Distributed Interrupts in SpaceWire Networks

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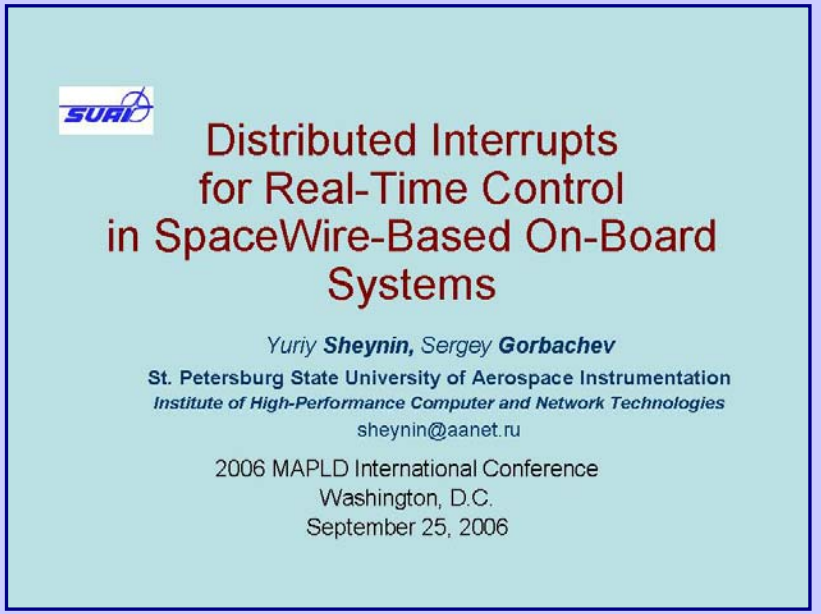
Updates in the Distributed Interrupts proposal

- Minor updates in the Distributed Interrupt basics:
  - **One** “spare” 2-bits Control Flags combination used instead of two code combinations
  - **5**-bit coding of Interrupt identifiers instead of 6-bit (**32** interrupts instead of 64)
  - Poll-code renamed to Interrupt_Acknowledge Code
- Error recovery procedures specification extended



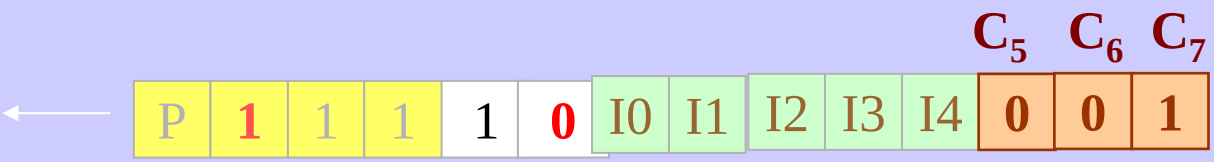
Distributed Interrupts coding (updated)

