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CCSDS Time Critical Onboard Network Services

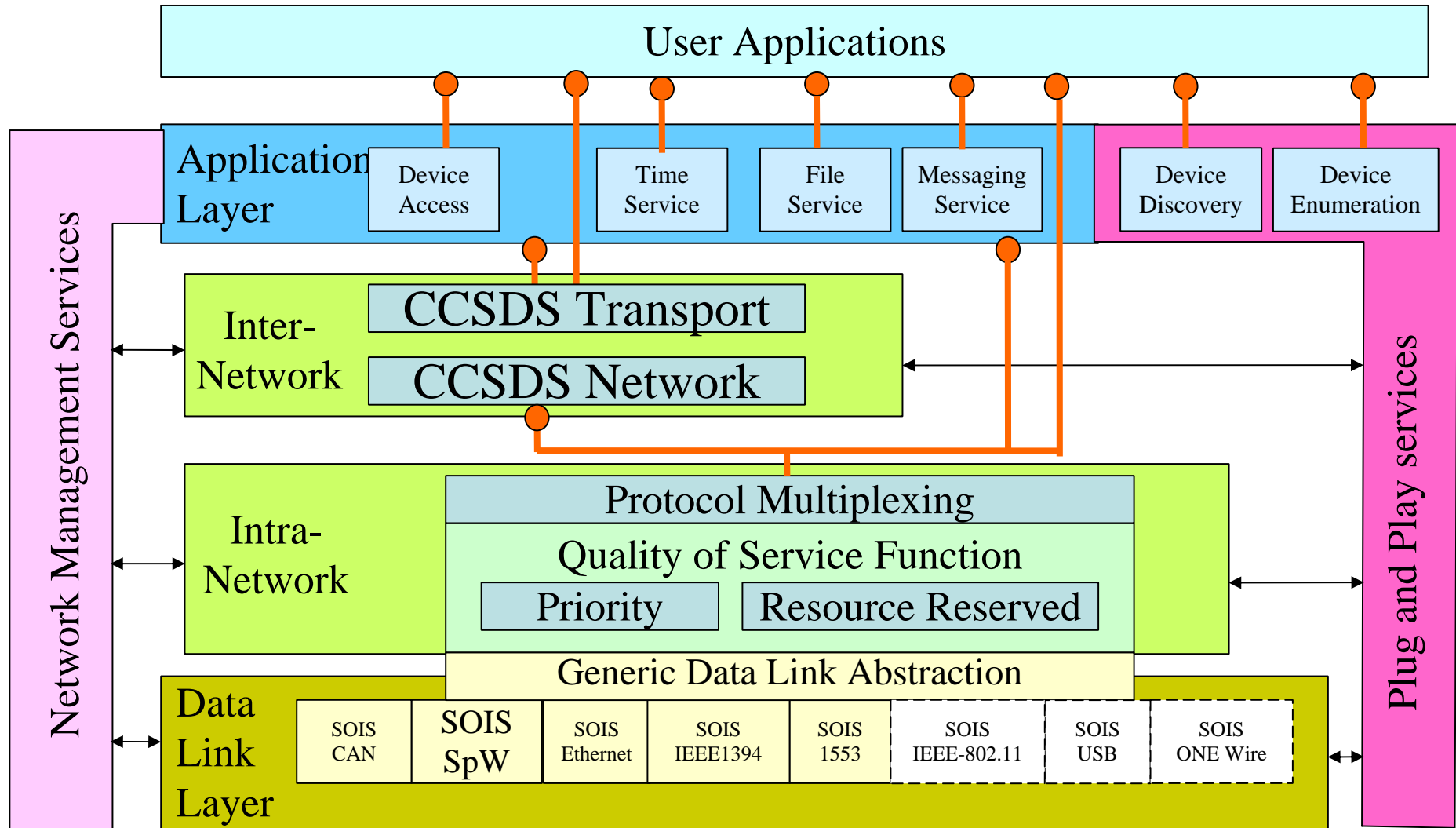
TCONS/OBL Working Group

Spacecraft Onboard Traffic

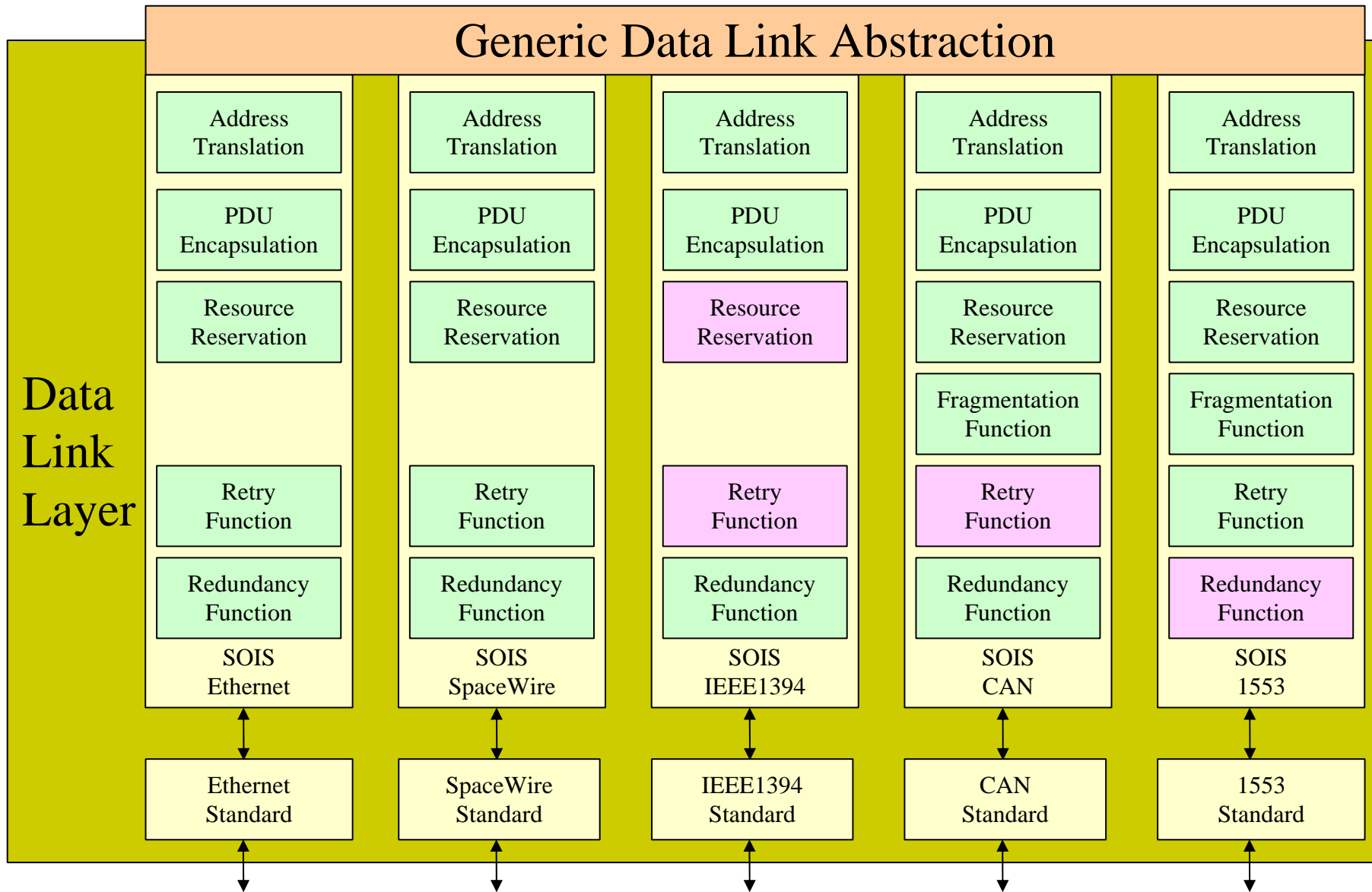
Table 1-1: Types of Onboard Traffic	
Traffic Type	Characteristics
Command data:	Reliability Timeliness Low data rates
Housekeeping Telemetry:	Low data rates
Payload science data:	Wide range of data rates from very low to very high.
Real time control data:	Reliability Timeliness Low to moderate data rates
User messaging data	Ad hoc Asynchronous Variable timeliness Variable length

