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To: T10 Technical Committee
From: William Petty, LSI Logic Corp.
Subj: **SCSI out of band communications method**

Change Control

Rev.	Date	Description of Change
0	7/7/99	Initial Document

1. PROPOSAL SUMMARY

There is a need to communicate with “Transparent” devices residing on a SCSI bus. This includes expanders, terminators, and other possible device types. A method to allow control of these devices without requiring the consumption of a SCSI ID is herein proposed.

1.1 Primary Goals

- This out of band communication method must be transparent to all existing devices.
- It must not cause any adverse conditions or errors to occur even in expanded systems.
- It must utilize only existing SCSI signals as defined in the SPI-2 P Cable description.
- This method should not be restricted to one bus mode. I.E. Single ended.
- Each participating device should be uniquely addressable and or accept broadcast commands.
- The host controller must be capable of read and write operations. (Bi-directional)
- The communications protocol should be adaptable to other devices.

1.2 Assumptions

- High data rates are not required. (Less than 1MB/s)
- All 16 data bits may be used. ***Note: Not backward compatible with 8-bit systems.***
- Expanders will allow split bit-bidirectionality within the data bus.
- All participating devices of a given class should accept broadcast commands.

1.3 New Timing Definitions

- Handshake timeout delay (xx us): The minimum time the host waits for target responses.

- OB hold time (xx ns): The minimum times used during broadcast transfers to ensure all devices see all signal transitions.

2. PROTOCOL REQUIREMENTS

This section outlines the primary protocol requirements. Following sections explore each item in more detail.

2.1 Data Integrity

Each byte sent/received is transferred via an asynchronous fully interlocked handshake method, except in OB broadcast phase. A CRC byte is appended to each information packet.

2.2 Device Class segregation

Each class of device may have a unique command structure optimized for its particular need.

2.3 Signal Format

The 18 SCSI data lines in conjunction with BSY and SEL are the only signals used and assigned as follows:

BIT	SP0	SD7	SD6	SD5	SD4	SD3	SD2	SD1	SD0
Function	Res	Res	Res	Res	RXER	OBSL	SEND	TSTB	HSTB

SP0, SD[7:0] bit definitions

BIT	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
Function	Res	Data Byte							

SP1,SD[15:8] bit definitions

3. METHOD DESCRIPTION

3.1 OB Selection procedure

1. The BSY and SEL pins along with SD[15:0] are used to perform a standard bus arbitration cycle as defined in the SPI-2 document.
2. Once arbitration is won, the source ID is removed for one bus settle delay to signify to all targets that an alternate selection may follow. SD[15:0] = 0000h. (Negated)
3. OBSL and SEND are asserted.
4. The requested target's Class Code and ID (see 4.3) are placed on SD[15:8]. Note: ID 0Fh = Broadcast to all devices within a class, Class Code 7 = all device types.
5. After at least a deskew setup delay, the host asserts HSTB to strobe the ID into **All** target devices.
6. If this is a broadcast command, HSTB is negated after a minimum of one OB hold time has passed and then, after at least one deskew delay, OBSL is negated. OB selection is assumed to be completed at this point. (Proceed to OB Command/Data.) Else, if this is not a broadcast command:
7. The host waits up to one handshake timeout delay for the selected target to assert TSTB.
8. Upon receipt of TSTB the host negates HSTB, then after at least one deskew delay, negates OBSL. The host then proceeds to OB command/data phase.
9. If no TSTB is detected, then OB de-selection phase shall follow.

3.2 OB Command/Data Send Phase

1. The SEND bit, still asserted from the OB selection phase, indicates a data direction from host to target.
2. The OB command/data byte is placed on SD[15:8].

3. After at least a deskew delay, the HSTB bit is asserted to strobe data into the target device.
4. The host holds data valid until it detect the TSTB bit is asserted by the target or until a handshake timeout delay occurs.
5. When the target asserts TSTB, the RXER bit is strobed into the host.
6. The host negates HSTB.
7. The host waits for up to one handshake timeout delay for the target to negate TSTB and negates HSTB to close the handshake.
8. Loop back to step 2 for more bytes.
9. After the last command byte is sent, the host shall release SD[15:8], wait one bus settle delay, and then negate the SEND bit.

3.3 OB Data Receive Phase

Note: The roles of HSTB, TSTB, and RXER now exchange roles.

