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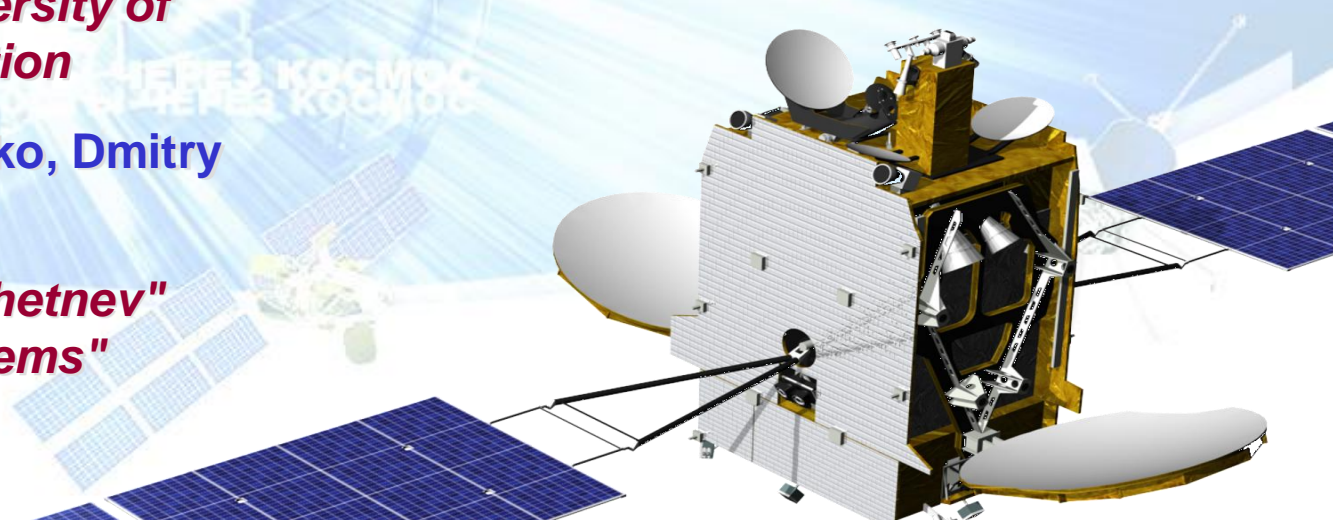
# ***STP-ISS Transport Protocol for Spacecraft On-board Networks***

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# SpaceWire standard



SpaceWire is a data-handling network for spacecrafts which combines simple, low-cost implementation, with high performance and architectural flexibility

SpaceWire technology admits a variety of transport protocols but does not provide yet required transport layer services

SpaceWire does not address such aspects of quality of service as robustness, determinism and durability that are essential requirements.

*Current Russian space industry demands a Transport protocol running over SpaceWire which will provide:*

