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SFF Committee

SFF-8079 Specification for

SFP Rate and Application Selection

Rev 1.7 February 2, 2005

Secretariat: SFF Committee

Abstract: This specification defines the operational requirements for SFP (Small Formfactor Pluggable) transceiver rate and application select functionality. Documents INF-8074 and SFF-8472 reference RateSelect as a two state (rate high and rate low) optional hardware and/or software input to an SFP transceiver. RateSelect, as conceived in these two documents, allows two distinct performance regimes by controlling the receiver bandwidth. In order to provide support for multiple rates (>2) beyond receiver bandwidth selection and to have the flexibility in a single device to support multiple applications, this document describes a new Extended RateSelect and a new generalized approach, named ApplicationSelect for multiple application selection capability for SFP transceivers via a combination of hardware and/or 2-wire software interfaces. If implemented, SFPs are intended to standardize their response to Extended RateSelect and ApplicationSelect by setting performance characteristics to comply with the requirements as defined in this document.

This specification provides a common specification for systems manufacturers, system integrators, and suppliers of serial communication modules. This is an internal working specification of the SFF Committee, an industry ad hoc group.

This specification is made available for public review, and written comments are solicited from readers. Comments received by the members will be considered for inclusion in future revisions of this specification.

Support: This specification is supported by the identified member companies of the SFF Committee.

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EXPRESSION OF SUPPORT BY MANUFACTURERS

The following member companies of the SFF Committee voted in favor of this industry specification.

ENDL
Infineon
Intel
Nexans
Sun Microsystems
Vitesse Semi

The following SFF member companies voted no on the technical content of this industry specification.

Hewlett Packard

The following member companies of the SFF Committee voted to abstain on this industry specification.

Adaptec
Dell
FCI/Berg
Foxconn Int'l
Fujitsu CPA
Hitachi GST
Madison Cable
Maxtor
Molex
Seagate
Tyco AMP
Unisys

The user's attention is called to the possibility that implementation to this Specification may require use of an invention covered by patent rights. By distribution of this Specification, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. Members of the SFF Committee which advise that a patent exists are required to provide a statement of willingness to grant a license under these rights on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain such a license.

If you are not a member of the SFF Committee, but you are interested in participating, the following principles have been reprinted here for your information.

PRINCIPLES OF THE SFF COMMITTEE

The SFF Committee is an ad hoc group formed to address storage industry needs in a prompt manner. When formed in 1990, the original goals were limited to defining de facto mechanical envelopes within which disk drives can be developed to fit compact computer and other small products.

Adopting a common industry size simplifies the integration of small drives (2 1/2" or less) into such systems. Board-board connectors carrying power and signals, and their position relative to the envelope are critical parameters in a product that has no cables to provide packaging leeway for the integrator.

In November 1992, the SFF Committee objectives were broadened to encompass other areas which needed similar attention, such as pin-outs for interface applications, and form factor issues on larger disk drives. SFF is a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

Specifications created by the SFF Committee are expected to be submitted to bodies such as EIA (Electronic Industries Association) or an ASC (Accredited Standards Committee). They may be accepted for separate standards, or incorporated into other standards activities.

The principles of operation for the SFF Committee are not unlike those of an accredited standards committee. There are 3 levels of participation:

- Attending the meetings is open to all, but taking part in discussions is limited to member companies, or those invited by member companies
- The minutes and copies of material which are discussed during meetings are distributed only to those who sign up to receive documentation.
- The individuals who represent member companies of the SFF Committee receive documentation and vote on issues that arise. Votes are not taken during meetings, only guidance on directions. All voting is by letter ballot, which ensures all members an equal opportunity to be heard.

Material presented at SFF Committee meetings becomes public domain. There are no restrictions on the open mailing of material presented at committee meetings. In order to reduce disagreements and misunderstandings, copies must be provided for all agenda items that are discussed. Copies of the material presented, or revisions if completed in time, are included in the documentation mailings.

The sites for SFF Committee meetings rotate based on which member companies volunteer to host the meetings. Meetings have typically been held during the ASC T10 weeks.

The funds received from the annual membership fees are placed in escrow, and are used to reimburse ENDL for the services to manage the SFF Committee.

If you are not receiving the documentation of SFF Committee activities or are interested in becoming a member, the following signup information is reprinted here for your information.

Membership includes voting privileges on SFF Specs under development.

CD_Access Electronic documentation contains:
- Minutes for the year-to-date plus all of last year
- Email traffic for the year-to-date plus all of last year
- The current revision of all the SFF Specifications, as well as any previous revisions distributed during the current year.

