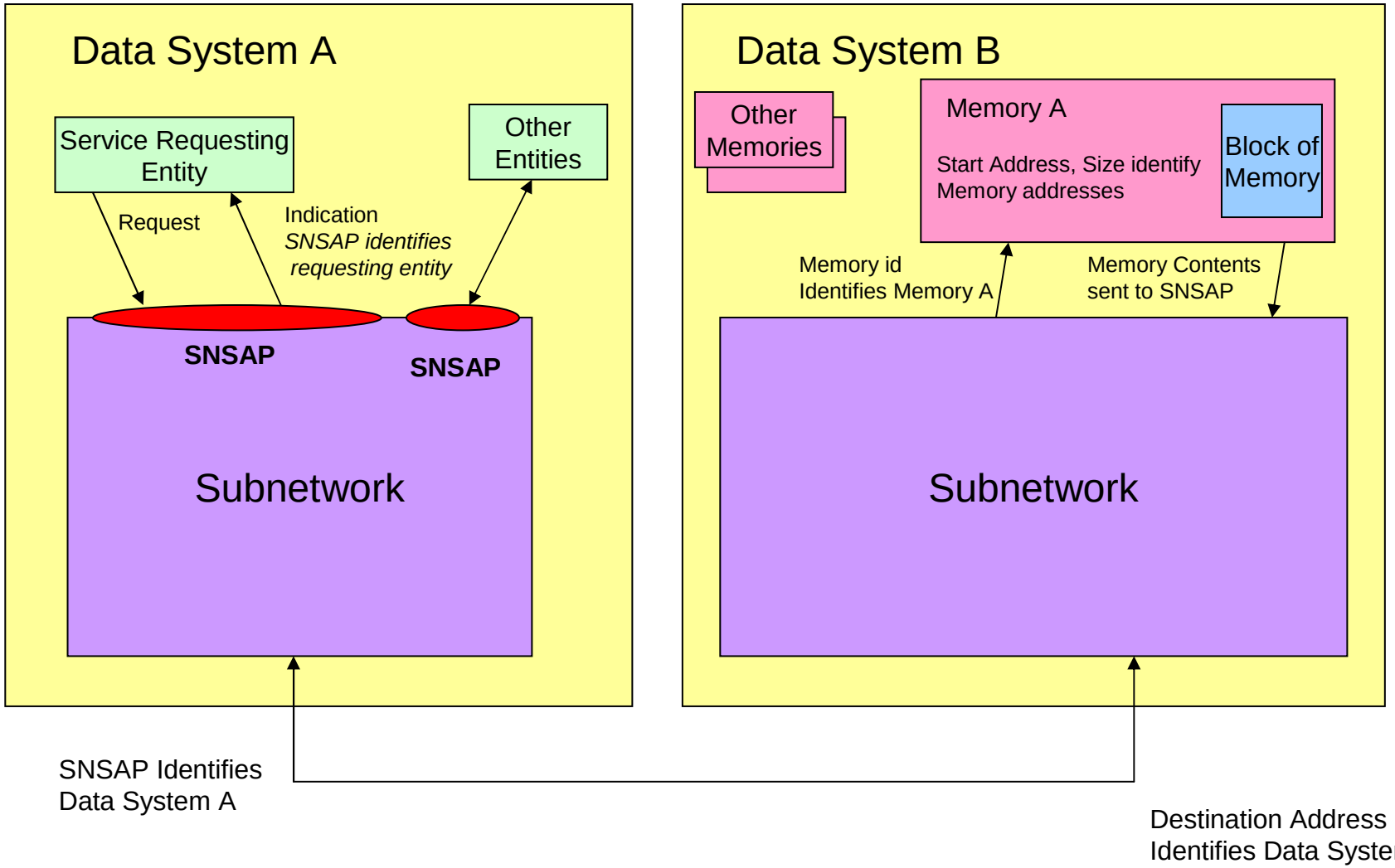
SOIS Subnetwork Services

- Packet
  - Provides packet delivery over a single subnetwork;
- Memory Access
  - Memory location read/write, includes block move;
  - Provides direct access to device memory;
  - Provides parameter get/set functionality.
- Time Distribution
  - Provides transmission and reception of spacecraft time;
- Device Discovery
  - Provides dynamic device recognition;
- Test Service
  - Provides establishment of subnetwork functionality and availability.