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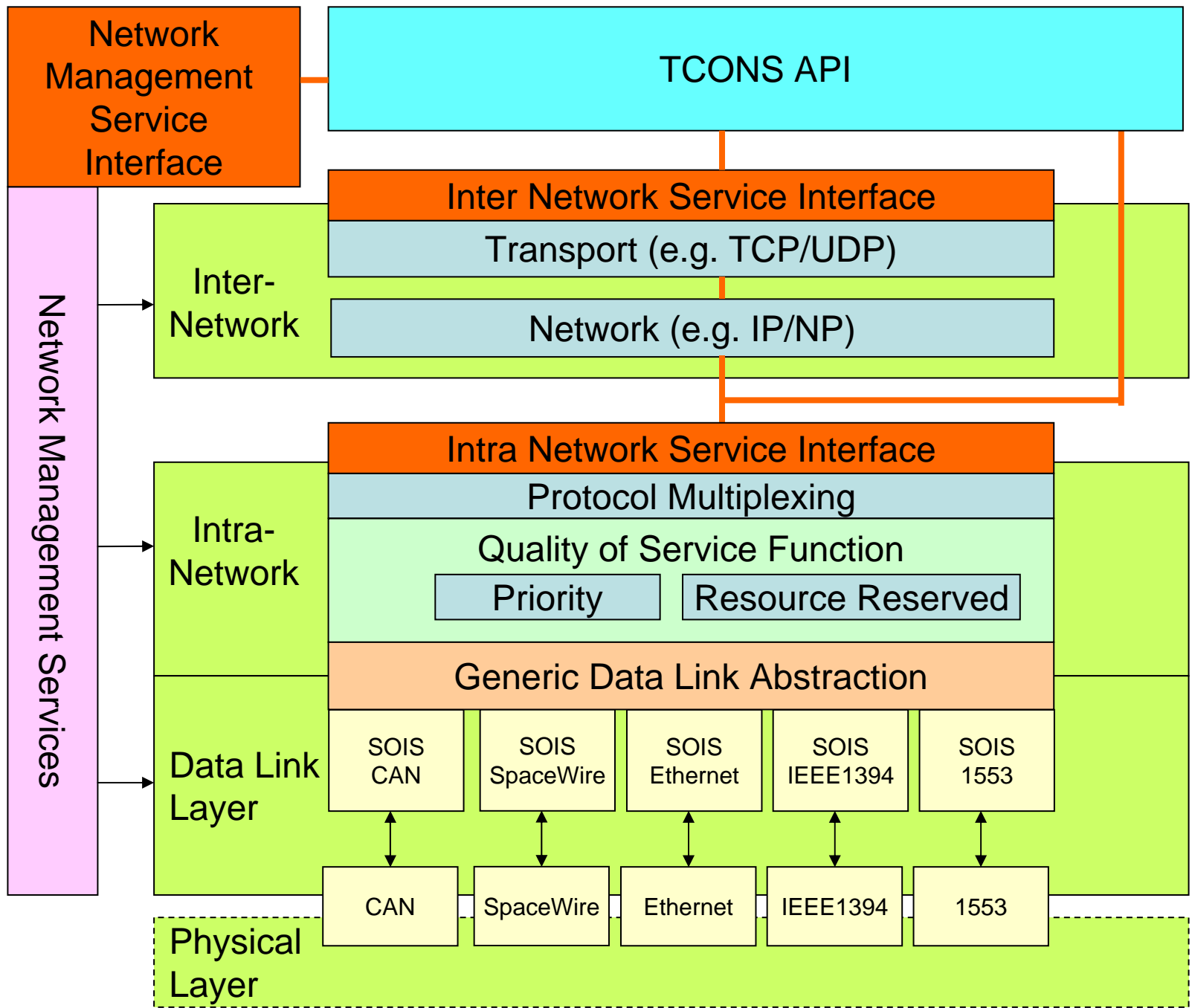
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● Denotes service access point



Means that the function is, to a substantial extent, already included in the specific data-link



- QoS is ability to provide predictable, differentiated communication services
- Characterised in terms of features relevant to a communications service
 - Reliability
 - Transmission rate
 - Effective bandwidth
 - Latency
 - Error rate

- Three levels to TCONS QoS Model:
 - a) Priority
 - b) Resource reserved / non-reserved
 - c) Try once / retry
- Result in four service types
 - Best Effort: Non-reserved, try once
 - Assured: Non-reserved, retry
 - Reserved: Resource reserved, try once
 - Guaranteed: Resource reserved, retry
- Each of these service types also has several priority levels
 - Priority for non-reserved types is global
 - Priority for reserved types is within a channel

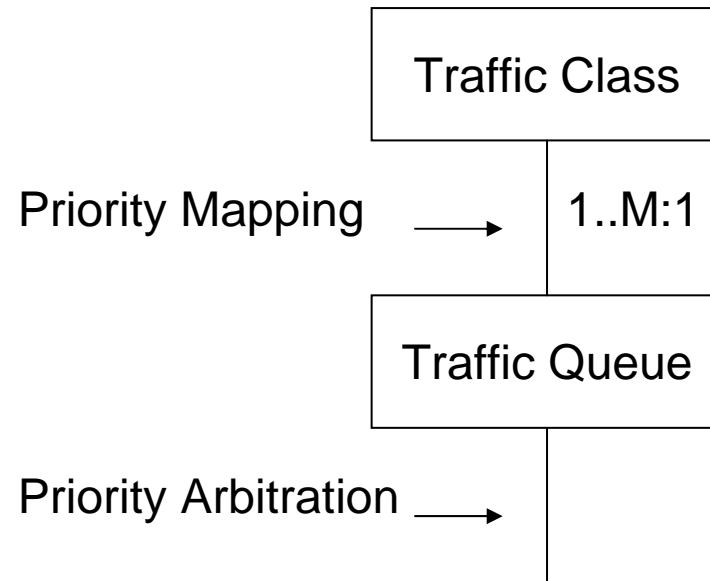
- Traffic Class
 - A traffic class is a category of traffic on a sub-network distinguished by its quality of service.
- Channel
 - A reservation of resources between source and destination
 - Specifies
 - Source
 - Destination(s)
 - Usage of reserved resources
 - E.g. percentage bandwidth of communications link

