X3T10 Project 1155D

Serial Bus Protocol 2

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Technical Editor

Design goals

- Build upon SBP
- Encapsulate 12-byte CDB's, minimum
- Optimize for single-initiator environment
  - Simple queuing model
  - No asynchronous event notification (AEN)
  - Permit multiple-initiator architecture
- Simplify target hardware and firmware
  - No FIFO's to accept "taps"
  - Small request blocks to maximize use of on-chip memory
  - Uniform fixed-length status information
- Isochronous support optional

Key differences from SBP

- New command delivery mechanism
  - No “taps”
  - Target paces all command delivery to suit its needs
  - One fetch agent per initiator per logical unit
    - No need for subchains or round-robin scheduling
    - Eliminate some request block fields (e.g., LUN)
- Compact, 32-byte request block
- SAM requirements simplified
  - No asynchronous event notification (AEN)
  - No auto contingent allegiance (ACA)

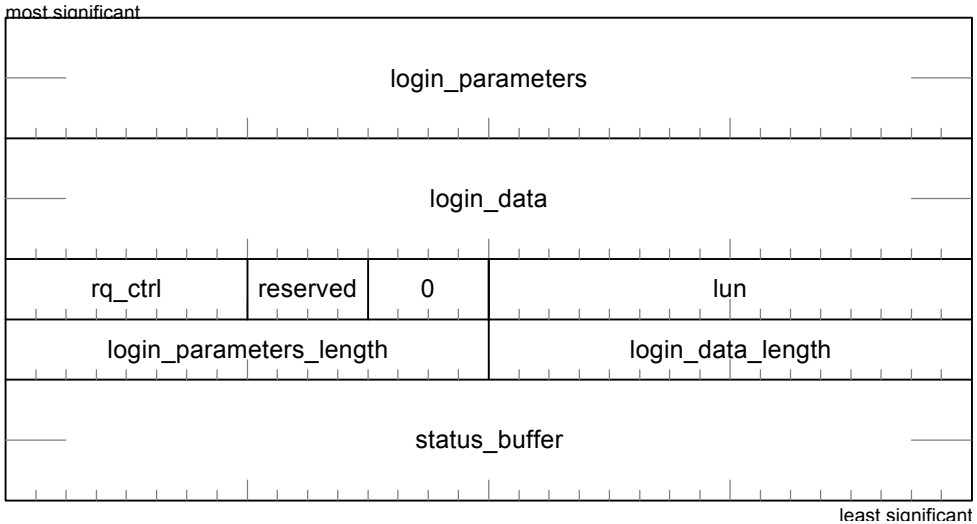
Key enhancements to SBP

- Isochronous model articulated better
  - Isochronous stream is the unifying concept
    - One or more channels form a stream
  - Two target objects work in tandem to support a stream
    - Device manager takes care of transfers to or from the medium
    - Stream controller synchronizes talking or listening on 1394
- Connection management documented
  - Plug control registers (PCR's) to be part of P1394a
- Recorded isochronous data format (CIP) documented
- Isochronous data transforms specified
  - Physical ID substitution upon playback
  - Time stamp modification upon recording and playback

Request types

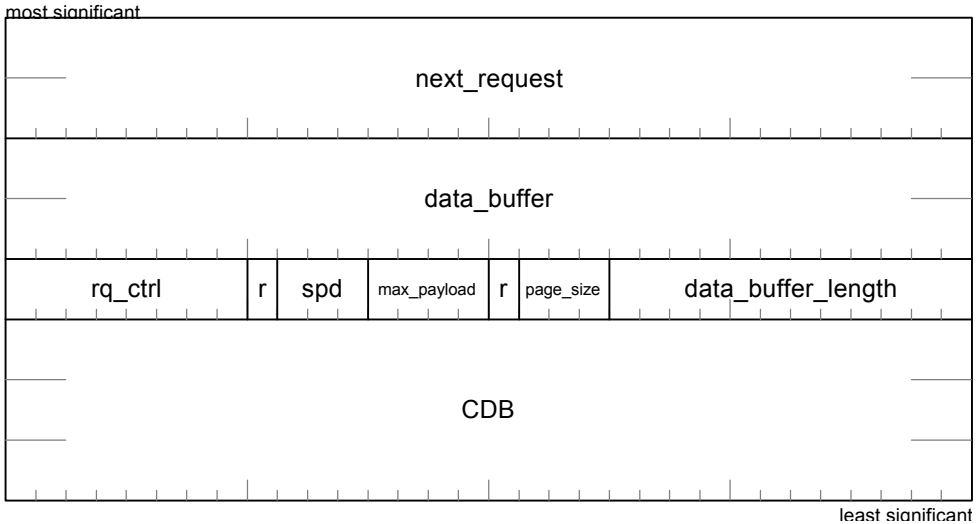
- Four basic types
  - Management, which includes login (32 bytes)
  - Conventional SCSI (32 and 64 bytes)
  - SCSI stream (64 bytes)
  - Stream control (64 bytes)
- All except management requests may be linked together
  - Working set of requests limited by initiator memory, not by target memory
  - New requests may be appended without interrupting target
- Both SCSI stream and stream control requests must be used together for isochronous