a) ESC+L-char

NULL=ESC+FCT

b) ESC + N-Char

Time-code

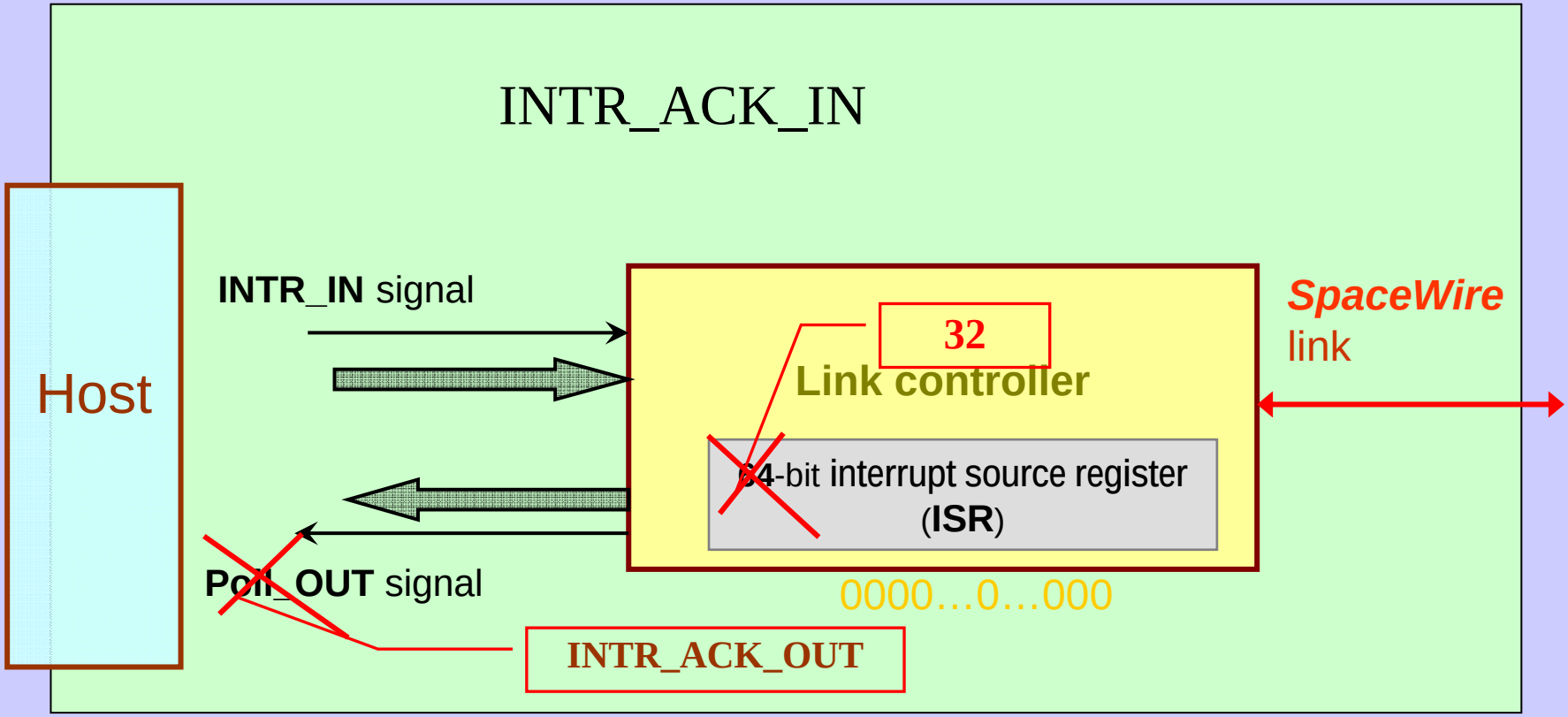


Interrupt-code

Interrupt_Acknowledge code

Extension-codes (reserved)