Traffic Class Summary

Table 3-1 Traffic Class Summary		
Traffic Class Category	Traffic Class Attributes	Managed Parameters
Best Effort	Priority	None
Assured	Priority,	Redundancy on/off Retry attempts
Reserved	Priority, Channel number	For each channel: Bandwidth allocation / schedule slot id
Guaranteed	Priority, Channel number	For each channel: Bandwidth allocation / schedule slot id Redundancy on/off Retry attempts

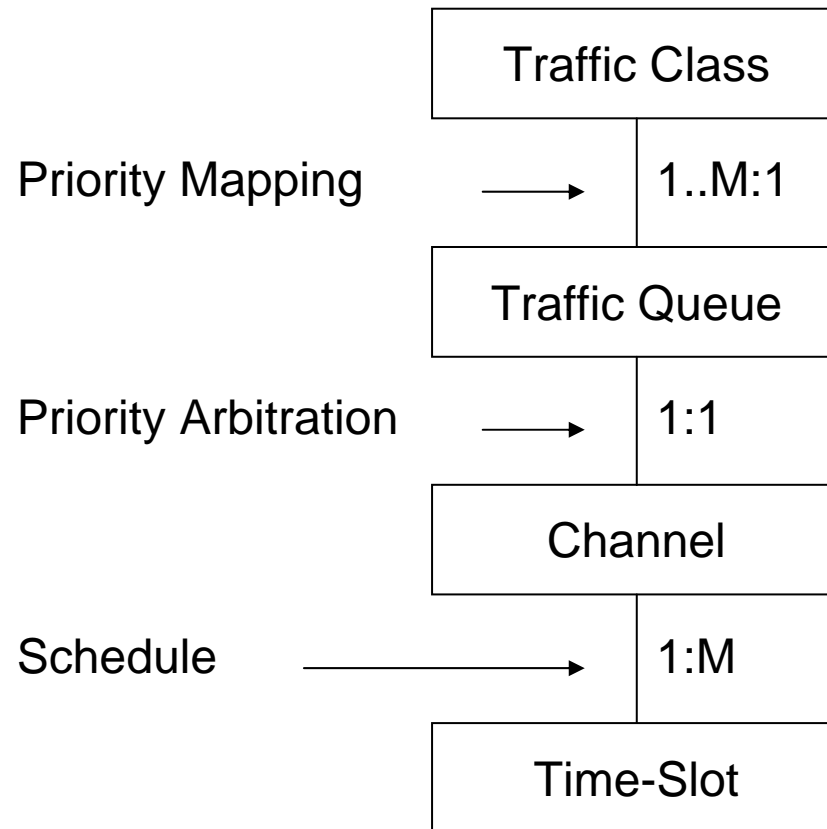
- A traffic queue permits differentiation of quality of service
- May be thought of as being a physical queue
 - But they may be of zero length
 - Implemented in many different ways

Priority in an Asynchronous System



- 1:1 means a one to one mapping
- 1:M means a one to many mapping
- 1..M:1 means a one to one or many to one mapping

Resource Reservation in a Scheduled System

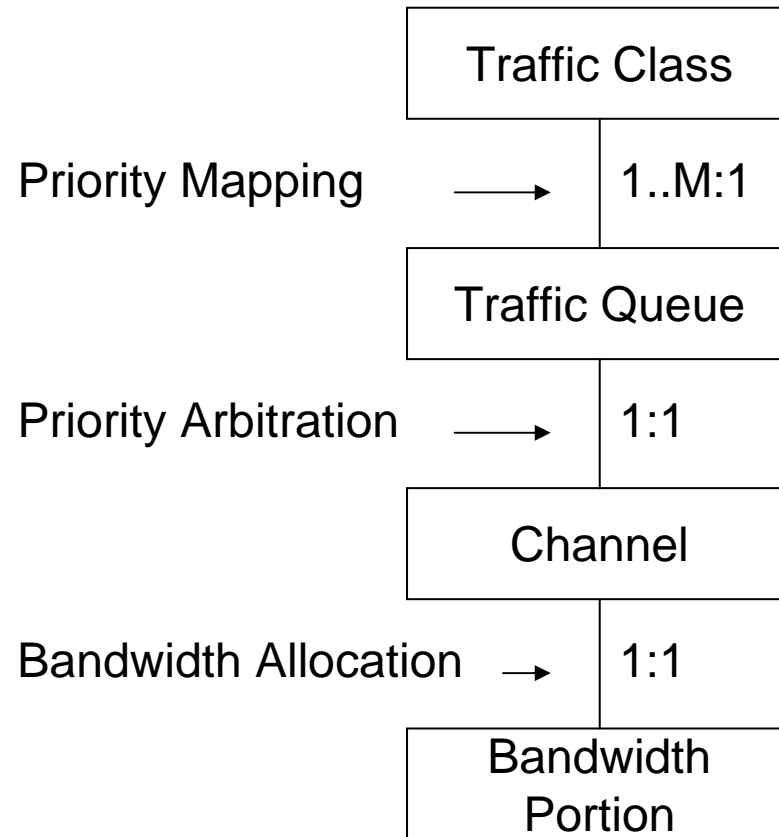


1:1 means a one to one mapping

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Resource Reservation in an Asynchronous System



1:1 means a one to one mapping

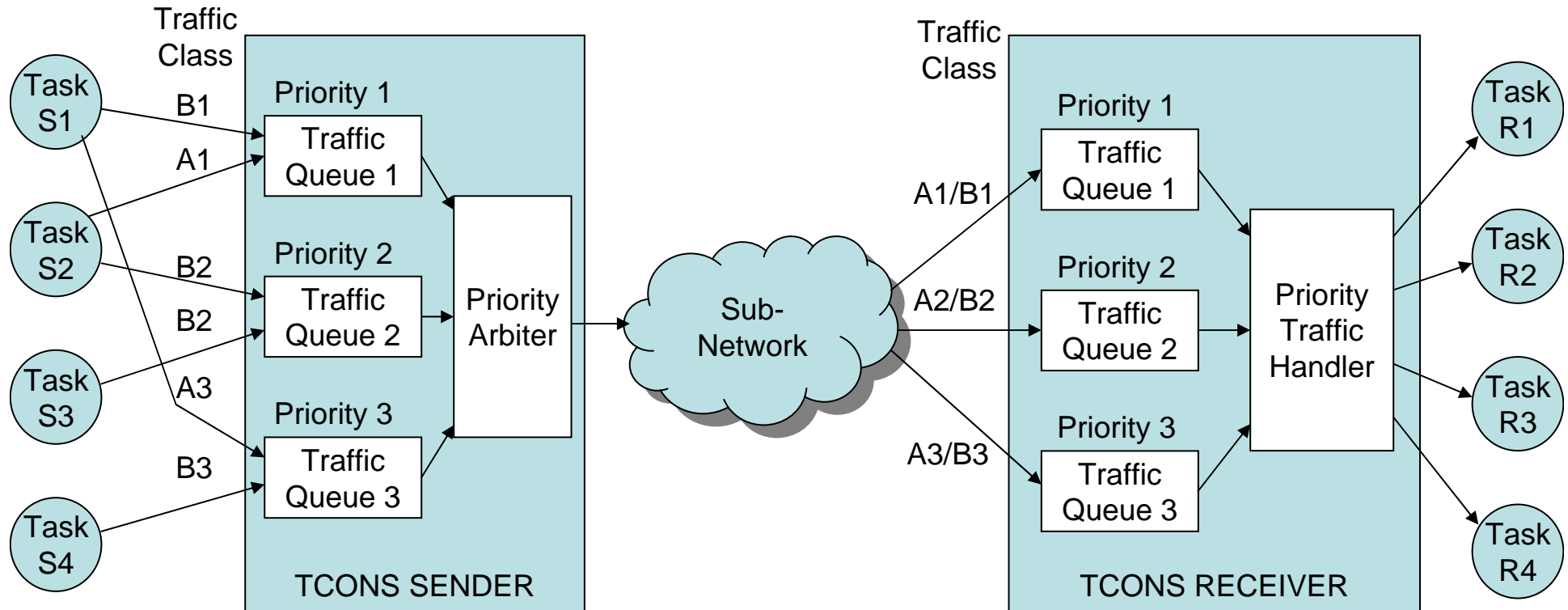
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Traffic Queues with One to One Mapping