Meeting documentation contains:
- Minutes for the current meeting cycle.
- Copies of Specifications revised during the current meeting cycle.

Each electronic mailing obsoletes the previous mailing of that year e.g. July replaces May. To build a complete set of archives of all SFF documentation, retain the last SFF CD_Access mailing of each year.

Name: _____ Title: _____

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Please register me with the SFF Committee for one year.

___ Voting Membership w/Electronic documentation $ 2,160

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$ 760 Overseas

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Foreword

When 2 1/2" diameter disk drives were introduced, there was no commonality on external dimensions e.g. physical size, mounting locations, connector type, connector location, between vendors.

The first use of these disk drives was in specific applications such as laptop portable computers in which space was at a premium and time to market with the latest machine was an important factor. System integrators worked individually with vendors to develop the packaging. The result was wide diversity, and with space being such a major consideration in packaging, it was not possible to replace one vendor's drive with a competitive product.

The desire to reduce disk drive sizes to even smaller dimensions such as 1.8" and 1.3" made it likely that devices would become even more constrained in dimensions because of a possibility that such small devices could be inserted into a socket, not unlike the method of retaining semiconductor devices.

The problems faced by integrators, device suppliers, and component suppliers led to the formation of an industry ad hoc group to address the marketing and engineering considerations of the emerging new technology in disk drives. After two informal gatherings on the subject in the summer of 1990, the SFF Committee held its first meeting in August.

During the development of the form factor definitions, other activities were suggested because participants in the SFF Committee faced problems other than the physical form factors of disk drives. In November 1992, the members approved an expansion in charter to address any issues of general interest and concern to the storage industry. The SFF Committee became a forum for resolving industry issues that are either not addressed by the standards process or need an immediate solution.

At the same time, the principle was adopted of restricting the scope of an SFF project to a narrow area, so that the majority of specifications would be small and the projects could be completed in a rapid timeframe. If proposals are made by a number of contributors, the participating members select the best concepts and uses them to develop specifications which address specific issues in emerging storage markets.

Those companies which have agreed to support a specification are identified in the first pages of each SFF Specification. Industry consensus is not an essential requirement to publish an SFF Specification because it is recognized that in an emerging product area, there is room for more than one approach. By making the documentation on competing proposals available, an integrator can examine the alternatives available and select the product that is felt to be most suitable.

Suggestions for improvement of this specification will be welcome. They should be sent to the SFF Committee, 14426 Black Walnut Ct, Saratoga, CA 95070.

The development work on this specification was done by the SFF Committee, an industry group. The membership of the committee since its formation in 1990 has included a mix of companies which are leaders across the industry.

TABLE OF CONTENTS

List of Tables

SFF Committee

SFP Rate and Application Selection

1.0 Scope

This specification defines the operational requirements for SFP (Small Formfactor Pluggable) transceiver rate and application select functionality.

INF-8074 and SFF-8472 reference RateSelect as a two state (rate high and rate low) optional hardware and/or software input to an SFP transceiver. RateSelect, as conceived in these two documents, allows two distinct performance regimes by controlling the receiver bandwidth. In order to provide support for multiple rates (>2) beyond receiver bandwidth selection and to have the flexibility in a single device to support multiple applications, this specification describes a new Extended RateSelect and a new generalized approach, named ApplicationSelect for multiple application selection capability for SFP transceivers via a combination of hardware and/or 2-wire software interfaces. If implemented, SFPs are intended to standardize their response to Extended RateSelect and ApplicationSelect by setting performance characteristics to comply with the requirements as defined in this specification.

1.1 Description of Clauses

Clause 1 contains the Scope and Purpose.
Clause 2 contains Referenced and Related Standards and SFF Specifications.
Clause 3 contains the Introduction to SFF-8079.
Clause 4 defines the details of Part 1 of SFF-8079, Extended RateSelect.
Clause 5 defines the details of Part 2 of SFF-8079, ApplicationSelect.
Clause 6 provides additional important notes.

2.0 References

The SFF Committee activities support the requirements of the storage industry, and it is involved with several standards.

2.1 Industry Documents

The following interface standards may be relevant to this specification.