Login request



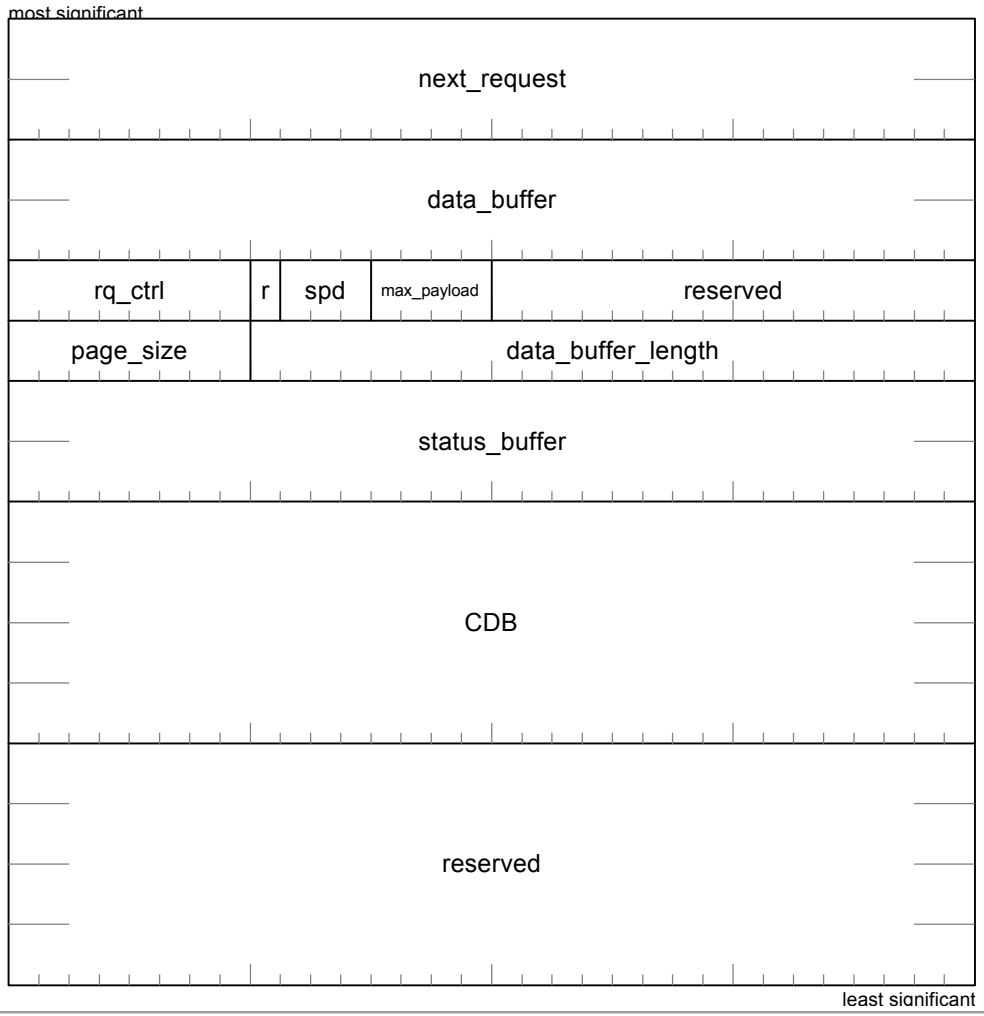
- Login parameters
  - Login type (conventional, listener or talker)
  - Constant status offset
- Login data
  - Fetch agent CSR addresses

32-byte conventional SCSI request



- Up to a 12-byte CDB supported
- Status always returned at a fixed offset from the request block address
  - Offset established at login