Interrupt in Master node



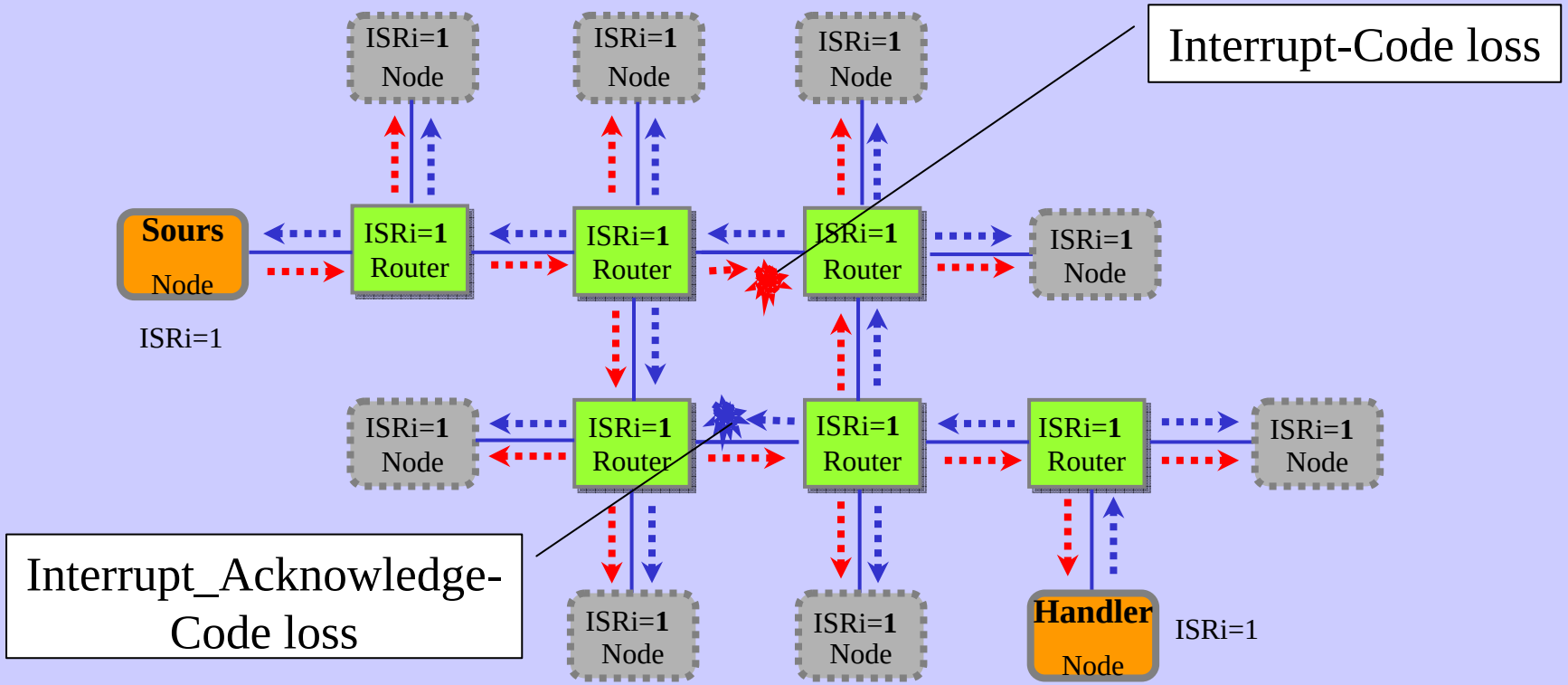
Interrupt Codes distribution errors

Causes that can lead to an Interrupt/Interrupt_Ack.-Code distribution errors :

- link disconnect error can cause an Interrupt/Interrupt_Ack.-Code loss;
- spontaneous change of an ISR bit state as a result of intermittent faults in a node or in a router;
- parity error in Interrupt/Interrupt_Ack.-Code transmission by a link. can cause an Interrupt/Interrupt_Ack.-Code loss.

NOTE. In SpaceWire networks with redundant links and circular connections (e.g. mesh, torus, fat tree, etc.) an error that causes an Interrupt/Interrupt_Ack.-Code loss will not stop the Interrupt control codes distribution to network nodes.

Interrupt control codes distribution in SpaceWire networks with circular connections



Interrupt Codes distribution recovery in case of errors

a. Each ISR in a node or in a router should have a timer per ISR bit.

b. A timer shall start at the receipt of an Interrupt-Code with the correspondent five-bit interrupt source identifier and reset at receipt of an Interrupt_Acknowledge-Code with the same five-bit interrupt source identifier.