- INCITS 230-1994 FC-PH Fibre Channel Physical Interface
- INCITS 297-1997 FC-PH-2 Fibre Channel Physical Interface
- INCITS 352-2002 FC-PI Fibre Channel Physical Interface
- INCITS 339-2000 Very Long Length Single Mode Optical Variant (SM-LL-V)
- INCITS 364-200x Fibre Channel -10 Gigabit (10GFC)
- INCITS Project 1506-D Fibre Channel Physical Interfaces - 2 (FC-PI-2)
- INCITS Project 1625-D Fibre Channel Physical Interfaces - 3 (FC-PI-3)
- INCITS Project Fibre Channel Physical Interfaces - 4 (FC-PI-4)
- IEEE-802.3 Edition 2002 Ethernet Specification
- Telcordia GR-253-CORE Synchronous Optical Network (SONET) Transport Systems
- ITU-T G.691 Transmission Systems/Media, Digital Systems/Networks

2.2 Key SFF Documents

- INF-8074 SFP (Small Formfactor Pluggable) Transceiver
- SFF-8472 Digital Diagnostic Monitoring Interface for Optical Transceivers
- SFF-8089 SFP Rate and Application Codes

2.3 SFF Specifications

There are several projects active within the SFF Committee. At the date of printing specification numbers had been assigned to the following projects. The status of Specifications is dependent on committee activities.

F = Forwarded The specification has been approved by the members for forwarding to a formal standards body.
P = Published The specification has been balloted by members and is available as a published SFF Specification.
A = Approved The specification has been approved by ballot of the members and is in preparation as an SFF Specification.
C = Canceled The project was canceled, and no Specification was Published.
D = Development The specification is under development at SFF.
E = Expired The specification has been published, and the members voted against re-publishing when it came up for review.
a = archive Used as a suffix to indicate an SFF Specification which has been Archived. This specification will always be available at the ftp site and new development effort in the subject area shall be done under a new number.
e = electronic Used as a suffix to indicate an SFF Specification which has Expired but is still available in electronic form from SFF e.g. a specification has been incorporated into a draft or published standard which is only available in hard copy.
i = Information The specification has no SFF project activity in progress, but it defines features in developing industry standards. The document was provided by a company, editor of an accredited standard in development, or an individual. It is provided for broad review (comments to the author are encouraged). As the copyright on such documents is retained by the author, the INF or 'i' specifications cannot be freely copied for distribution.
s = submitted The document is a proposal to the members for consideration to become an SFF Specification.

Spec #	Rev	List of Specifications as of February 2, 2005
SFF-8000		SFF Committee Information
INF-8001i	E	44-pin ATA (AT Attachment) Pinouts for SFF Drives
INF-8002i	E	68-pin ATA (AT Attachment) for SFF Drives
SFF-8003	E	SCSI Pinouts for SFF Drives
SFF-8004	E	Small Form Factor 2.5" Drives
SFF-8005	E	Small Form Factor 1.8" Drives
SFF-8006	E	Small Form Factor 1.3" Drives
SFF-8007	E	2mm Connector Alternatives
SFF-8008	E	68-pin Embedded Interface for SFF Drives
SFF-8009	4.1	Unitized Connector for Cabled Drives
SFF-8010	E	Small Form Factor 15mm 1.8" Drives
INF-8011i	E	ATA Timing Extensions for Local Bus
SFF-8012	3.0	4-Pin Power Connector Dimensions
SFF-8013	E	ATA Download Microcode Command
SFF-8014	C	Unitized Connector for Rack Mounted Drives
SFF-8015	E	SCA Connector for Rack Mounted SFF SCSI Drives
SFF-8016	C	Small Form Factor 10mm 2.5" Drives
SFF-8017	E	SCSI Wiring Rules for Mixed Cable Plants
SFF-8018	E	ATA Low Power Modes
SFF-8019	E	Identify Drive Data for ATA Disks up to 8 GB
INF-8020i	E	ATA Packet Interface for CD-ROMs
SFF-8025	0.7	SFF Committee Specification Categories
INF-8028i	E	- Errata to SFF-8020 Rev 2.5
SFF-8029	E	- Errata to SFF-8020 Rev 1.2
SFF-8030	2.0	SFF Committee Charter
SFF-8031		Named Representatives of SFF Committee Members
SFF-8032	1.6	SFF Committee Principles of Operation