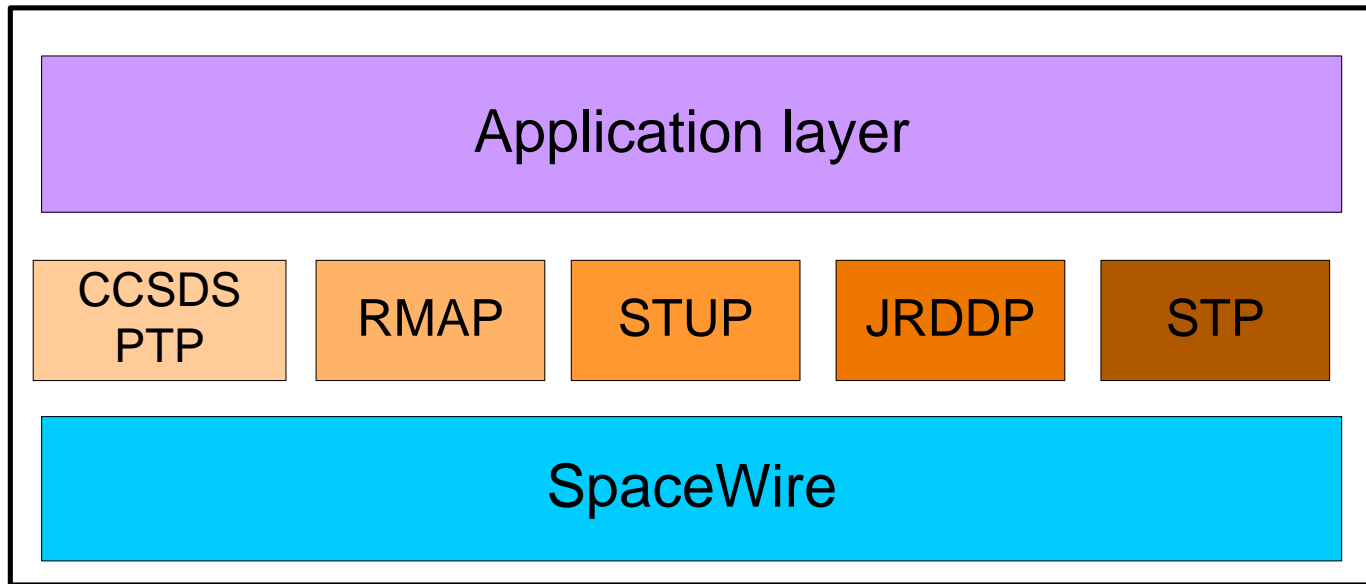
**reliability**

**guaranteed data delivery**

**data flows of different priorities**

**errors detection**

# Transport Protocols for SpaceWire



Transport protocols intended to operate over SpaceWire:

- Remote Memory Access Protocol
- CCSDS Packet Transfer Protocol
- Serial Transport Universal Protocol
- Joint Reliable Data Delivery Protocol
- Streaming Transport Protocol