64-byte conventional SCSI request

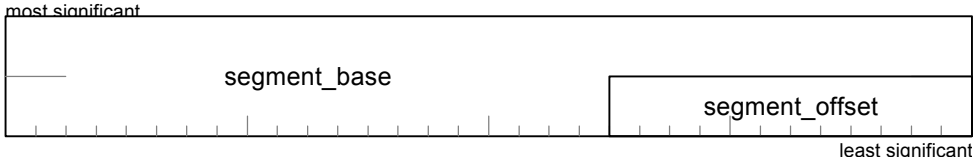


Data transfer

- Application buffer described by data_buffer and data_buffer_length
- If page_size is zero, direct addressing
- If page_size is nonzero, indirect addressing via page table
  - Page table address is in data_buffer
  - Count of page table elements is in data_buffer_length
- In either case, spd and max_payload constrain speed and packet size when the target fetches or stores data in the application buffer

Page table

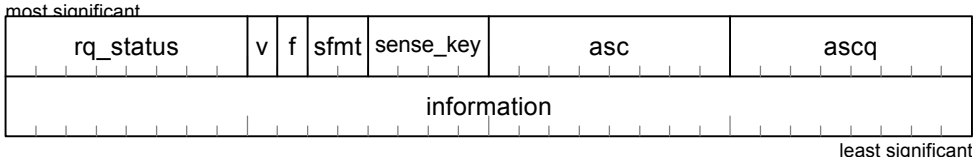
- Page table is an array of 8-byte elements



- In this example, page size is 4,096 bytes
  - The segment_offset field is page_size+8 bits wide
- Elements are constructed as follows:
  - All elements, transfer length = 2^{page_size+8} - segment_offset
  - First element, concatenate segment_base and segment_offset to get starting transfer address
  - Second through last elements, concatenate segment_base and least significant bits of zero to get starting transfer address

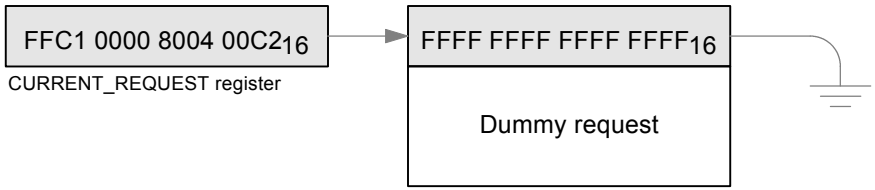
Completion status

- Fixed-length, 8-byte status block



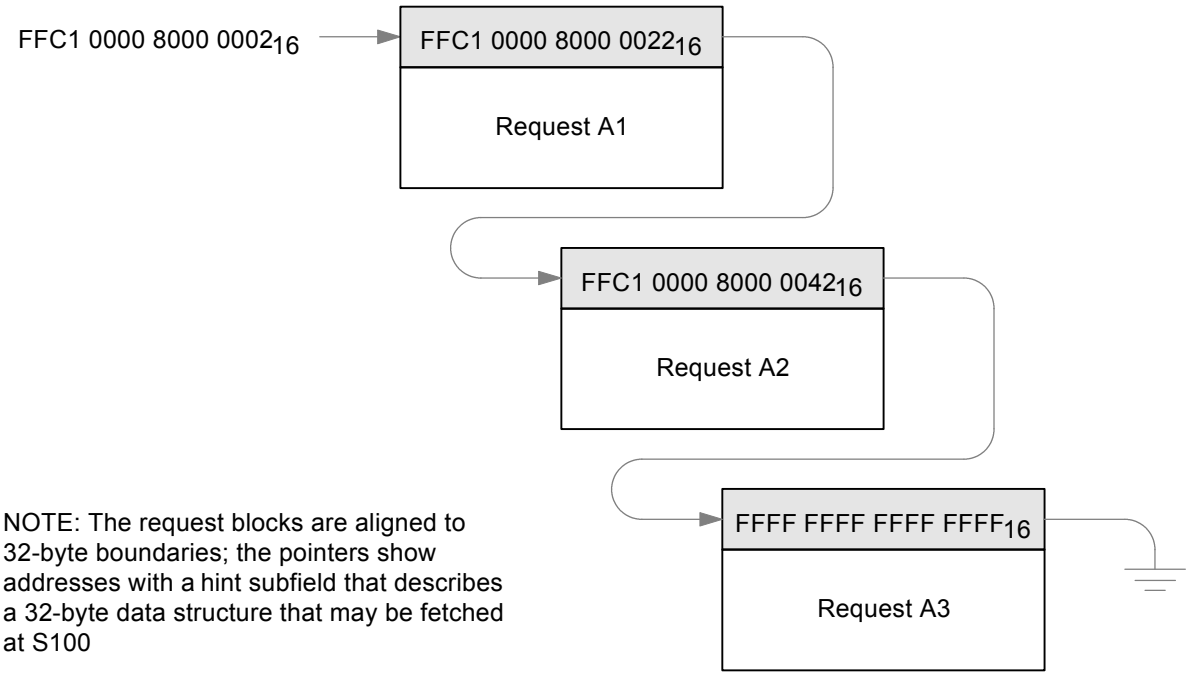
- Overload the rq_status field to encode both SBP-2 and SCSI status
  - When rq_status equals FF_{16}, no SCSI status present
- The sfmt field encodes SCSI sense data error code
  - Current, deferred or vendor unique (70_{16}, 71_{16} or $7F_{16}$)
- The information field is the same as in SCSI sense data
  - Logical block address or transfer residual, as appropriate to device