INF-8033i	E	Improved ATA Timing Extensions to 16.6 MBs
INF-8034i	E	High Speed Local Bus ATA Line Termination Issues
INF-8035i	E	Self-Monitoring, Analysis & Reporting Technology
INF-8036i	E	ATA Signal Integrity Issues
INF-8037i	E	Intel Small PCI SIG
INF-8038i	E	Intel Bus Master IDE ATA Specification
INF-8039i	E	Phoenix EDD (Enhanced Disk Drive) Specification
SFF-8040	1.2	25-pin Asynchronous SCSI Pinout
SFF-8041	C	SCA-2 Connector Backend Configurations
SFF-8042	C	VHDCI Connector Backend Configurations
SFF-8043	E	40-pin MicroSCSI Pinout
SFF-8045	4.7	40-pin SCA-2 Connector w/Parallel Selection
SFF-8046	E	80-pin SCA-2 Connector for SCSI Disk Drives
SFF-8047	C	40-pin SCA-2 Connector w/Serial Selection
SFF-8048	C	80-pin SCA-2 Connector w/Parallel ESI
SFF-8049	E	80-conductor ATA Cable Assembly
INF-8050i	1.0	Bootable CD-ROM
INF-8051i	E	Small Form Factor 3" Drives
INF-8052i	E	ATA Interface for 3" Removable Devices
SFF-8053	5.5	GBIC (Gigabit Interface Converter)
SFF-8054	0.2	Automation Drive Interface Connector
INF-8055i	E	SMART Application Guide for ATA Interface
SFF-8056	C	50-pin 2mm Connector
SFF-8057	E	Unitized ATA 2-plus Connector
SFF-8058	E	Unitized ATA 3-in-1 Connector
SFF-8059	E	40-pin ATA Connector
SFF-8060	1.1	SFF Committee Patent Policy
SFF-8061	E	Emailing drawings over the SFF Reflector
SFF-8062		Rolling Calendar of SSWGs and Plenaries
SFF-8064		Unshielded HD Cable/Board Connector System
SFF-8065	C	40-pin SCA-2 Connector w/High Voltage
SFF-8066	C	80-pin SCA-2 Connector w/High Voltage
SFF-8067	3.3	40-pin SCA-2 Connector w/Bidirectional ESI
INF-8068i	E	Guidelines to Import Drawings into SFF Specs
SFF-8069	E	Fax-Access Instructions
INF-8070i	1.3	ATAPI for Rewritable Removable Media
SFF-8072	1.2	80-pin SCA-2 for Fibre Channel Tape Applications
SFF-8073	C	20-pin SCA-2 for GBIC Applications
INF-8074i	1.0	SFP (Small Formfactor Pluggable) Transceiver
SFF-8075	1.0	PCI Card Version of SFP Cage
SFF-8076	-	SFP Additional IDs
INF-8077i	3.1	XFP (10 Gbs Small Form Factor Pluggable Module)
SFF-8078	C	XFP-E
SFF-8079	1.7	SFP Rate and Application Selection
SFF-8080	E	ATAPI for CD-Recordable Media
SFF-8082	4.0	Labeling of Ports and Cable Assemblies
SFF-8084	0.2	0.8mm SFP Card Edge Connector Dimensioning
SFF-8085	0.9	100 Mbs Small Formfactor Transceivers
SFF-8086		0.8mm Card Edge Connector Mating Interface
SFF-8087		0.8mm Unshielded Connector
SFF-8088		0.8mm Shielded Connector
SFF-8089	1.3	SFP Rate and Application Selection Values
INF-8090i	1.6	ATAPI for Multimedia Devices (Mt Fuji5)
SFF-8101	C	3 Gbs and 4 Gbs Signal Characteristics
SFF-8110	C	5V Parallel 1.8" drive form factor
SFF-8111	1.3	1.8" drive form factor (60x70mm)
SFF-8122		1.8" (60x70mm) w/SCA-2 Connector
SFF-8120	2.6	1.8" drive form factor (78x54mm)
SFF-8123	C	1.8" (60x70mm) w/Serial Attachment Connector