1. The host requests a data receive phase by negating the SEND signal following the OB command/data send phase and waits up to one handshake timeout delay between any target TSTB response.
2. The target device waits one bus settle delay before driving any data.
3. The target places an OB data byte on the SD[15:8] lines.
4. After at least a deskew delay, the target shall assert TSTB strobing the OB data into the host.
5. Host receipt of the OB data is acknowledged by asserting HSTB. Note: RXER asserted by the host indicates a host receive error has occurred.
6. The target holds data valid until it receives HSTB from the host.
7. The host waits for up to one handshake timeout delay for the target to negate TSTB and then negates HSTB to complete the handshake.
8. Loop back to step 3 for more bytes

3.4 OB Deselection Phase

1. SD[15:0], SP1, and SP0 shall be release for at least one bus settle delay.
2. SEL shall be released to deselect any OB targets.
3. After one bus settle delay, BSY shall be released to return the SCSI bus to the bus free phase.

3.5 OB Broadcast Phase

1. Following the OB broadcast selection phase, which does not wait for the TSTB handshake, the host waits at least a bus settle delay before changing any signals.
2. The SEND bit, still asserted from the selection phase, indicates a data direction from host to target.
3. A OB command/data byte is placed on SD[15:8].
4. After at least a deskew delay, the host asserts the HSTB bit to strobe the data into target devices.
5. After a minimum of one OB hold time has passed, the host negates the HSTB bit and may then change the data on SD[15:8].
6. The host waits a minimum of one OB hold time before changing any control signals.
7. Loop back to step 3 for more bytes.

4. Data Format of Full Handshake Signaling

4.1 Command Format

Byte	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
1	Res	Res			Command				
2	Res	Command Length							
3	Res	Data 1							
--	Res	--							
N	Res	Data n							
Last	Res	CRC							

Command Format

4.2 Response Format

Byte	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
1	Res	REJ	Length						
2	Res	Data 1							
--	Res	--							
N	Res	Data n							
Last	Res	CRC							

Response Format

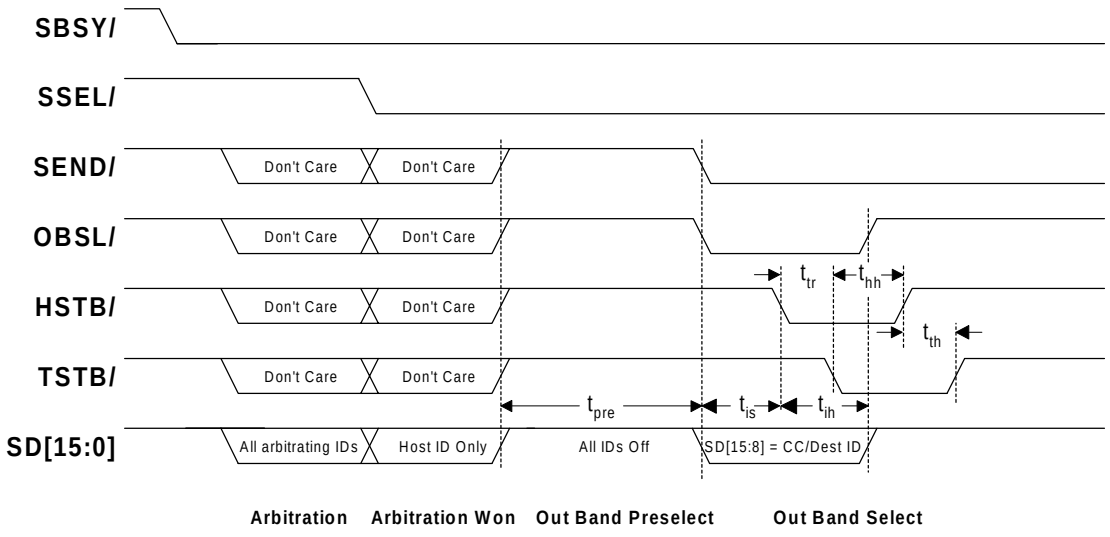
4.3 Selection Format

BIT	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
Function	Res	Class Code			Res	Destination ID			