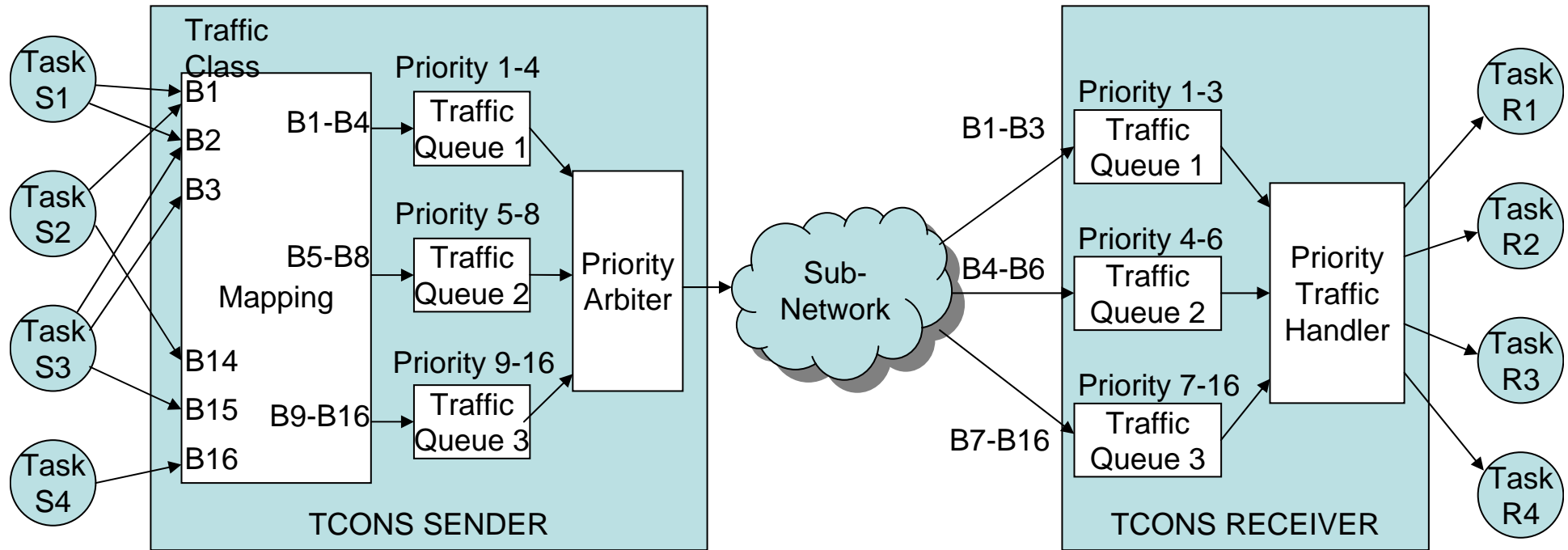
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Traffic Queues with Many to One Mapping