SFF-8124	0.2	Memory Form Factor Disk Drive Connections
SFF-8200e	1.1	2 1/2" drive form factors (all of 82xx family)
SFF-8201	2.3	2 1/2" drive form factor dimensions
SFF-8212e	1.2	2 1/2" drive w/SFF-8001 44-pin ATA Connector
SFF-8221	3.5	Pre-Aligned 2.5" Drive >10mm Form Factor
SFF-8222	2.1	2.5" Drive w/SCA-2 Connector
SFF-8223	2.4	2.5" Drive w/Serial Attachment Connector
SFF-8225	C	2.5" Single Voltage Drive
SFF-8300	1.2	3 1/2" drive form factors (all of 83xx family)
SFF-8301	1.4	3 1/2" drive form factor dimensions
SFF-8302e	1.1	3 1/2" Cabled Connector locations
SFF-8323	1.4	3 1/2" drive w/Serial Attachment Connector
SFF-8332e	E	3 1/2" drive w/80-pin SFF-8015 SCA Connector
SFF-8337e	E	3 1/2" drive w/SCA-2 Connector
SFF-8342e	1.3	3 1/2" drive w/Serial Unitized Connector
INF-8350i	E	3 1/2" Packaged Drives
SFF-8400	C	VHDCI (Very High Density Cable Interconnect)
SFF-8410	16.1	High Speed Serial Testing for Copper Links
INF-8411	1.0	High Speed Serial Testing for Backplanes
SFF-8412	12.2	HSOI (High Speed Optical Interconnect) Testing
SFF-8415	4.1	HPEI (High Performance Electrical Interconnect)
SFF-8416	10.0	HPEI Bulk Cable Measurement/Performance Reqmnts
SFF-8420	11.1	HSSDC-1 Shielded Connections
SFF-8421	2.4	HSSDC-2 Shielded Connections
SFF-8422	C	FCI Shielded Connections
SFF-8423	C	Molex Shielded Connections
SFF-8424	0.5	Dual Row HSSDC-2 Shielded Connections
SFF-8425	1.4	Single Voltage 12V Drives
SFF-8426		HSSDC Double Width
SFF-8429	0.0	Signal Specification Architecture for HSS Links
SFF-8430	4.1	MT-RJ Duplex Optical Connections
SFF-8431		SFP+
SFF-8441	14.1	VHDCI Shielded Configurations
SFF-8451	10.1	SCA-2 Unshielded Connections
SFF-8452	3.1	Glitch Free Mating Connections for Multidrop Aps
SFF-8453		Shielded High Speed Serial connectors
SFF-8460	1.2	HSS Backplane Design Guidelines
SFF-8464		Improved MM HSS Optical Link Performance
SFF-8470	2.9	Multi Lane Copper Connector
SFF-8471	C	ZFP Multi Lane Copper Connector
SFF-8472	9.5	Diagnostic Monitoring Interface for Optical Xcvrs
INF-8475i	2.2	XPAK Small Formfactor Pluggable Receiver
SFF-8480	2.1	HSS (High Speed Serial) DB9 Connections
SFF-8482	1.5	Unshielded Dual Port Serial Attachment Connector
SFF-8483	C	External Serial Attachment Connector
SFF-8484	0.6	MultiLane Unshielded Serial Attachment Connector
SFF-8485	0.4	Serial GPIO (General Purpose Input/Output) Bus
SFF-8500e	1.1	5 1/4" drive form factors (all of 85xx family)
SFF-8501e	1.1	5 1/4" drive form factor dimensions
SFF-8508e	1.1	5 1/4" ATAPI CD-ROM w/audio connectors
SFF-8523	1.3	5 1/4" drive w/Serial Attachment Connector
SFF-8551	3.2	5 1/4" CD Drives form factor
SFF-8552	1.1	5 1/4" 9.5mm/12.7mm Optical Drive Form Factor
SFF-8572	C	5 1/4" Tape form factor
SFF-8610	C	SDX (Storage Device Architecture)

2.4 Sources

Copies of ANSI standards or proposed ANSI standards may be purchased from Global Engineering.

15 Inverness Way East 800-854-7179 or 303-792-2181
Englewood 303-792-2192Fx
CO 80112-5704

Copies of SFF Specifications are available by joining the SFF Committee as an Observer or Member or by download at ftp://ftp.seagate.com/sff

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3.0 Introduction

This clause introduces the concepts of SFF-8079.

3.1 Important Terms Used in this Document

Other new terms are used in this document, but the ones below are defined and clarified here due to their particular likelihood to cause confusion. These terms are explained in more detail in subsequent sections of the document.