# Protocol Comparison

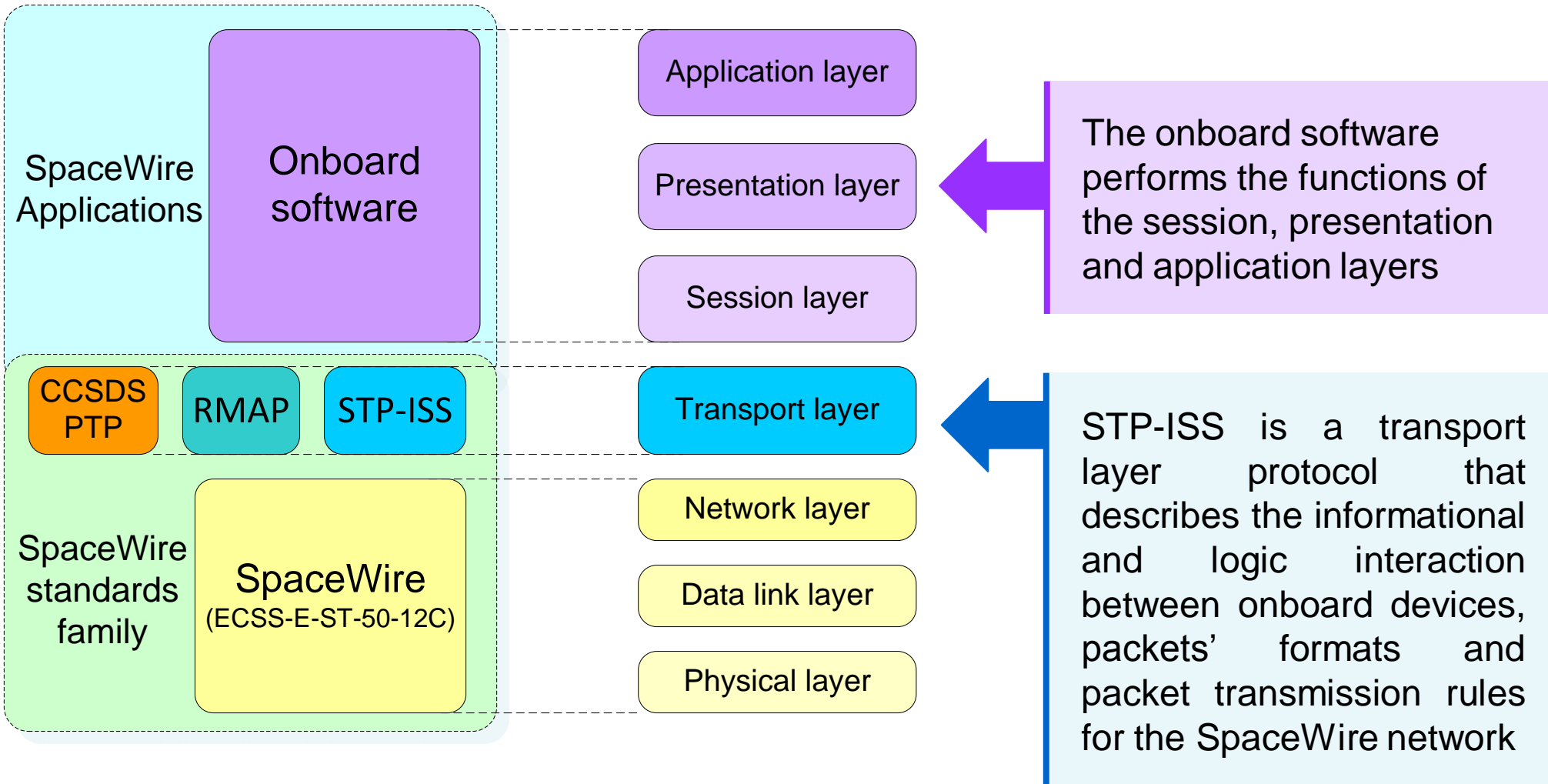


Feature	RMAP	PTP	STUP	JRDDP	STP
Multiple applications	-	-	-	✓	✓
Data flows of different priorities	-	-	-	✓	-
Data flow control	-	-	-	✓	✓
Configuration flexibility	✓	-	-	-	✓
Transport connection establishment	-	-	-	✓	✓
Segmentation	-	-	-	✓	-
Data correctness check	✓	-	✓	✓	✓
Data sequence check	-	-	-	✓	-
Scheduling	-	-	-	-	-
Data retransmission	-	-	-	✓	-
Acknowledgements	✓	-	-	✓	-