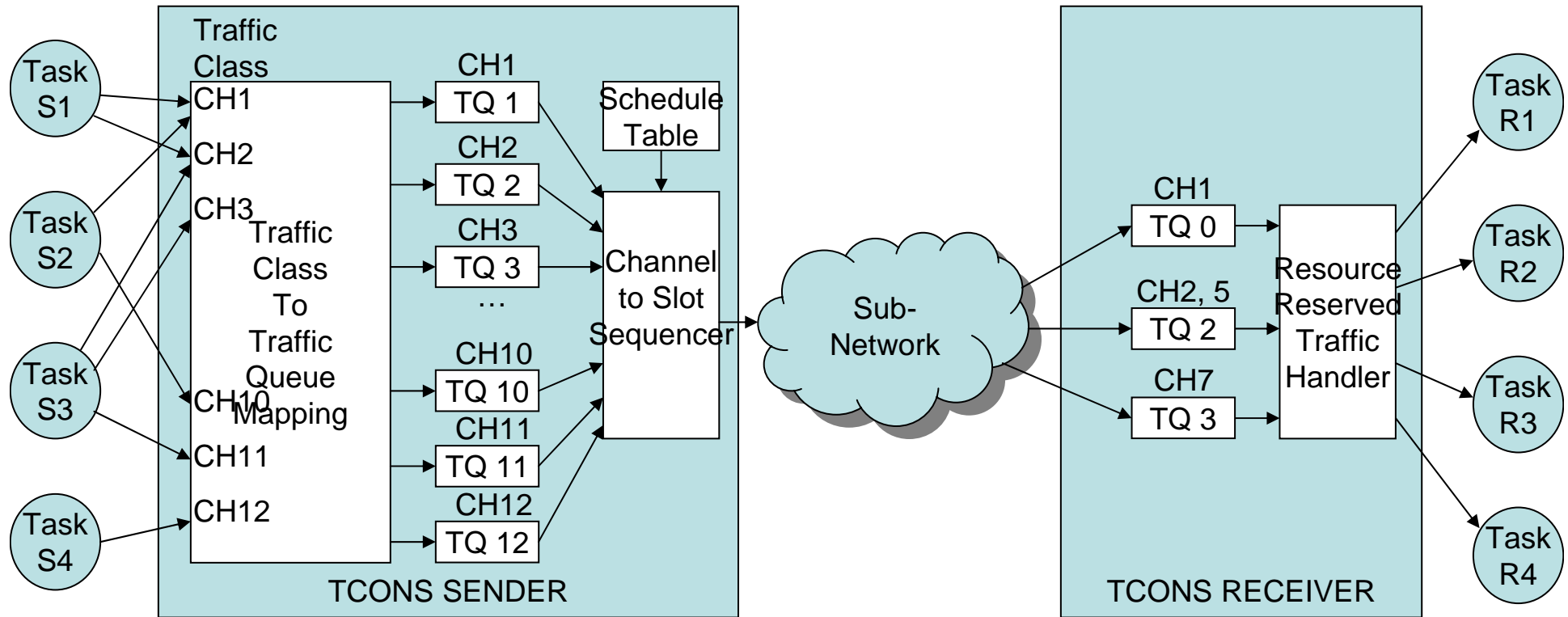
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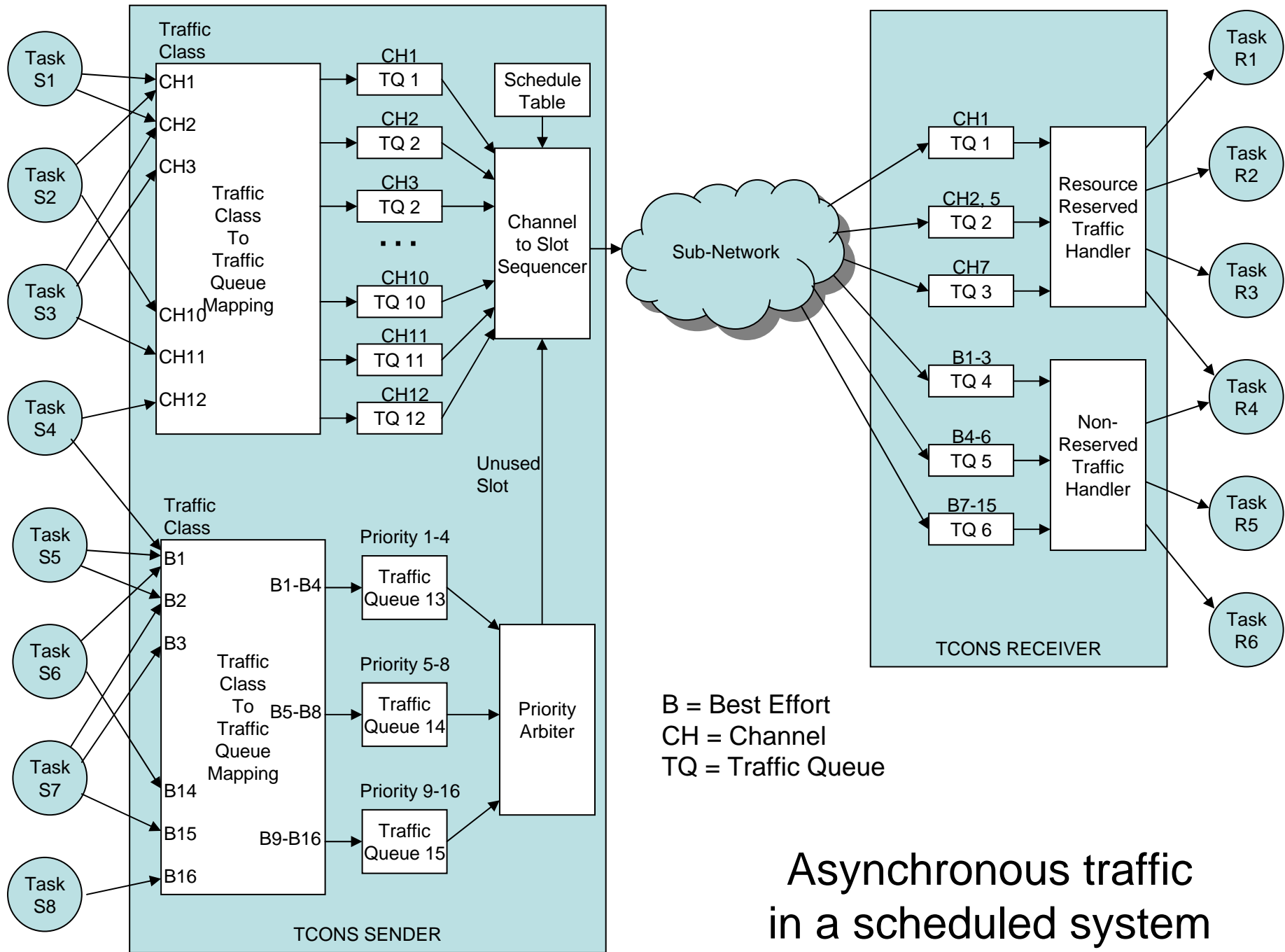
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Scheduled Resource Reserved

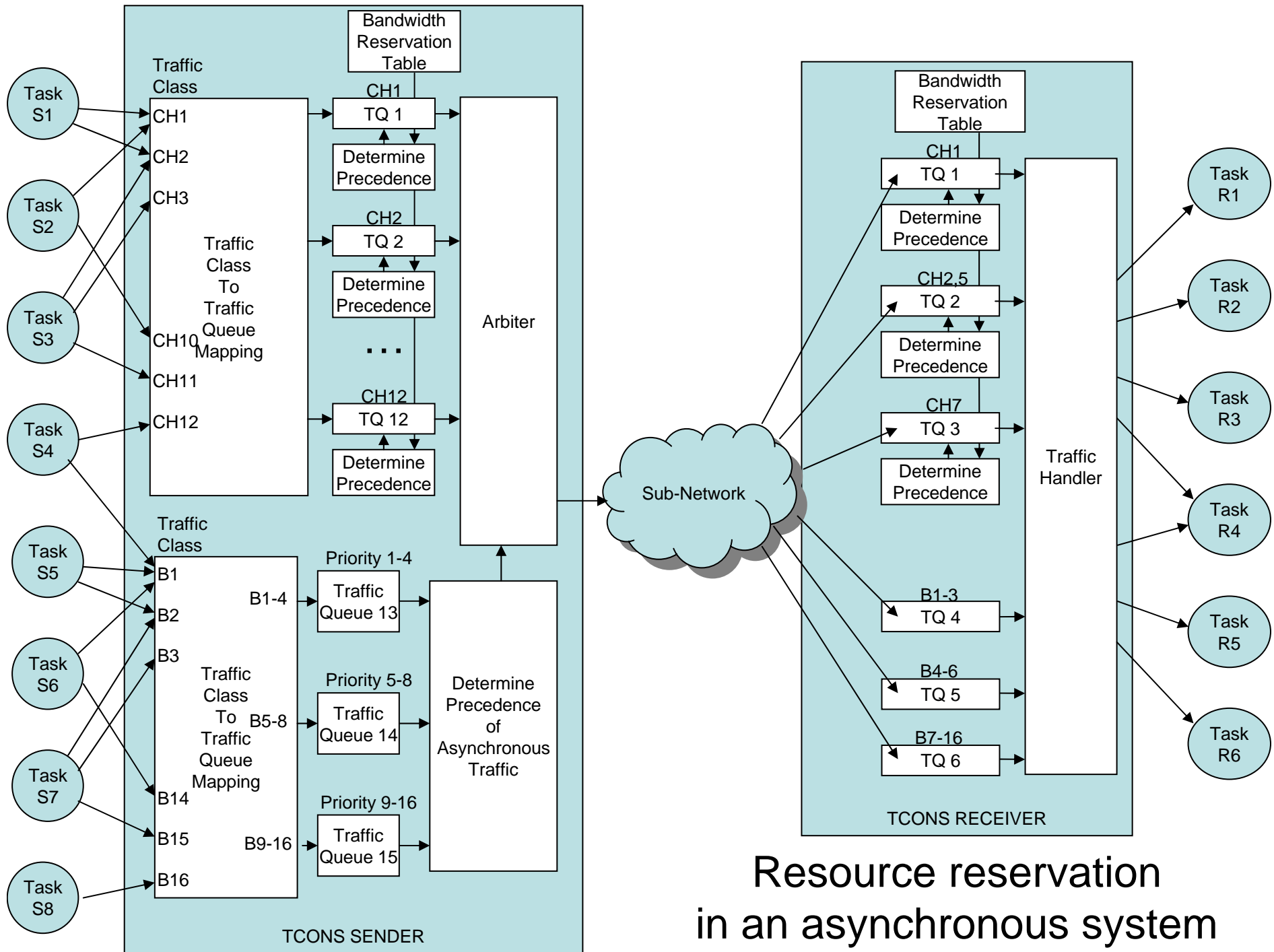
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Traffic Class	Time-Slot Numbers	Comment / Example
Reserved Channel 1	0, 4, 8, 12, 16, 20, 24, 28	Wide bandwidth requirement. Sending telemetry to downlink transmitter
Reserved Channel 2	1, 9, 17, 25	Gathering data from high rate sensor
Reserved Channel 3	2, 10, 18, 26	Gathering data from high rate sensor
Reserved Channel 4	3, 11, 19, 27	Gathering data from high rate sensor
Guaranteed Channel 5	5, 21,	GNC commands / responses
Reserved Channel 6	6, 22	Data from moderate rate sensor
Reserved Channel 7	7, 23	Data from moderate rate sensor
Reserved Channel 8	13, 29	Data from moderate rate sensor
Reserved Channel 9	14	Low bandwidth requirement GNC sensor acquisition
Reserved Channel 10	15	Unused reserved bandwidth
Reserved Channel 11	30	Low bandwidth requirement Thermal sensor acquisition
Reserved Channel 12	31	Unused reserved bandwidth