- RateSelect - the original function of controlling a module, typically receiver bandwidth, as defined in INF-8074 (via rate_select) and enhanced in SFF-8472 (via soft_rate_select).
- rate_select – the original hardware (HW) control interface for RateSelect, pin 7, as defined in INF-8074. The definition and usage for rate_select was not modified in SFF-8472 and still applies to Extended RateSelect in SFF-8079, Part 1.
- soft_rate_select – software (SW) control mechanism for RateSelect or Extended RateSelect via the 2-wire interface, as defined in SFF-8472. RateSelect and Extended RateSelect logically OR the control from rate_select and soft_rate_select, if both inputs are used.
- Extended RateSelect – an extended version of RateSelect, defined in SFF-8079 Part 1, for specific anticipated multi-rate module requirements. Extended RateSelect is backward compatible with RateSelect and is based on 1-bit control.
- ApplicationSelect – the new (set of) function(s) of controlling a module, as defined in this document, SFF-8079, Part 2. ApplicationSelect is backward compatible with Extended RateSelect and RateSelect.
- application_select – HW selection interface within ApplicationSelect via 2 control pins.
- soft_application_select – SW control mechanism within ApplicationSelect via the 2-wire interface.
- ApplicationSelect table (AST) – the memory table in the upper half of the module’s A0h page that identifies the specific applications it can support.
- Application Code table (ACT) – table in 8089 that defines numerous standardized Application Codes from which a module vendor can choose for writing into the module’s AST.
- Application Code – any of a set of specific codes of 13 bits as defined in SFF-8089’s ACT. When written into the AST, 3 additional bits are appended to the Application Code to define HW control.

3.2 General Description and Relationship to Other SFF Documents

RateSelect, as conceived in the original SFP Multi-Source Agreement (INF-8074), is an optional single-pin two-state input (logic high and logic low) function in an SFP transceiver allowing manufacturers to optimize performance for two distinct performance regimes. RateSelect is defined via control of pin 7 (rate_select) on the SFP electrical connector. At the original publishing, the intent of these two positions was understood to be 1.0625 Gb/s (rate_select Low or floating) and 2.125 Gb/s (rate_select High).

The ability to control RateSelect through the two-wire serial interface was added as an option in SFF-8472 at address A2h, byte 110, bit 3. An SFF-8472 compliant transceiver incorporating this option is to respond to the logic OR of SFP HW pin 7 (rate_select) and the contents of SW address A2h, byte 110, bit 3 (soft_rate_select) when written by the host. This logical HW and SW combination continues to be supported by SFF-8079.

There is no mandate in INF-8074 or SFF-8472 on what specific aspects of an SFP transceiver are to respond to a RateSelect input (i.e. transmitter, receiver or both), but it is most typically used to control the receiver bandwidth for

compatibility with multiple data rates. Exact definition(s) for standards compliance requirements are not given for either state.

There is a trend in the market to consolidate SFP transceivers in terms of data rates, encoding schemes, etc. In order to achieve multi-rate, multi-application capable SFP transceivers, and to prevent fragmentation in the industry on implemented behaviors for selecting applications, a standardized approach is warranted. This document, SFF-8079, addresses this objective.

The document is divided into two parts.

- Part 1 extends RateSelect functionality as originally conceived in INF-8074 and enhanced in SFF-8472. Particularly and currently, it addresses the 1G, 2G, and 4G Fibre Channel data rate groupings in a module that uses HW pin 7 and which may or may not be compliant with SFF-8472.
- Part 2 defines a new generalized HW and SW approach, named ApplicationSelect, for multiple application capability in SFP transceivers. It specifies the different combinations of data rates and applications (e.g., Fiber channel, SONET/SDH, Ethernet, Infiniband), provides a means for identifying the device’s capabilities through it’s two-wire interface A0h memory map, and defines how these applications may be selected by the host either via HW or SW control.

While this document describes the general methodology for Extended RateSelect and ApplicationSelect for SFP transceivers, a companion document, SFF-8089, itemizes Application Codes via its Application Code table. This table defines a large number of Application Codes, a standardized listing of the many potential definitions for ApplicationSelect compliance based on the requirements of various storage, enterprise and telecommunications applications. SFF-8089 is envisioned to be a “living” document.

SFF-8079 builds on the same 2-wire interface and memory map structures as defined in INF-8074 and SFF-8472. All requirements such as serial protocol, bit order, and relative bit significance shall be as defined in those other documents.

The fast response time required by the Fibre Channel speed negotiation algorithm requires using hardware pins. The Tx and Rx speeds are required to be independently settable. Up through the 4 G speed the assumption in this document is that only the Rx is controlled and that the Tx can work equally well at all speeds (1,2, and 4 G).

A summary of likely issues for extension beyond 4 G:

- Limited number of states allowed by pins
- Range of backward compatibility with legacy hosts
- Backward states take away from future states
- Need for (separate) Tx control
- Need for (separate) Rx control
- Number and location of break points (design grouping)
- Future compatibility
- Potential changes to speed negotiation?

Methods are known to maintain the hardware speeds and increase the information available through two pins (multi level coding for example) but such methods are not described in this document.