Fetch agent initialization



- Fetch agent usually initialized with a dummy request
  - Set next_request in the dummy request to null
  - Store the dummy request address in CURRENT_REQUEST
  - Write an op value of RUN to AGENT_CONTROL
- Dummy request has NOP that completes immediately
- Fetch agent pauses and waits for doorbell
  - CURRENT_REQUEST still points to next_request
- Upon resumption, status returned a second time

Dynamic append to request lists



- Update next_request in previous tail request with address of request to be appended
- Write any value to the DOORBELL register

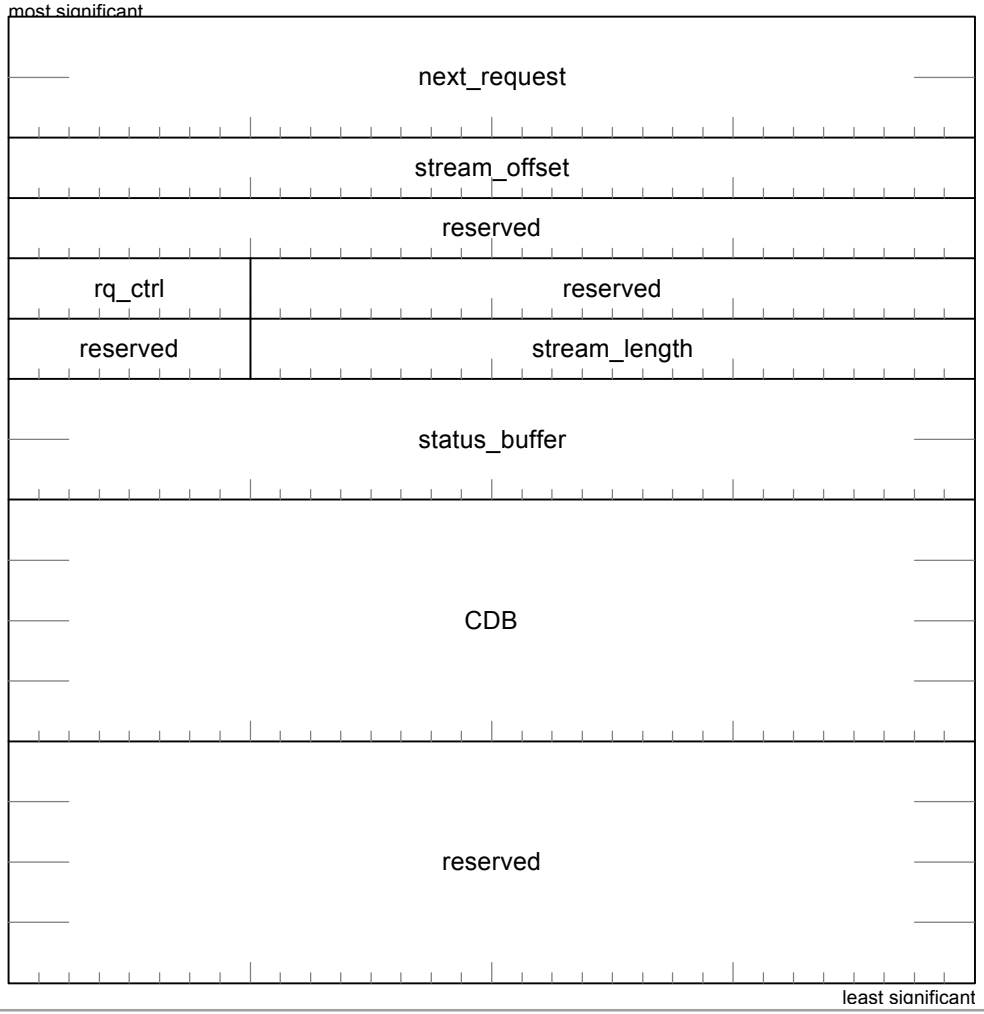
Basic task management

- No untagged tasks
  - Serial Bus address of the request block is the tag
- All tasks are SIMPLE
  - No ORDERED, ACA or HEAD OF QUEUE tasks
