

Implementation and Interoperability Tests of SpaceFibre

**Minoru Nakamura ⁽¹⁾, Takahiko Masuzaki⁽¹⁾, Toru Sasaki⁽²⁾,
Tetsuro Kato⁽¹⁾ and Yasunori Ido⁽¹⁾**

(1): Information Technology R&D Center

(2): Advanced Technology R&D Center



MITSUBISHI ELECTRIC CORPORATION

We have interesting in SpaceFibre (SpFi), especially for mission data transmission in satellites.

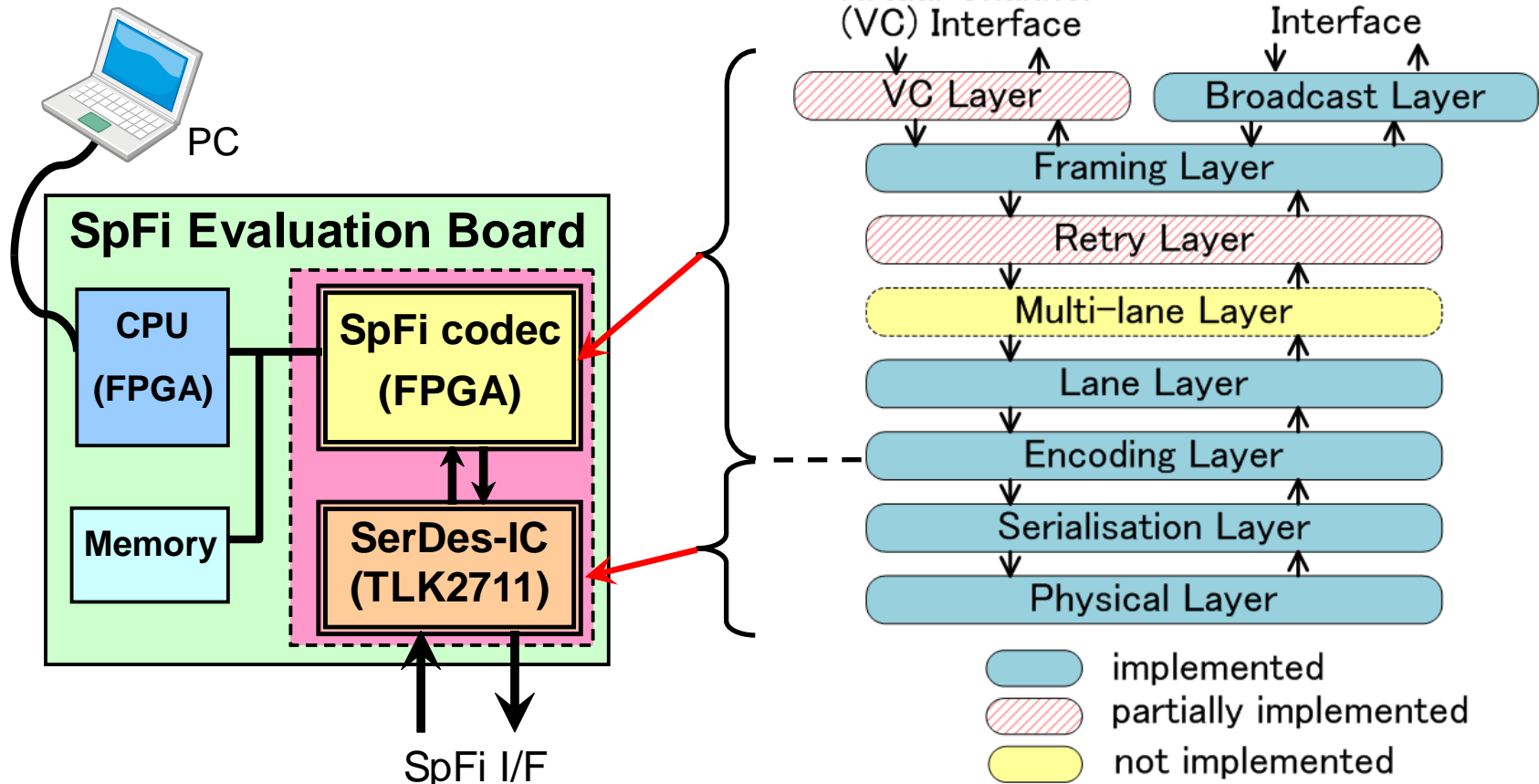
- High Speed
- Scalability
- Compatibility with SpaceWire

To develop components based on SpFi Standard, consistent specification is important.