4.0 PART 1 - Extended RateSelect

Extended RateSelect enhances RateSelect per INF-8074 and SFF-8472 by supporting more applications. Extended RateSelect compliance shall be indicated within an SFP memory map at address A0h page, byte 13. The purpose of this byte is to indicate compliance to specific technical requirements, and specify how the host should set this signal to choose a specific application from the module's capabilities.

Note that SFF-8472 (and page A2h) is compatible with but not required for operation of Extended RateSelect (or RateSelect).

Table 1. Extended RateSelect Compliance in A0h page

Data Address	Size (Bytes)	Name of Field	Description of Field
A0h, byte 13	1	Extended RateSelect Compliance	Tag(s) for Extended RateSelect compliance

4.1 Extended RateSelect Compliance Tag Field

A0h page, byte 13 is used as a "bit tag field" to allow a single SFP transceiver the flexibility to comply with single or multiple Extended RateSelect definitions. A definition is indicated by presence of a "1" in the specified bit tag position. If exclusive, non-overlapping bit tag definitions are used, A0h page byte 13 will allow compliance to 8 (1-8) distinct multi-rate definitions.

Table 2. Extended RateSelect Compliance Tag Assignments

Data Address	Bit	Description of Extended RateSelect Function
A0h Byte 13	1-7	Reserved
	0	Fibre Channel 1.0625/2.125/4.25 Gb/s

A value of 0 for all bits in address A0h byte 13 means Extended RateSelect behavior defaults to RateSelect operation as defined in INF-8074.

In the specific sub-clauses below, the host shall assert these states for operation at the listed speed(s) as it desires. Each portion of each sub-clause's table only applies to the module if the module is designed to operate at the listed speed, or to the host if the host is designed to operate at the listed speed.

4.2 Fibre Channel 1.0625/2.125/4.25 Gb/s Compliance Tag (Byte 13, Bit 0)

This clause defines Extended RateSelect operation for 1G, 2G and 4G multi-rate Fibre Channel modules. The grouping is backward compatible with INF-8074 and SFF-8472.

Table 3. Fibre Channel Extended RateSelect Groupings

Extended RateSelect State	Required Compliance	Description
Low	1.0625 Gb/s	Represents legacy performance of non-RateSelect enabled transceivers used in 1G applications. Must comply with the requirements in Clause 6 of FC-PI (until/unless modified by FC-PI-2) for 1.0625 Gb/s data rate. At the module supplier’s discretion, modules may be developed to also be compliant at the 2.125 Gb/s data rate at this setting. This position will also commonly result in compliance to 1000Base performance per IEEE 802.3z.
High	2.125 Gb/s, 4.25 Gb/s	Insures that legacy system applications which have used RateSelect in 1G/2G applications will continue to have the “high” state as 2.125 compliant. Must comply with the performance requirements in Clause 6 of FC-PI (until/unless modified by FC-PI-2) for 2.125 and/or 4.25 Gb/s data rates.

For this particular compliance tag, Extended RateSelect should control only the receiver (typically bandwidth). Specifically, to operate with Fibre Channel automatic speed negotiation, where transmitter and receiver speeds are independent, control of Extended RateSelect from the host must be slaved with the receiver date rate. It is assumed that transmitter control is not required for this compliance tag. This is consistent and compatible with INF-8074 and SFF-8472 practice.

4.3 Future Extended RateSelect Compliance Tags (Byte 13, Bits 7:1)

These other bit tags are reserved for future groupings as/when needs are determined.

5.0 PART 2 - ApplicationSelect

The intent of the ApplicationSelect method discussed in Part 2 of this document is that it is backward compatible with documents INF-8074, SFF-8472 and SFF-8079, Part 1 (Extended RateSelect). The approach has features that enable: (i) fast switching times between 4 or more applications via a hardware interface; and (ii) software switching among applications (via the 2-wire interface). The definition presented here allows 8192 possible Application Codes (see SFF-8089: 5 bits for categories and 8 bits for variants within a category). From these 8192 possible applications, a module vendor can choose to support up to 63 applications within a single module unit.

5.1 Hardware Interface (for HW application_select)

In INF-8074, the SFP transceiver electrical pad layout specifies HW pin 7 as the rate_select pin. Per Part 2 of this document, this pin is renamed to Application_Select_0, (AS0). HW pin 9 in INF-8074 is defined as a Receiver Ground. Per Part 2 of this document, this pin will be used as a second bit for HW ApplicationSelect and will be renamed to Application_Select_1 (AS1). A host that implements this feature must provide current limiting for compatibility with legacy modules where HW pin 9 is Receiver Ground. When HW pin 9 is implemented as AS1, the input shall be internally pulled down with >30kΩ resistor in the module in case the pin is not driven by the host. The voltage requirements for driving AS1 and AS0 by the host are identical to those defined in INF-8074 for the rate_select pin. FYI, SFF-8472 does not further define this pin.