SP1,SD[15:8] bit definitions

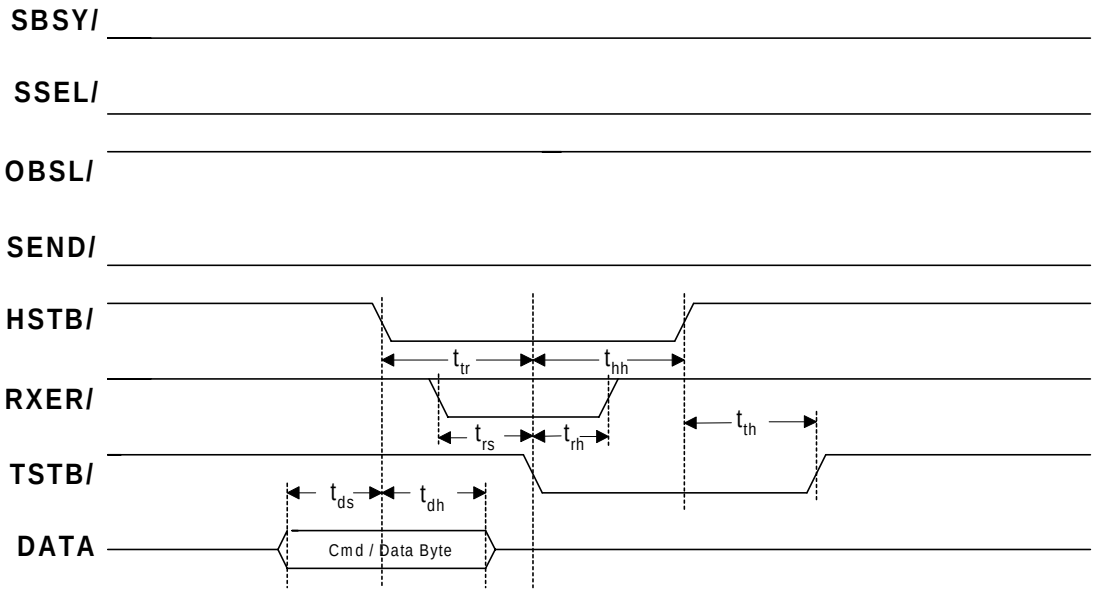
5. Full Handshake Timing Diagrams

5.1 Selection Waveform



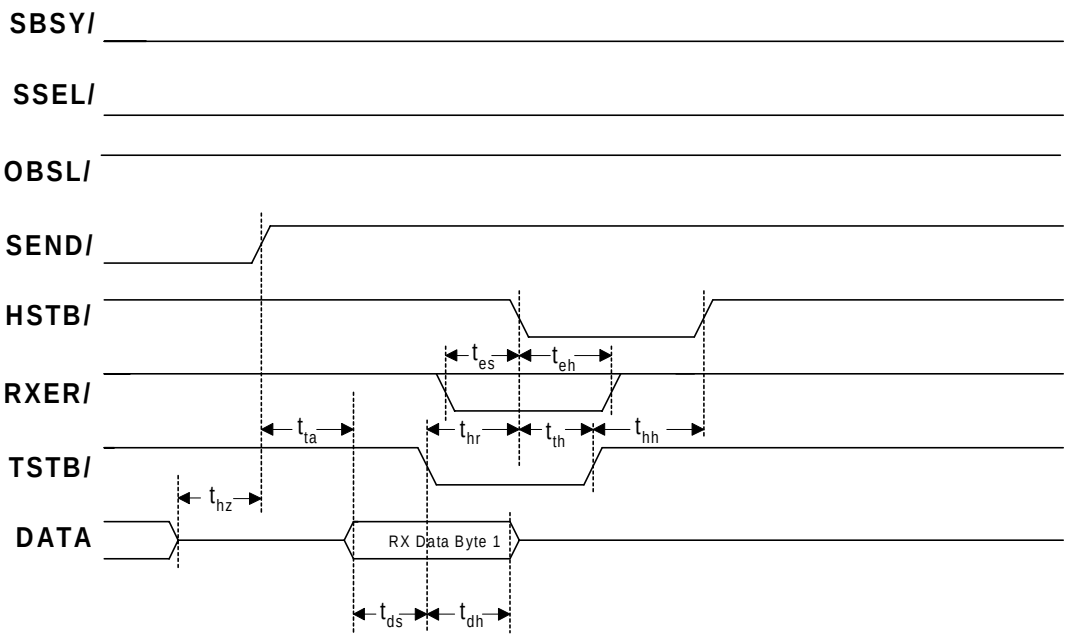
Selection Waveform

5.2 Data Send Waveform



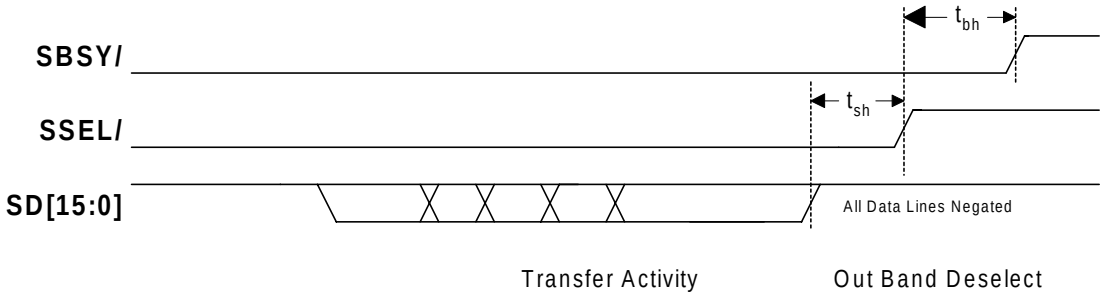
Data Send Waveform

5.3 Data Receive Waveform



Data Receive Waveform

5.4 De-Selection Waveform



De-Selection Waveform

6. Data Format of Broadcast Signaling

6.1 Command Format

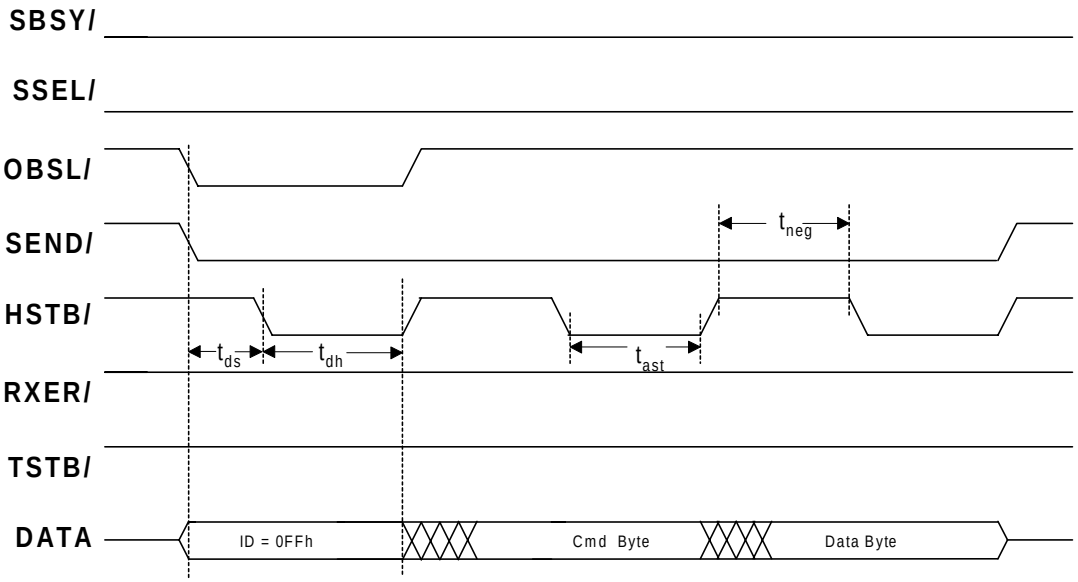
Byte	SP1	SD15	SD14	SD13	SD12	SD11	SD10	SD9	SD8
1	Res	Res			Command				
2	Res	Command Length							
3	Res	Data 1							
--	Res	--							
N	Res	Data n							
Last	Res	CRC							

Command Format

6.2 Response Format (None)

7. Broadcast Timing Diagrams

7.1 Broadcast Data Send Waveform



Broadcast Send Waveform

8. Field Code Definitions

8.1 Class Code

Code	Device Class
000	Reserved
001	Expanders/Repeaters
010	Terminators
011 - 110	Reserved
111	All Device types

8.2 Commands

Code	Command
00000	Reserved
00001	Margin Levels / Timing
00010	Identify Device
00011	Device Mode (Disable / Enable)
00100	Register Write
00101	Register Read
00110-11111	Reserved

9. OPEN ISSUES

1. **Definition of 8-bit CRC.**
2. **Definition of new timing values.**