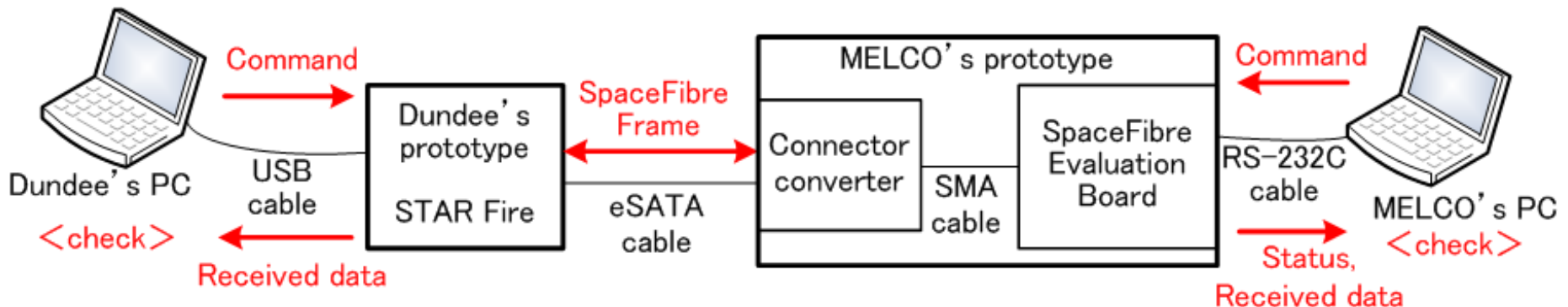


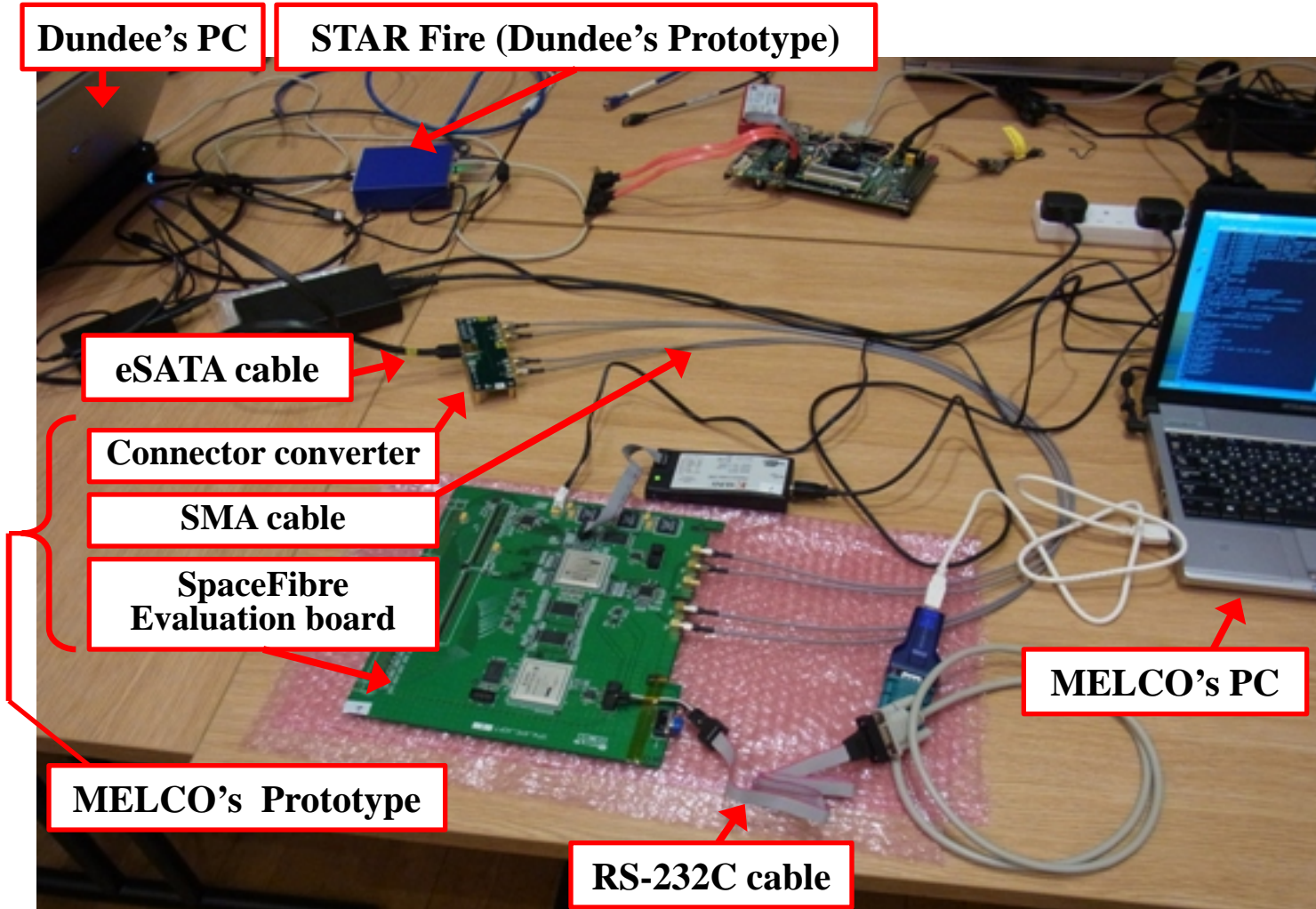
We are evaluating SpFi Standard by implementation of SpFi codec.