# STP-ISS: New Transport Protocol



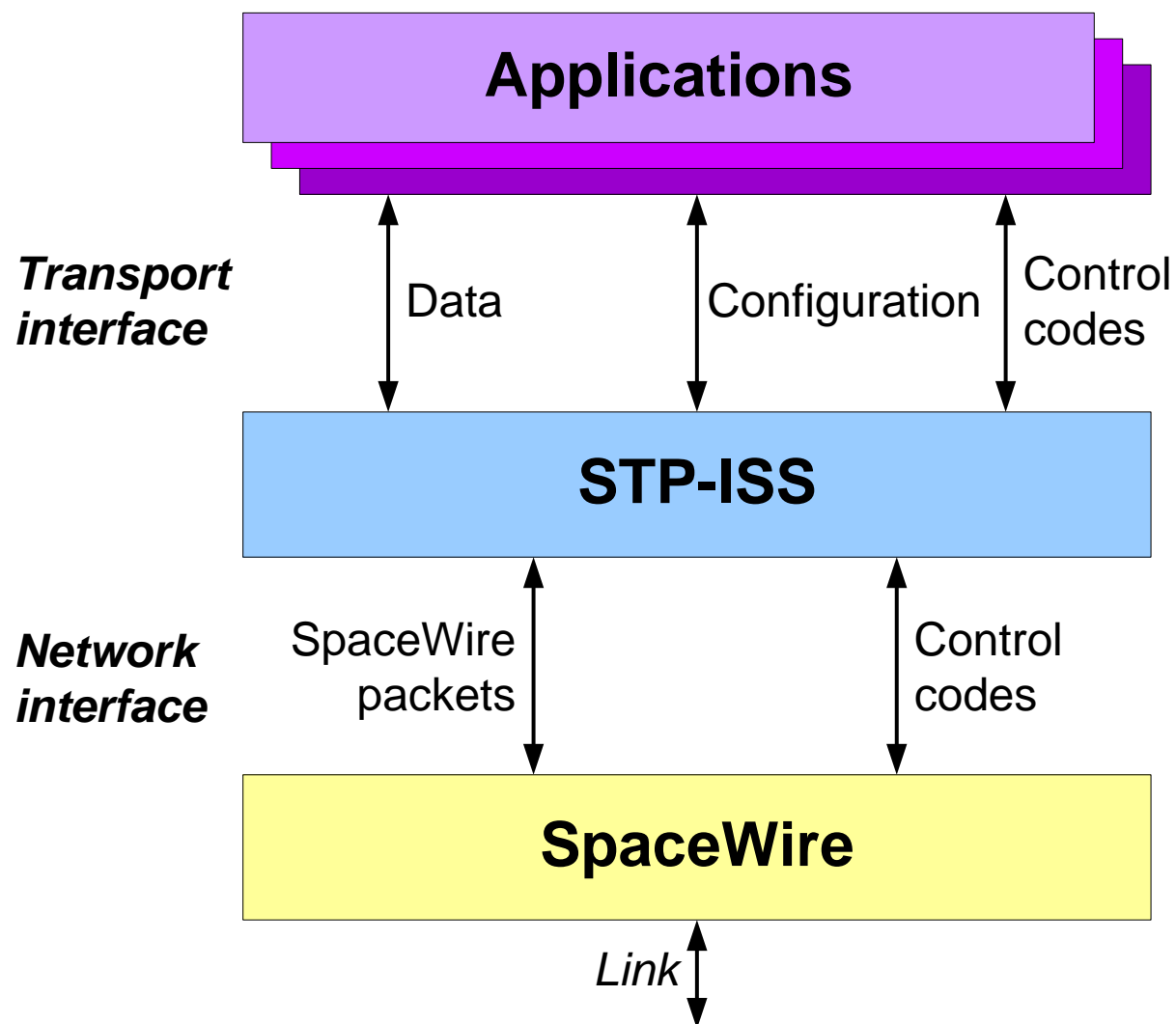
RESHETNEV  
C O M P A N Y



# STP-ISS Interfaces



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## Data interface:

- Messages
- Control commands

## Configuration interface:

- Protocol configuration
- Status information
- Reset and flush commands

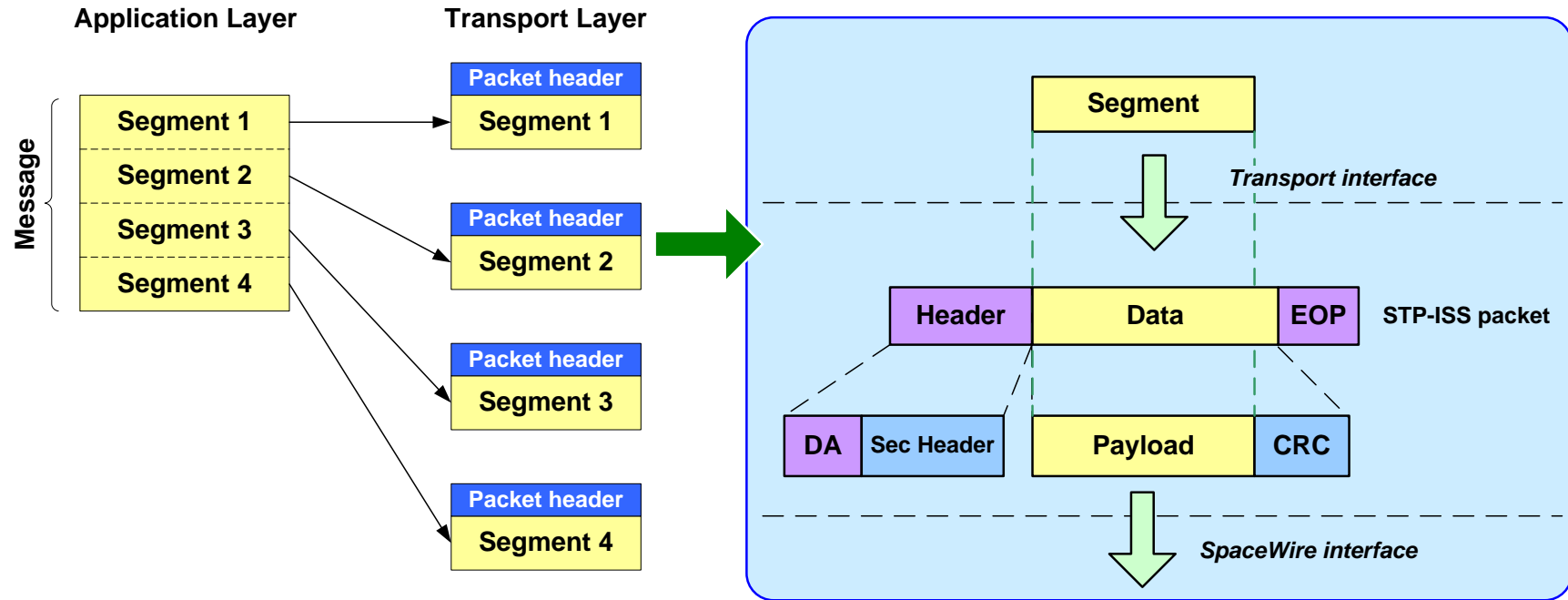
## Control codes interface

- Time-codes
- Interrupt-codes and acknowledges

# Application messages



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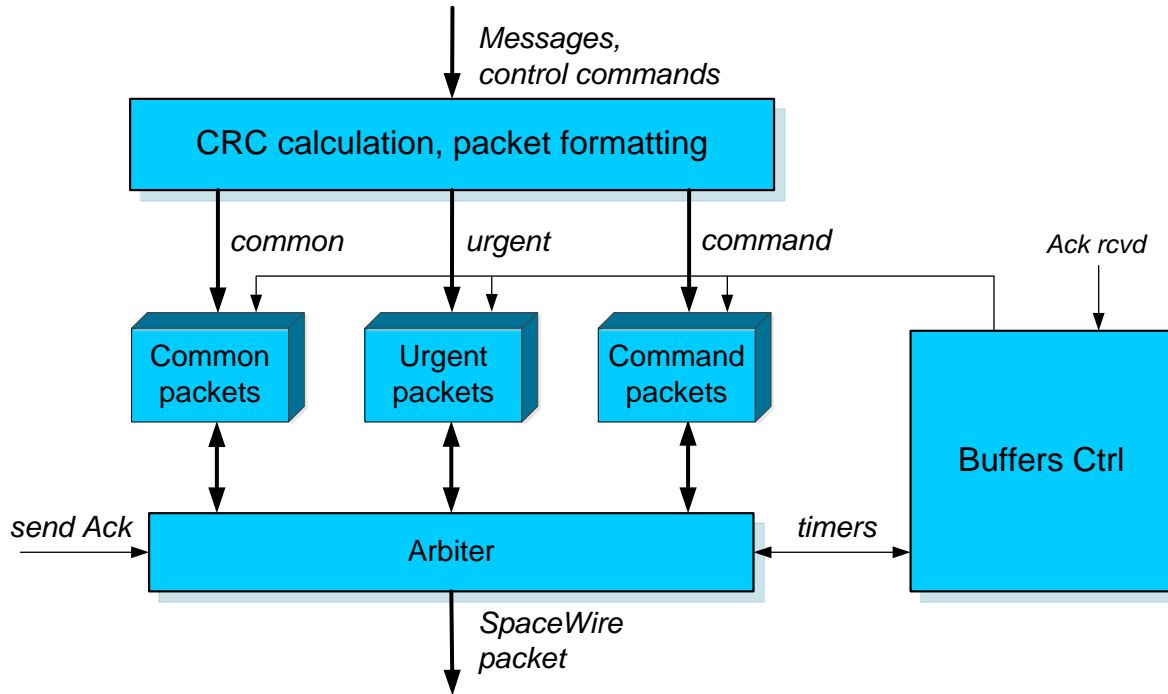
- ❑ Segmentation by the Application layer
- ❑ Messages encapsulation into the SpaceWire packets
- ❑ Maximum data field length is 2048 bytes
- ❑ A special field for a secondary header holding segment number and an end of message flag
- ❑ CRC-16 for protection of both payload and packet header



# Transmit and Receive Buffering



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## Transmitter

- ❑ Buffers for each type of the transmitted user data:
  - control command
  - urgent messages
  - common messages
- ❑ Lifetime timers for setting packet's actuality
- ❑ Indication to application about successful or unsuccessful packet delivery

## Receiver

- ❑ One buffer for all types of packets
- ❑ Processing of incoming data in a transmission order



## Priority

- 7 priority levels
- Main QoS type
- Data with higher priority should be transmitted first

## Guaranteed

- Positive acknowledges for the successful packet transmission
- Resend timer for each packet
- Resending mechanism based in the packets numeration

## Best Effort

- No acknowledges
- Packets with detected errors are also passed to the application, but with error indication

# Timers mechanism



## Lifetime Timer

## Resend Timer

**Application**

All packets

Guaranteed packets only

**Timer set**

Immediately after saving the packet into the corresponding resend buffer

After transmission of the last byte of the packet to the Network layer

**Timer expiration**

Packet is deleted from the buffer

Packet is resent to the remote node

## Configuration parameters

- Command lifetime
- Common message lifetime
- Urgent message lifetime
- Resend timeout
- Guaranteed / Best Effort QoS