  - Task attribute is implicit, not part of request block
  - Configuration ROM identifies task management model
- Lmited task management functions
  - ABORT TASK
  - ABORT TASK SET
  - TARGET RESET
- Upon a fault, entire task set is cleared

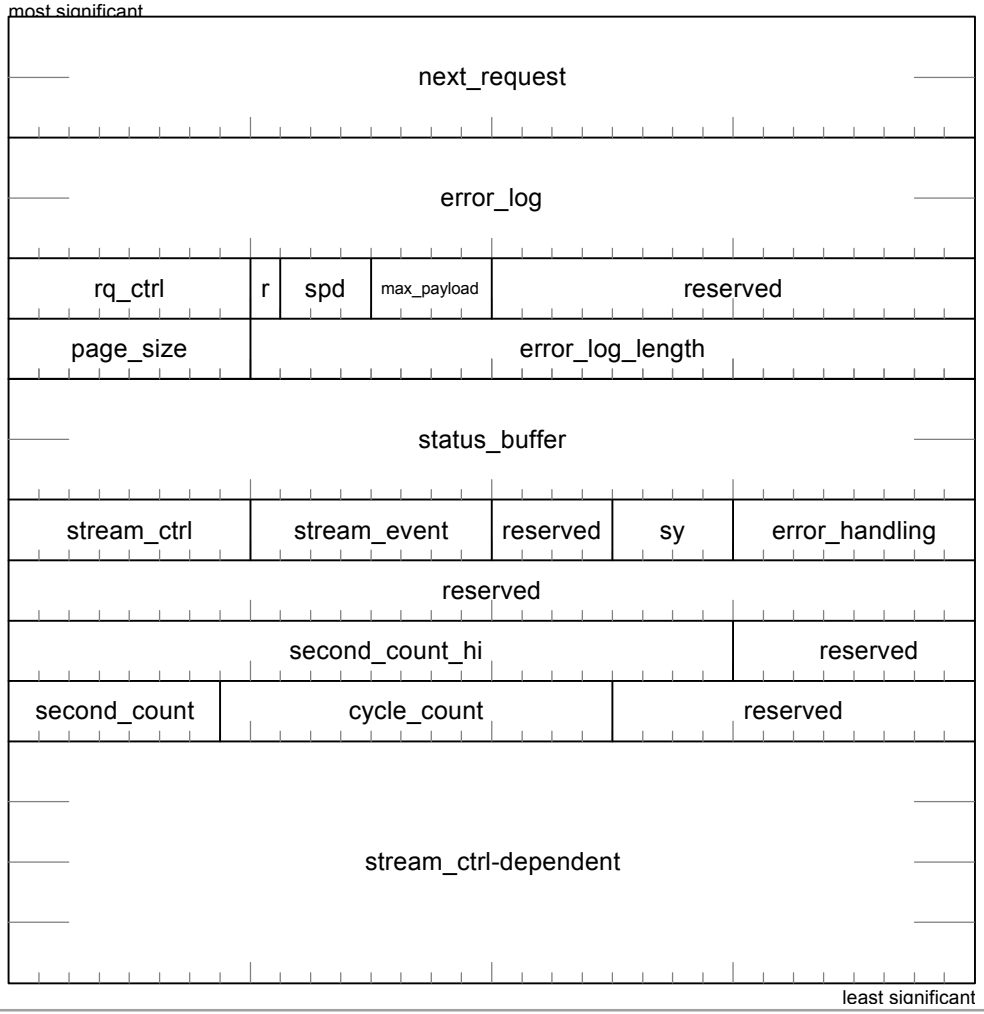
Isochronous task sets

- Leverage SAM terminology to describe isochronous
- Isochronous task sets are inherently ORDERED
- Multiple isochronous task sets per logical unit
  - Organizing concept is a stream
  - Login ID is the stream identifier
- Two target objects mediate stream data transfers
  - SCSI stream requests direct transfer to/from medium
  - Stream control requests direct transfer from/to 1394
- SCSI stream requests do not have buffer addresses
- Stream control requests support time synchronization