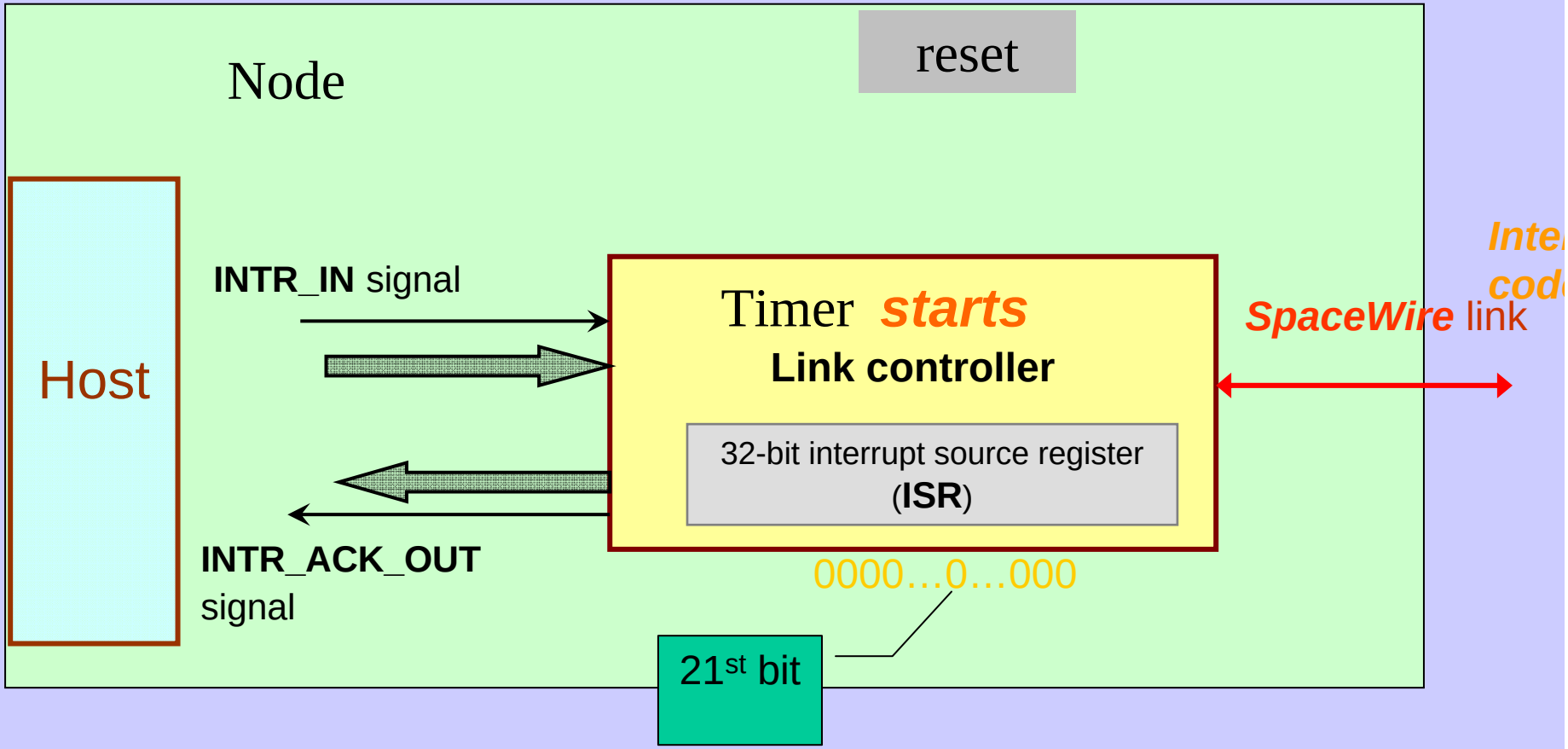
c. In case of timeout Ti before the timer is reset, the ISR **timeout event** arises.

- At an ISR timeout event in an Interrupt Source link, the link should reset the correspondent ISR bit to '0' and send an Interrupt_Acknowledge-Code with the five-bit interrupt source identifier that corresponds to the ISR bit.
- In each node and in each router at an ISR timeout event the correspondent ISR bit should be reset to '0'.