Addressing

- Adopt OSI Addressing Convention
  - Service Access Point identifies a service user entity uniquely inside addressing domain
  - The addressing domain is the subnetwork
  - Addressing outside the subnetwork is a network layer responsibility
  - Network layer translates between network and subnetwork layer addresses
  - No global addressing required at subnetwork level
- Destination or Source Address identify data systems on the subnetwork
- In general, Subnetwork SAP is the concatenation of Source or Destination address and an identifier of the user entity within the data system (e.g. protocol id)

Addressing Example – Memory Access Service



SOIS Subnetwork Packet Service

- Provides for the movement of a Service Data Unit (SDU) over a subnetwork
- An SDU consists of a variable length assembly of octets.
- Enables the multiplexing of multiple network protocols with a range of QoS support over underlying Data Links.
- QoS is provided by means of prioritisation of PDUs and resource reservation
- All four QoS's supported on an SDU by SDU basis
- Requires underlying data transfer service
- Parameters:
  - Source Subnetwork Service Access Point (SSNSAP)
  - Destination Subnetwork Service Access Point (DSNSAP)
  - Service Class
  - Channel (Used for reserved or guaranteed service classes only)
  - Priority
  - Failure Metadata

SOIS Subnetwork Packet Service (contd.)

- Primitives
  - **PACKET_SEND.request** (SSNSAP, DSNSAP, Data, Priority, Service Class, Channel)
    - requests to send an SDU
  - **PACKET_RECEIVE.indication** (SSNSAP, DSNSAP, Priority, Channel, Data)
    - indicates that a packet has been received and passes the corresponding SDU to the user
  - **PACKET_FAILURE.indication** (SSNSAP, DSNSAP, Failure Metadata)
    - indicates a failure to provide an assured or guaranteed service
    - Passed to **Sending** user
- Management Information
  - Best effort is mandatory
  - Implementation Details
    - Priority Levels
    - Channelisation
    - Failure Metadata

SOIS Subnetwork Memory Access Service

- Simple service which may be used to read from or write to memory locations or memory blocks held in data systems or in unsophisticated devices.
- Service interface is only present in the data system invoking the service.
- Data can be read/written one word at a time, or as a block of words that are located in contiguous memory locations on the target device.
- Atomic read/modify/write capability
- Requires underlying memory access functions
- Parameters:
  - Source Subnetwork Service Access Point (SSNSAP)
  - Destination Address
  - Memory ID
  - Start Memory Address
  - Size
  - Mask (for read/modify write, defines bits which are to be unchanged)
  - Data
  - Service Class
  - Channel (Used for reserved or guaranteed service classes only)
  - Priority
  - Failure Metadata

SOIS Subnetwork Memory Access Service (contd.)

- Primitives
  - **READ.request** (SSNSAP, Destination Address, Memory ID, Start Memory Address, Size)
    - requests to retrieve the contents of memory
  - **READ.indication** (SSNSAP, Destination Address, Memory ID, Start Memory Address, Size, Data)
    - returns the retrieved contents of memory
  - **WRITE.request** (SSNSAP, Destination Address, Memory ID, Start Memory Address, Size, Data)
    - requests to change the contents of memory
  - **READ/MODIFY/WRITE.request** (SSNSAP, Destination Address, Memory ID, Memory Address, Size, Mask, Data)
    - invokes an atomic Read/Modify/Write cycle at the memory
  - **MEMORY_ACCESS_FAILURE.indication** (SSNSAP, Destination Address, Memory ID, Start Memory Address, Size, Failure Metadata) CT4
    - informs a user of the failure of a memory access operation in guaranteed and assured QoS classes
- Management Information
  - Read capability and Best effort are mandatory
    - certain data systems may not be allowed to have access to the WRITE.request primitive.