Asynchronous traffic
in a scheduled system

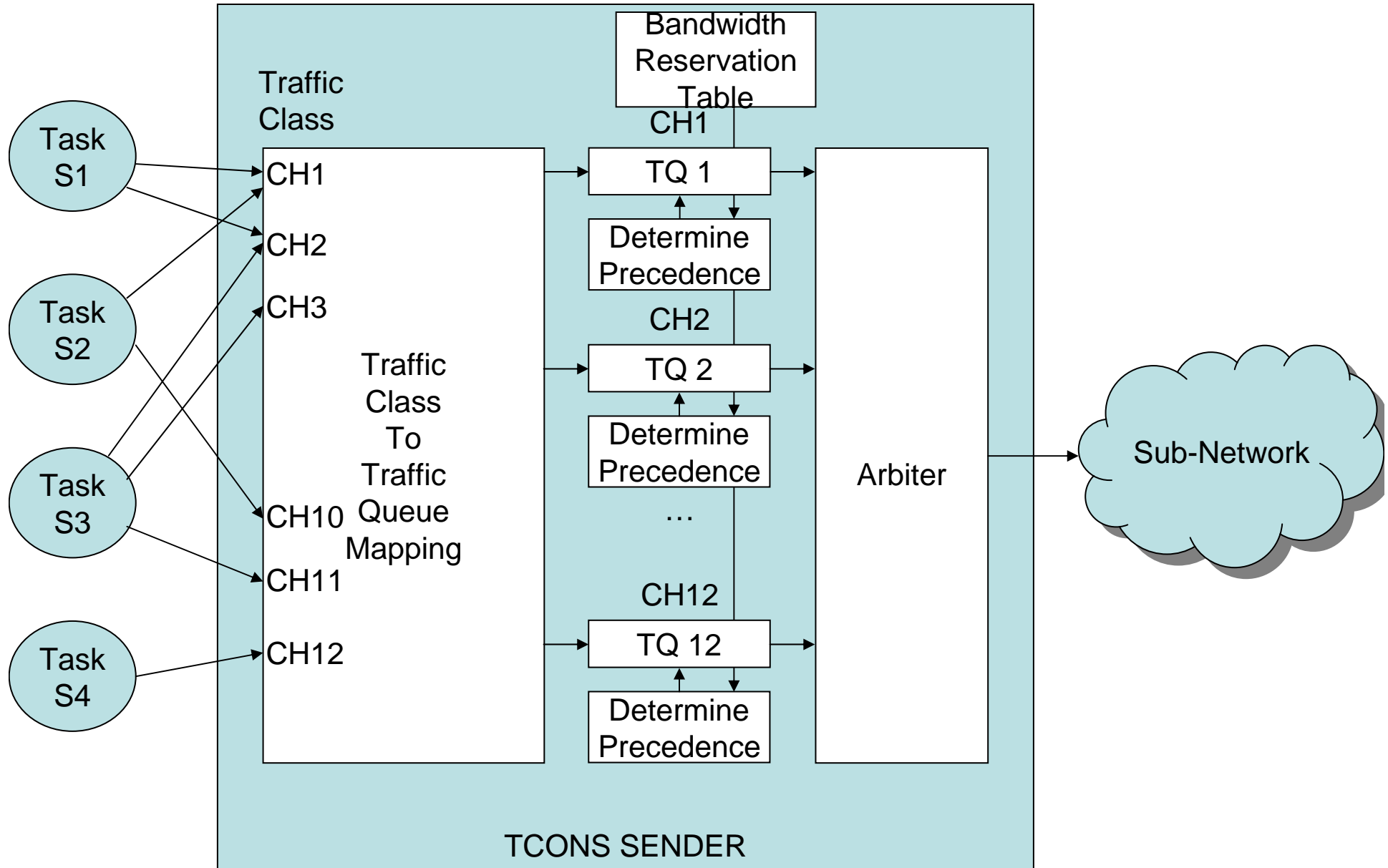


Resource reservation in an asynchronous system

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Resource reservation in an asynchronous system