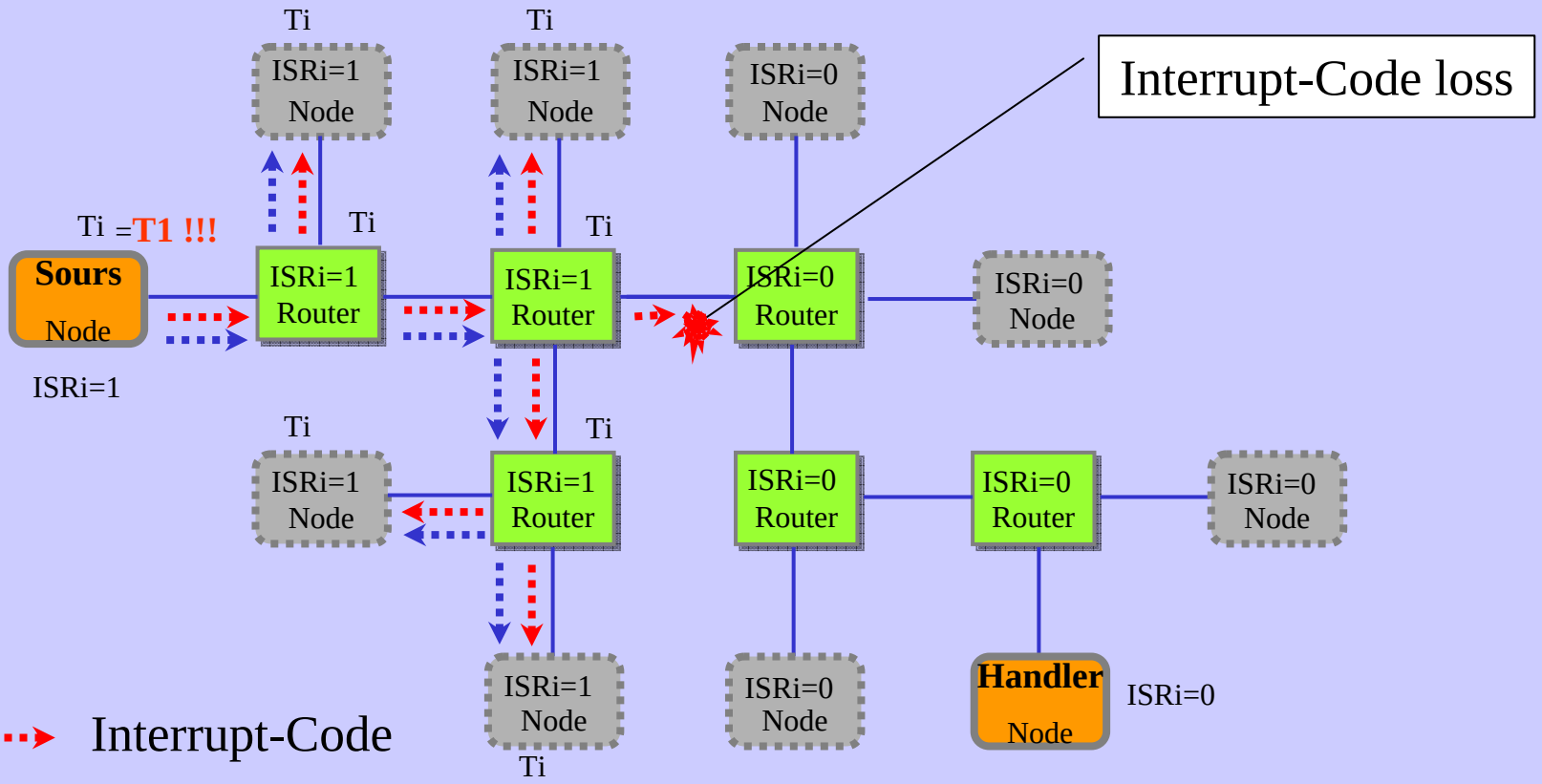
Interrupt Codes distribution recovery in case of errors (2)

- For an Interrupt Source link the reset timeout Ti=T1 shall be not less than double Interrupt/Interrupt_Ack.-Code worst propagation time in the network with diameter D plus delay in an Interrupt Handler node that should send an Interrupt_Ack.-Code.
- Reset timeout Ti for routers and non-Interrupt Source nodes can be set Ti=T2, where $T2 \geq T1$.
- Propagation time in the network depends upon the SpaceWire network interconnection topology
- Delay in an Interrupt Handler node that should send an Interrupt_Ack.-Code depends upon implementation
- Timeouts Ti are to be set in a SpaceWire network configuration procedure.