SCSI stream request

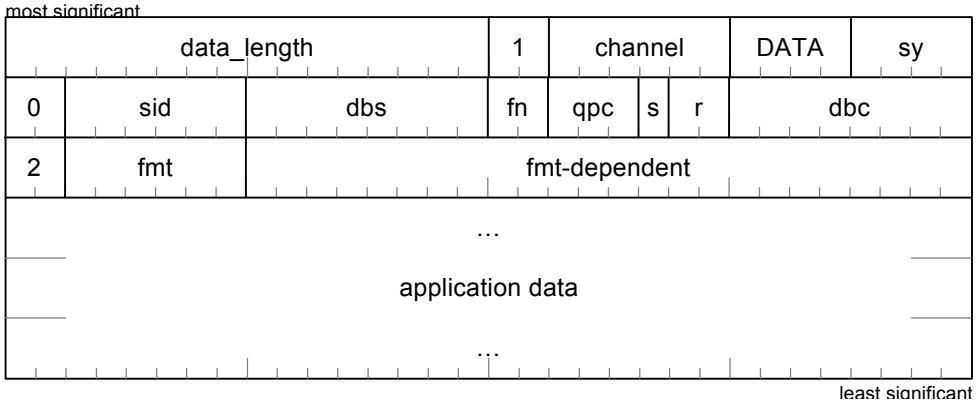


Stream control request



Common isochronous packet format

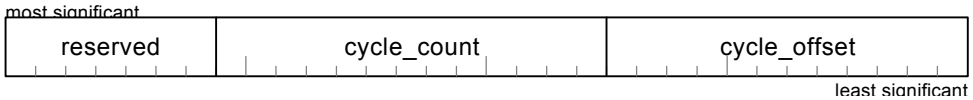
- CIP format indicated by sy value of one



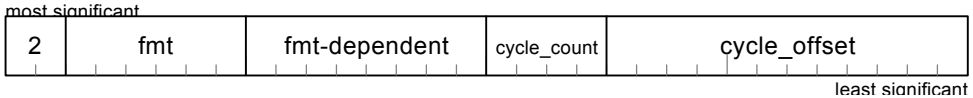
- Replace sid with own physical ID on playback
- If s bit is set, source packet header (time stamp) follows in first quadlet of application data
- For some fmt values, time stamp is present in the fmt-dependent field

Time stamp formats

- Source packet header format



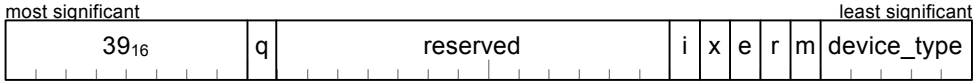
- Synchronization time (syt) format



- Both present as absolute time stamps on 1394
- Convert to relative time stamps when recorded
  - $sph\_time_{stored} = (sph\_time_{observed} \& 0x1FFF000) - (CYCLE\_TIME \& 0x01FFF000)$
  - $syt_{stored} = (syt_{observed} \& 0xF00) - (CYCLE\_TIME \& 0x0000F000)$
- Reconvert to absolute time stamps upon playback
- Hardware support recommended

Unit_Characteristics entry

- Configuration ROM entry in unit directory



- The q bit indicates the task management model
  - Basic or full (today's SAM model)
- The i bit indicates isochronous support
- The x bit indicates support for 64-byte request blocks
- The e bit is equivalent to RMB (removable media)
- The m bit is clear when device has a single logical unit
  - Logical unit number is zero
  - The device_type field is the same as in INQUIRY data

SAM compliance

- SBP-2 intended to be stand-alone document for implementors
  - SAM and other SCSI standards are normative references, but are not necessary to understand SBP-2
- SBP-2 intended to be useful to implementors who build devices that don't claim SCSI or SAM compliance
- SAM compliance described in a normative annex
  - In the body of the standard, SBP-2 behavior is specified with minimal recourse to SAM terminology
  - SAM formalisms may be easily referenced in one location

Next steps

- Modify SAM queuing for a new subsets
  - Basic task management
- Working group meetings
  - Develop security proposals
  - Isochronous data requirements
  - August 13 hosted by Microsoft in Redmond, WA
- Document review
  - Schedule editor's meetings
- Aggressive schedule; stabilize by November