- To evaluate the SpFi Standard, we are implementing SpFi codec on FPGA with SerDes-IC (TLK2711).
- As the first step, we have implemented subset of functions.



- Aim: To confirm following test items
 - Lane initialization sequence
 - Basic communication (single-shot frames, sequential frames)
- Implementation
 - Based on Draft E1 (except retry function)
- Testing condition
 - Transmission rate: 2.5Gbps
 - Transmission cable
 - eSATA cable: 1m
 - (SMA cable: 1m (in MELCO's prototype))





Test Environment

No.	Test Item	Result
1	Lane initialization sequence <ul style="list-style-type: none"> •Link up •Timeout occurs or not •Flow Control Token (FCT) transmission •After Link-up, Lane_Start OFF -> ON •After Link-up, disconnection -> connection 	Timeout occurred. Other items: OK
2	Single frame transmission <ul style="list-style-type: none"> •Data Frame <ul style="list-style-type: none"> - MELCO prototype -> STAR Fire - STAR Fire -> MELCO prototype •Broadcast Frame <ul style="list-style-type: none"> - MELCO prototype -> STAR Fire - STAR Fire -> MELCO prototype 	OK.
3	Loopback transmission of sequential frames STAR Fire -> MELCO prototype (loopback) MELCO prototype -> STAR Fire	STAR Fire detected received data error. The reason is our bug of SKIP control word insertion.

Number of Timeout counts

No.	No signal detect setting (MELCO)	Timeout period setting (both)	Number of trials	Result: number of timeout counts	Remark
1	OFF	300us	2	1, 12	
2	OFF	500us	2	11, 3	
3	OFF	1ms	4	2, 4, 24, 13	
4	ON	1ms	23	8, 8, 4, 15, 1, 1, 12, 7, 8, 3, 2, 1, 1, 3, 1, 14, 6, 1, 17, 21, 9, 4, 7	"No signal" could not be detected.

Even if timeout period is 1ms, timeout occurred.



We are under investigation about this issue.