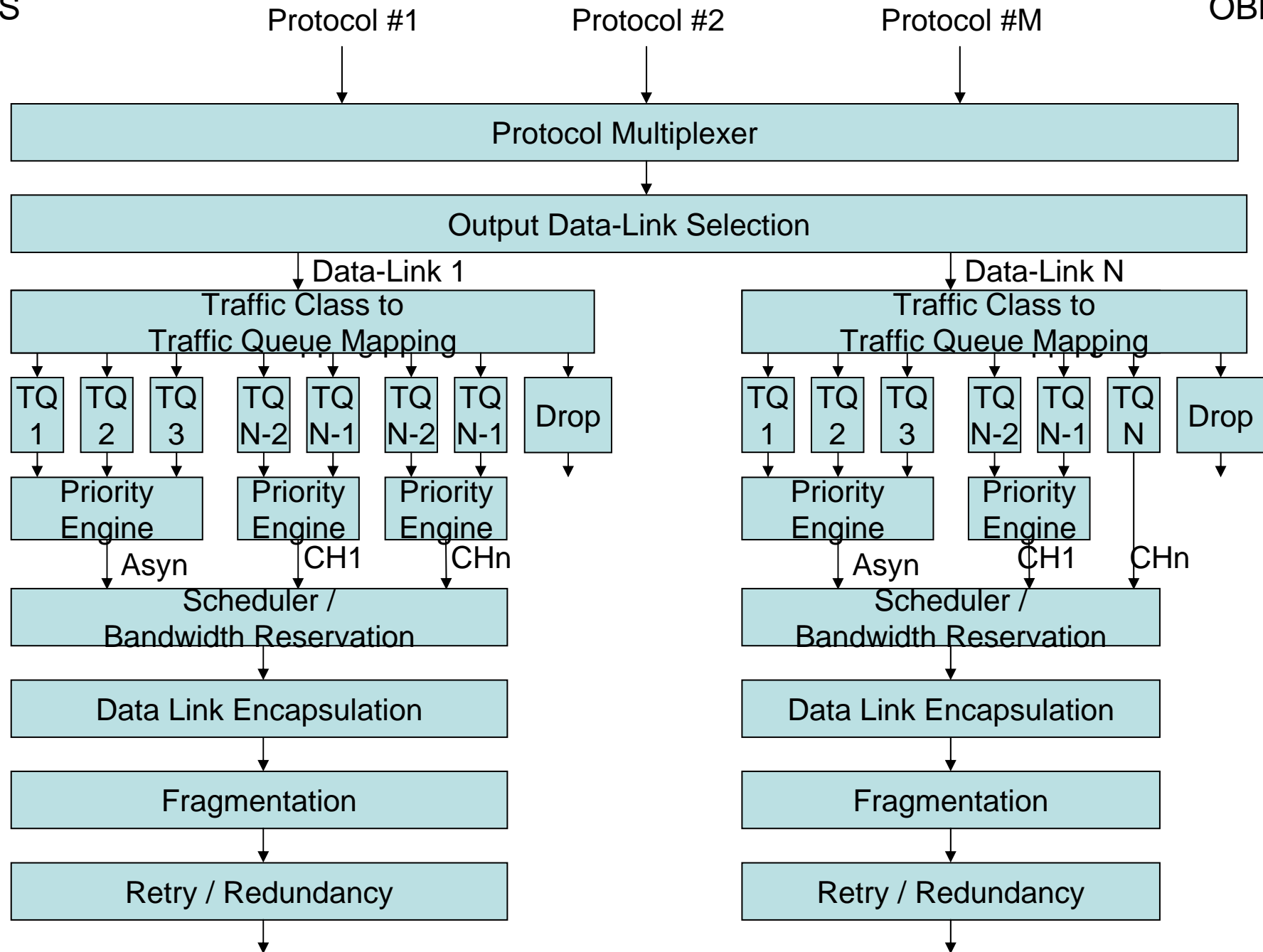
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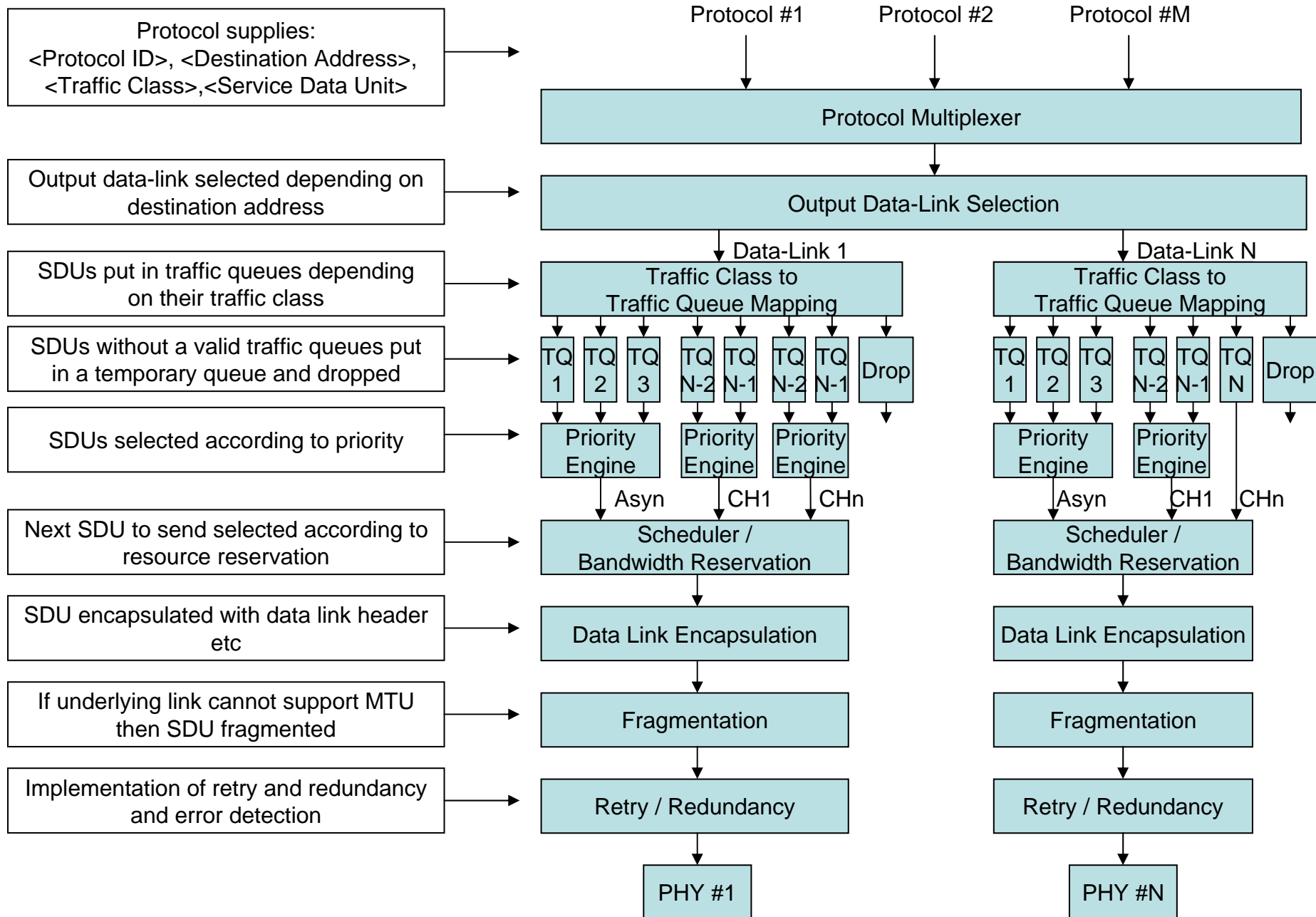
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Sender Architecture