Slide 15

CT4 text is bollocks

Chris Taylor, 23/04/2007

SOIS Subnetwork Time Distribution Service

- Provides the capability to distribute a centrally maintained reference time to multiple users throughout the spacecraft.
- Asymmetric producer/consumer service.
- Service can be used to correlate the locally maintained time sources used by the SOIS time access service that is provided at the Application Support Layer.
- Requires underlying data transfer service and time provision application
- Operates with a best-effort Quality of Service:
  - Service consumer requests service until time data begins to be delivered,
  - Time data is delivered with best effort and with bounded latency,
  - bounded latency achieved via data link-specific mechanisms such as resource reservation, system analysis, or via the use of a dedicated timing bus,
  - quality of the bounded latency will depend on the mechanisms available.
- Parameters:
  - Source Subnetwork Service Access Point (SSNSAP)
  - Destination Subnetwork Service Access Point (DSNSAP)
  - Time

SOIS Subnetwork Time Distribution Service (contd.)

- Primitives
  - **TIME_DISTRIBUTION.request** (SSNSAP, DSNSAP)
    - by which the time consumer requests time data
  - **TIME_DISTRIBUTION.indication** (SSNSAP, DSNSAP)
    - informs the time producer of the time distribution request
  - **TIME.request** (SSNSAP, DSNSAP, Time)
    - by which the time producer requests time to be sent to the consumer
  - **TIME.indication** (SSNSAP, DSNSAP, Time)
    - delivers time data to the consumer
- Management Information
  - Data system is provider, consumer or both
  - Implementation Details
    - Time format and accuracy

SOIS Subnetwork Device Discovery Service

- Provided by data link-specific mechanisms within the subnetwork layers
- Invoked by a subnetwork user entity or by mechanisms internal to the subnetwork (e.g., when a device is first connected to the subnetwork).
- Provides the capability to detect devices becoming active following a change in the hardware configuration of the spacecraft.
- Operates in solicited or unsolicited discovery mode.
- Unsolicited mode requires functions to detect hardware configurations, e.g., by detecting hardware events, or by periodically scanning for attached devices.
- Operates with a best-effort Quality of Service:
  - Management Information Base (MIB) sets default channel and priority levels to ensure adherence to an overall subnetwork prioritisation and resource-reservation scheme.
- Parameters:
  - Source Subnetwork Service Access Point (SSNSAP)
  - Destination Address

SOIS Subnetwork Device Discovery Service (contd.)

- Primitives
  - **DEVICE_DISCOVERY.request** (SSNSAP)
    - requests that device identities be retrieved from the subnetwork
  - **DEVICE_DISCOVERY.indication** (SSNSAP, Address)
    - returns device identities
- Management Information
  - Device_Discovery.Indication is mandatory

SOIS Subnetwork Test Service

- Tests data system functionality and connectivity of the subnetwork service
- Interface is only present in the data system invoking the service
- Return parameters dependent on capabilities of the interface and that provided by the Data Link layer protocol.
- Minimum service should return a go/no-go status
- May be augmented by error codes, bit rate selection, prime/redundant media active, etc.
- Requires underlying subnetwork test capability.
- Operates with a best-effort Quality of Service:
  - Management Information Base (MIB) sets default channel and priority levels to ensure adherence to an overall subnetwork prioritisation and resource-reservation scheme.
- Parameters:
  - Source Subnetwork Service Access Point (SSNSAP)
  - Destination Subnetwork Service Access Point (DSNSAP)
  - Test Status

SOIS Subnetwork Test Service (contd.)

- Primitives
  - **TEST.request** (SSNSAP, Destination Address)
    - requests that a verification be performed
  - **TEST.indication** (SSNSAP, Destination Address, Test Status)
    - returns the results of the verification
- Management Information
  - Both primitives mandatory
  - Implementation Details
    - Supported Test Status values

Issue summary

- Do we have the correct set of services?
- Do we need all of the QOS classes?
- Is sequence preservation required for best effort, resource reserved classes?
  - Price to pay is deletion of out of sequence SDUs
  - Requires sequencing mechanism in subnet (per priority and channel)
  - Are subnets inherently sequence preserving?