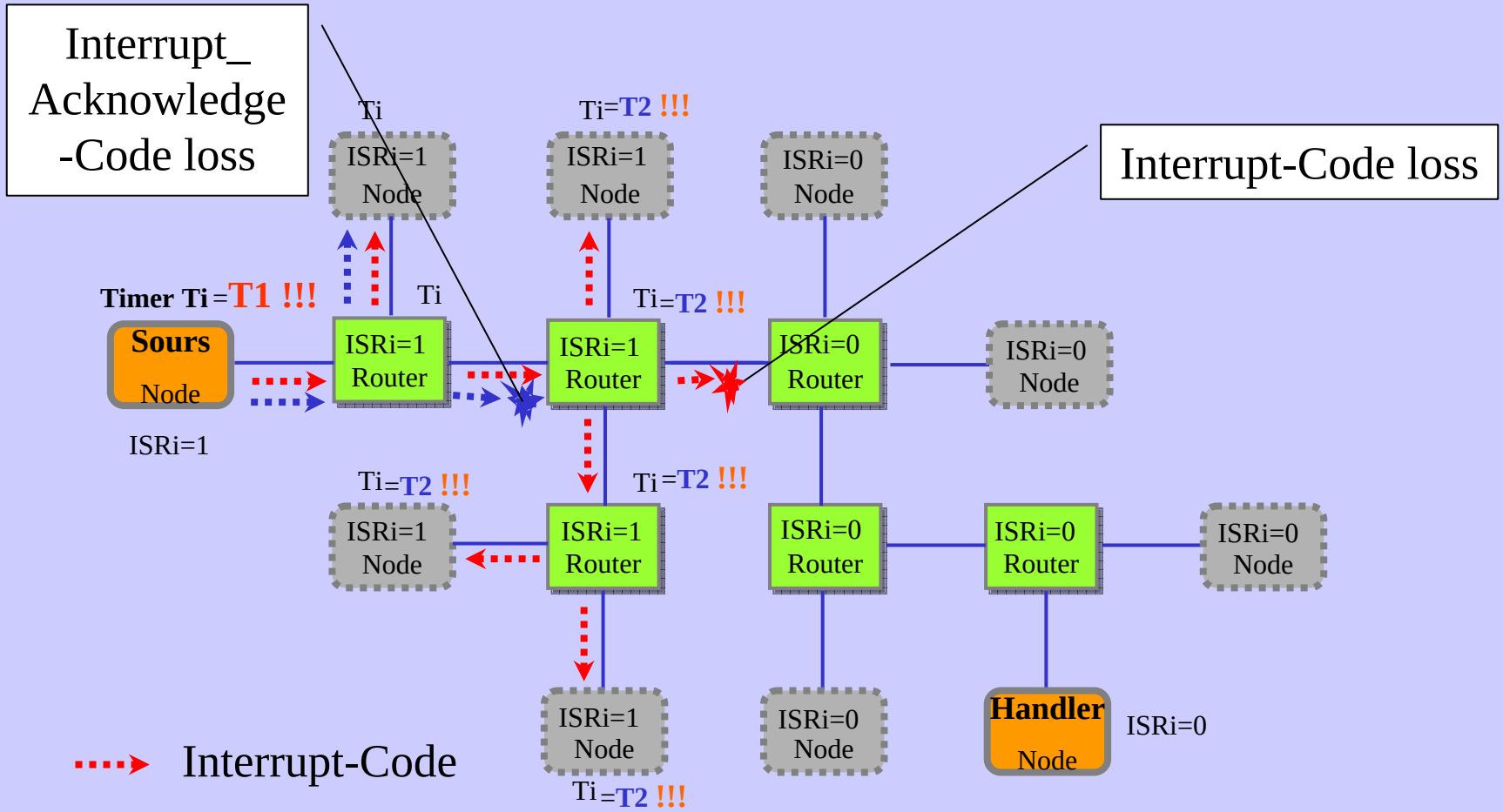
Interrupt in a Source node and the ISR Timer Handling



Interrupt Codes distribution recovery in case ISR timeout event (Ti=T1)



Interrupt Codes distribution recovery in case of ISR timeout event (Ti=T2)



Interrupt Codes distribution recovery

- ISR reset timeouts recover Interrupt –Codes distribution for following interrupt requests.
- ISR reset timeouts recover Interrupt –Codes distribution both after Interrupt-Code and Interrupt_Ack.-Code losses.
- Some nodes in SpaceWire networks (e.g. network management nodes) may have rights to send Interrupt_Ack.-Codes while not being the sources for correspondent Interrupt–Codes.

Thank you!