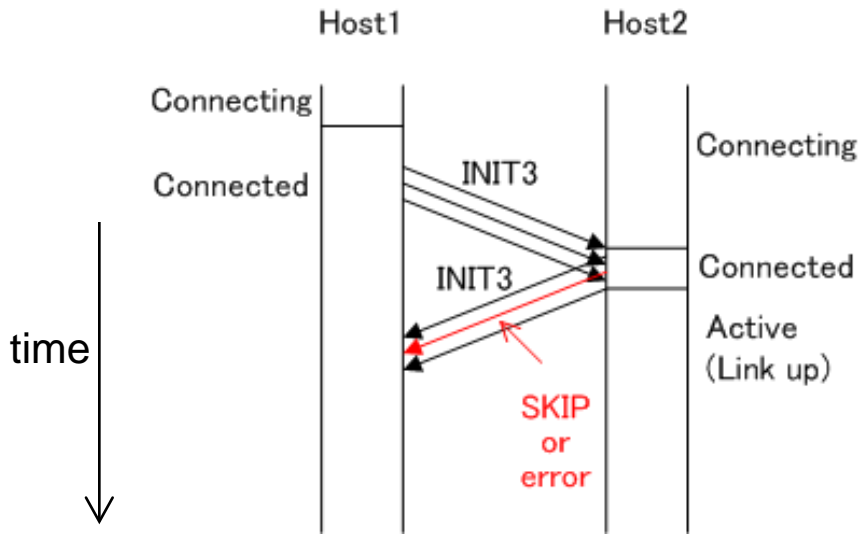
Timeout mechanism should be clarified with additional tests and analysis.

- state transition
- sent/received control words' correctness

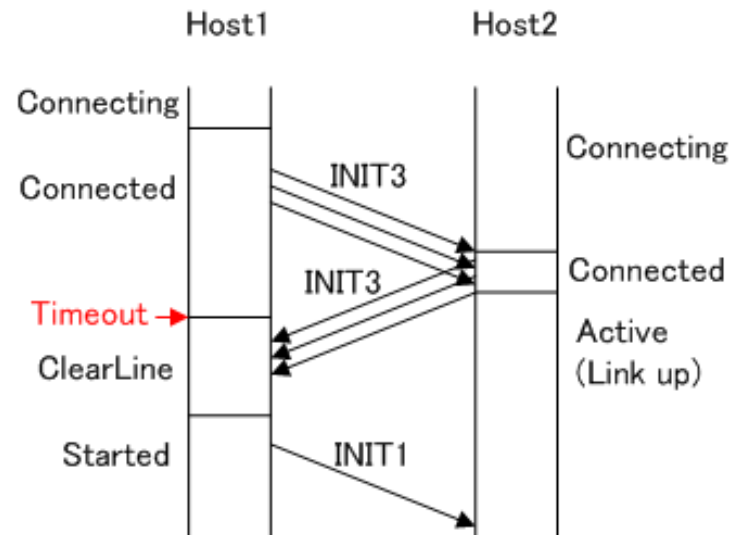
Consideration about Lane Initialization Sequence

Item	Explanation	Comment
Timeout period mismatch and transceiver PLL lock time.	<ul style="list-style-type: none"> •TLK2711: MAX 0.4ms + 1024Bits •Spartan[®]-6 GTP: MAX 1ms + 0.2ms However, longer timeout period didn't reduce timeout counts.	It may be better not to disable the PLL on every timeout.
State change on PLL is instability	<ul style="list-style-type: none"> •If INIT1 is detected, the state machine goes to the next state even if PLL is unstable. •State machine doesn't transit to initial state by unexpected words. 	A mechanism to promote stable state may be necessary.
"No signal" is not clearly defined	<ul style="list-style-type: none"> •TLK2711 has "Loss of Signal Detection" circuit. MELCO uses this. •XILINX[®] FPGA transceivers do not have "No signal" detect function. 	Clarification of "No signal" is necessary.

- Lane Layer: Unbalanced (one side) link up
 - Case1: SKIP insertion to INIT3
 - Case2: INIT3 transmission error
 - Case3: Timeout before receiving INIT3



The case of 1 or 2



The case of 3

Proposal

- Transmitter sends at least three or more INIT3.
- If INIT1 is received in Active state, the state machine return to ClearLine.

- Summary
 - SpFi codec implementation for evaluation
 - Interoperability test with Dundee
 - Some comments for lane initialization sequence
 - Other comments for Draft E1
- Future plans
 - Additional evaluation of SpFi Standard
 - Full-function SpFi codec implementation