## Cases for configuration

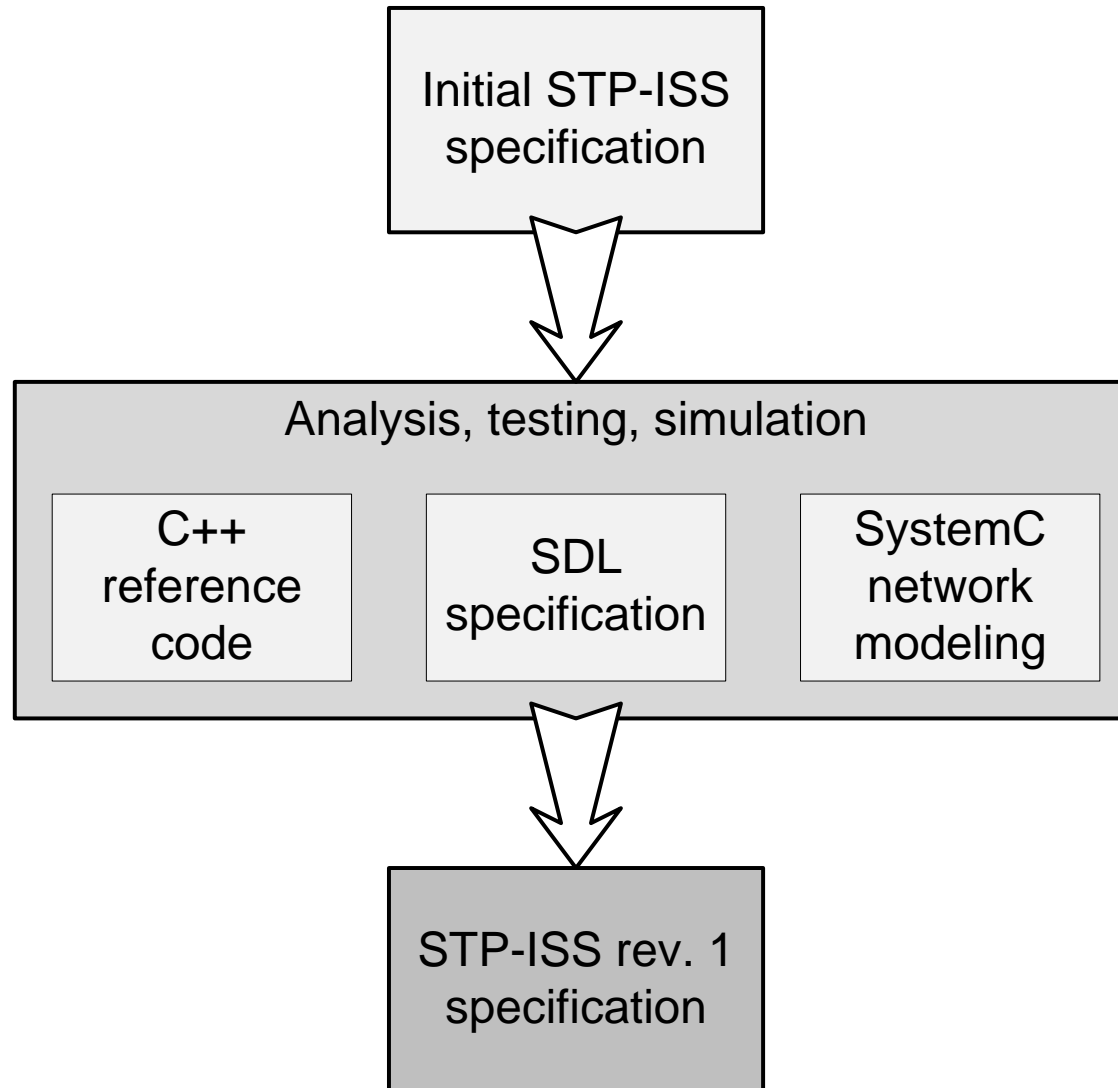
- switching-on/off the device
- reset
- switching to the redundant onboard device
- emergency recovery

# Reset and Flush



<b>Corresponds to</b>	Warm reset	User controlled flush of buffers
<b>Buffers</b>	Cleared	Cleared
<b>Timers</b>	Reset	Reset
<b>Configuration parameters</b>	Set to initial values	No action

# STP-ISS Modeling and Testing



- ❑ The **reference code** is intended to be used as the reference for the programmers, who will implement STP ISS in the onboard software.
- ❑ The **SDL model** is needed for the clear formal description of the STP-ISS internal mechanisms and specification analysis.
- ❑ The SDL specification could be used as a separate document describing the specified mechanisms, and it would be a useful part for the main protocol specification document.
- ❑ The **SystemC model** shows the STP-ISS protocol operation over SpaceWire network, and it gives an ability to test the network configuration and test networking features.

- ❑ Scheduled quality of service, when each node of the SpaceWire network will have a permission to send data during the particular time-slot only.
- ❑ Connection-oriented data transmission.
- ❑ Flow control mechanism for each transport connection.
- ❑ Duplicate command packets detection.

Second revision of STP-ISS would successfully work with the first revision.



# THANK YOU!

If you have any questions, please feel free to ask me

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