Comments based on the lessons learned

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Time-Counter and FCT

❑ Back Ground

- System integration tests have been carried out for several projects in Japan, which include the compatibility test of SpaceWire I/F with other organizations, and some points have found on the specification.
  As for the points which we mentioned in the last February meeting, the following additions are found to be useful for stable connections.

- **Time-Counter**
  - **Since SpaceWire routers are connected to multiple nodes, its internal time-counter does not have to be initialized after reset or disconnect-reconnect occurs in one port.**

- **FCT**
  - **Due to some reasons, FCT transmission sometimes vanishes ("dead lock" in other words).**
  - **One major cause of FCT disappearance is considered as the discrepancies of credit counters between an initiator and a target.**

Time-Counter

- ❑ Original Specification
    - **8.12 System time distribution (normative)**
    - **8.12.2 Handling**
    - **m. After reset or disconnect-reconnect (state machine in ErrroReset state) the time-counter shall be set to zero and any control-flag outputs shall be set to zero.**

- ❑ Possible modification
    - **8.12 System time distribution (normative)**
    - **8.12.2 Handling**
    - **m. After reset or disconnect-reconnect (state machine in ErrroReset state) the time-counters in time master nodes and end nodes, excluding routers, shall be set to zero and any control-flag outputs shall be set to zero.**

- ❑ **Remark**
    - The statement "After reset or disconnect-reconnect (state machine in ErrorReset state) the time-counter shall be set to zero and any control-flag outputs shall be set to zero." would not be suitable for router use.
    - Since a router accommodates several SpaceWire links, the internal counter, which is described as "the router's time- counter" in term k and l, should not be reset. In other words, one reset operation on a link should not have influence on other links.

FCT (credit counter) (1)

❑ **Original Specification**
- – 8.3 Flow control (normative)
- – e. The transmitter shall keep a credit count of the number of N-Chars that it has been authorized to send, as follows:
  - • 1. Each time a link interface receives an FCT its transmitter increments the credit count by eight.
  - • 2. Whenever the transmitter sends an N-Char it decrements the credit count by one.

❑ **Possible modification (addition)**
- – The following item might be useful for addition on e.;
  - • 3. Credit count in the transmitter and the receiver might be checked, or the flow control could be re-established within upper protocol layers.

❑ **Remark**
- – Transmission error is considered in current specification, whereas some specific case, in that the credit counter in sending end becomes less than the one in receiving end due to some reason, has to be considered.
- – Strictly speaking, a credit counter in a receiving end, which corresponds to 8.3.c is not specified explicitly.

FCT (credit counter) (2)

❑ **Implementation candidates for breaking dead-lock**

– Cross-check method might be considered for credit counter on sending end and receiving end in the upper protocol layers.

– Additional state for the state diagram for SpaceWire link interface might cause incompatibility for already built equipments. On the other hand, additional state transition, other than exchange level, for making disconnect and re-establish communication could be useful.

- Since the sending end can send nothing to the receiving end in the case, the only way to break dead-lock state is "Link Reset".

- There are some ways could be possible to detect dead-lock, and one typical method is providing a time out counter, in other words watch dog timer (WDT).

- Typical WDT specification is as follows;
  Start: credit counter in sending node = 0, and has a packet to be sent,
  Stop: credit counter in sending node != 0.

FCT (credit counter) (3)

☐ **Implementation Option shared between SpaceWire layer and upper layer**

- Option 1
    - [Upper layer]: Set initial WDT counter value on network initialization.
    - [SpaceWire layer]: Transition to ErrorReset on time out.

- Option 2
    - [Upper layer]: Set initial WDT counter value on network initialization, and issue "Link Disable" and "Link Enable" in series on time out.
    - [SpaceWire layer]: Raise time out to upper layer.
- Option 3
    - [Upper layer]: Set initial WDT counter value on network initialization, read-out credit counter of sending end periodically, and issue "Link Disable" and "Link Enable" in series on time out.
    - [SpaceWire layer]: Enable read-out of credit counter on the sending end for upper layer.