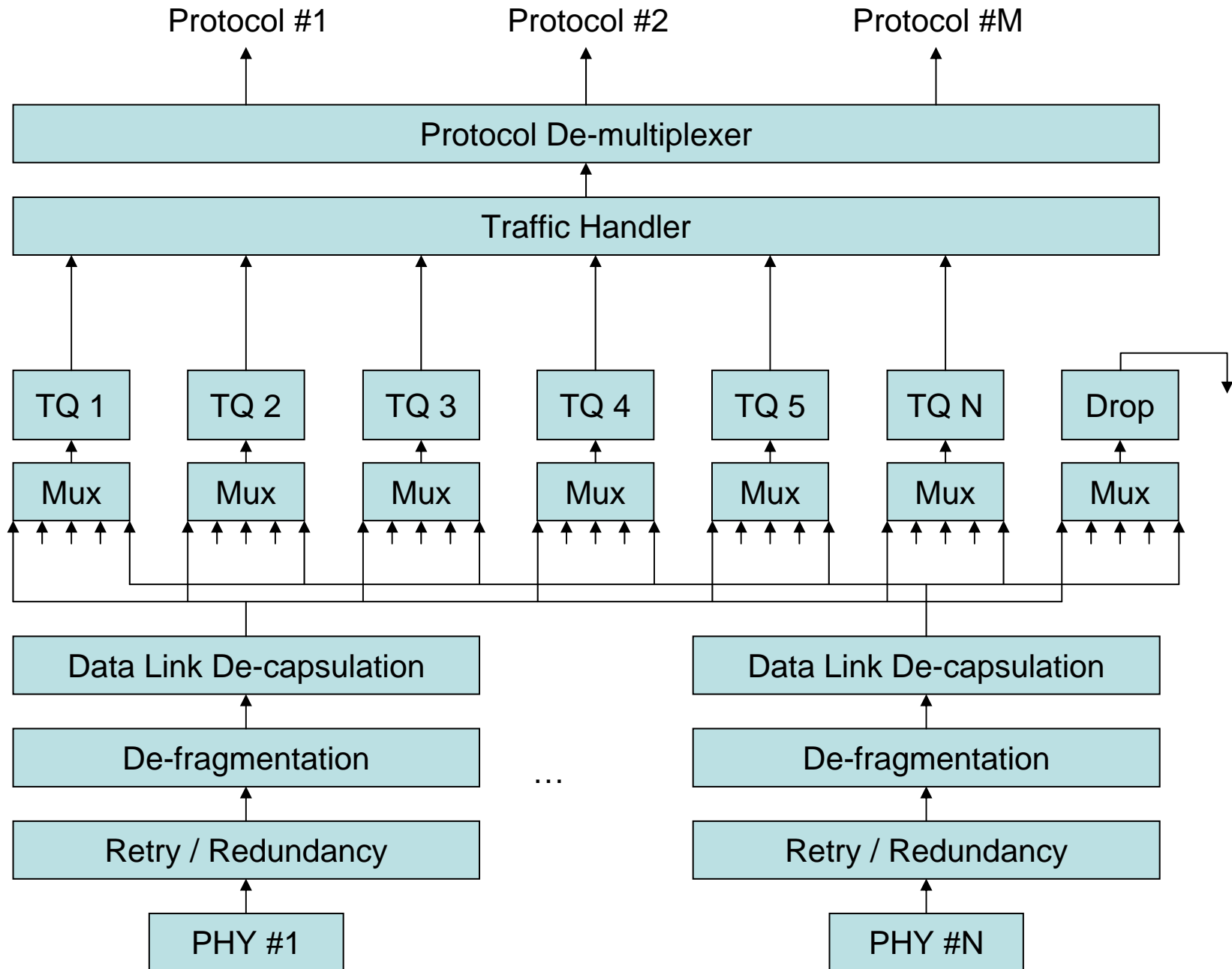
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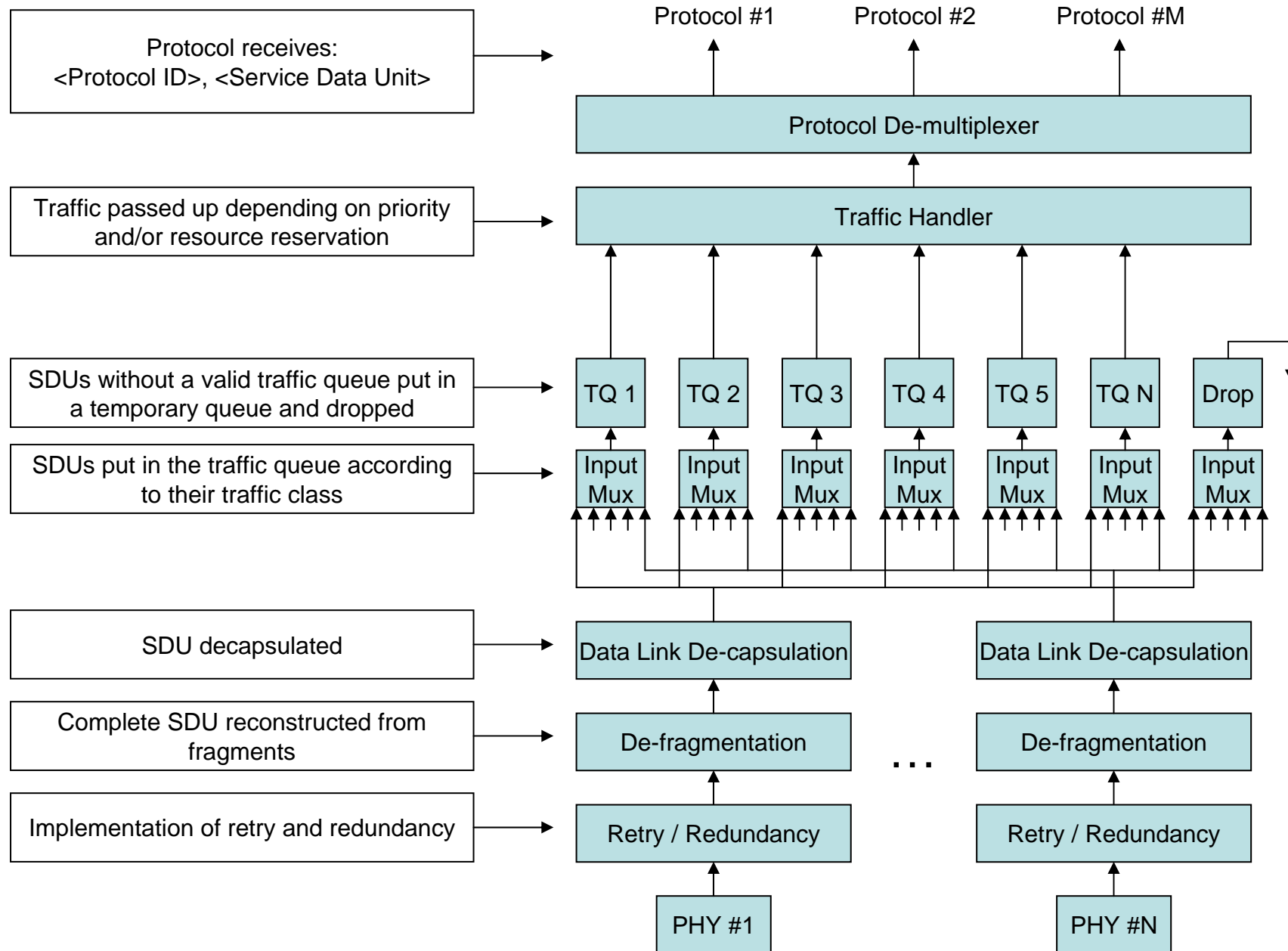
Sender Architecture



Receiver Architecture



Receiver Architecture



- Architecture that provides:
 - Uniform interface for communicating over various underlying buses
 - Scheduled
 - Asynchronous
 - Comprehensive QoS for onboard applications
 - Priority
 - Reserved / non-reserved
 - Retry / try once
 - Can be implemented in many different ways
 - E.g. Merging many traffic classes into single traffic queue for simple unit
 - E.g. Multiple traffic queues to support required QoS
 - E.g. Buffered or un-buffered operation
 - Can make use of features of underlying buses
 - E.g. retry mechanism of IEEE1394
 - E.g. group adaptive routing of SpaceWire
 - Missing functions will be defined in a common way
 - All traffic classes are order preserving

- TCONS/OBL architecture defined and draft magenta book written
 - Submitted to SOIS for passing to CESG
- QoS document written
 - Out for SOIS area review
- TCONS service interfaces
 - Intra-network service draft red book written
 - Intra-network service API being written
 - Intra-network – use of CCSDS Internetworking protocols
- OBL
 - Concurrent work on mapping
 - To SpaceWire
 - To Ethernet
 - To 1553