Table 4. Hardware Pin Function Definitions

HW Pin #	INF-8074		SFF-8079	
	Name	Function	Name	Function
7	rate_select	Selects between full or reduced bandwidth	Application_ Select_0, AS0	Selects among applications
9	VeeR	Receiver Ground	Application_ Select_1, AS1	

AS<1:0> allows 4 binary states, but when optical/electrical compatibilities exist, possibly more than 4 applications may be supported depending on their potential overlap of technical specifications. Additional applications, up to a total of 63, may be selected via the 2-wire interface.

5.2 A0h Page Memory Utilization and Rationale

SFP transceiver modules that are not SFF-8472 compliant do not have a A2h page in their memory map. These modules do have a read-only A0h page that describes the application capabilities of the module to the host. This allows implementation of 2 bit (AS<1:0>) HW application selection independent of SFF-8472, while maintaining a read-only A0h page. The following table shows the new definitions in A0h required to support SFF-8079.

Table 5. New Definitions in A0h Page (read-only)

Page	Data Address	Bit Range	Description
A0h	93	2	ApplicationSelect implemented per SFF-8079, Part 2.
A0h	128-255	{7:0}	ApplicationSelect Table (AST)

Bit 2 of byte 93 set “high” in the module indicates the presence of the optional ApplicationSelect capability per Part 2 of this document. Bytes 128-255 are where the information about the Application Codes and choices are stored in the module.

5.2.1 ApplicationSelect Table (AST) Contents

Each application that a module can support has an Application Code chosen from SFF-8089. Per SFF-8089, each Application Code consists of a category and a variant within the category - 5 bits are assigned for category definition and 8 bits for variant definition. Thus, 8192 (2^{13}) possible Application Codes are allowed. However, any given transceiver can only support up to 63 different Application Codes, as limited by space in the A0h page. When written into the AST, 3 additional bits are appended to each Application Code to define HW control (see below).

Data addresses 128-255 in A0h page define the ApplicationSelect Table (AST).

Table 6. Application Select Table (AST)

A0h Data Address	Bit range	Name of Field	Description
128	{7:0}	CC_APPS	Check code for the AST; the check code shall be the low order 8 bits of the sum of the contents of all the bytes from byte 129 to byte 255, inclusive.
129	{7:6}	Reserved	
129	{5:0}	AST Table Length, TL	A 6-bit binary number, TL, that specifies how many application table entries are defined in bytes 130-255 addresses. TL is valid between 0 (1 entry) and 62 (for a total of 63 entries).
130, 131	{7:0};{7:0}	Application Code 0	Definition of first application supported
And so on …..			
130+2*TL, 131+2*TL	{7:0};{7:0}	Application Code TL	Definition of TL^{th} application supported where $0 \leq TL \leq 62$

5.2.2 Application Code Structure for the AST

The structure or format for each Application Code within the AST (starting at Byte 130) is as follows. Note that 3 bits for HW control are appended to the Application Code from SFF-8089 when written into the AST.

Table 7. AST Application Code Structure

Low-Byte Address								High-Byte Address							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
HWS	AS<1:0>		CATEGORY					VARIANT							

Description:

HWS: Hardware Select: HWS=1, defines that the table entry is selectable via the hardware interface. HWS=0, defines that the table entry is not selectable via the hardware interface.

AS<1:0>: The state of the hardware bits AS1 and AS0 that a host must assert to select this application entry as the operating mode of the transceiver. Ignored if HWS=0.

CATEGORY: The category (e.g. FC, GbE, SONET, etc) of the application entry. See SFF-8089 for entry options.

VARIANT: The variant (e.g., 1xLW, 2xLW, 4xLW, etc) of the application. See SFF-8089 for entry options.

5.2.3 Backward compatibility of AS<1:0> settings

To support the full behavior of ApplicationSelect modules in legacy hosts (i.e., AS1 is inactive or asserted low), the application grouping and operation associated with AS<1:0>, if used, must be backward compatible with RateSelect and Extended RateSelect. That is, where the applications supported by AS<1:0> include, as a subset, a grouping defined in the original RateSelect (INF-8074) or the new Extended RateSelect (Part 1 of SFF-8079), the grouping and operation of AS<1:0> must be backward compatible with those definitions. For example:

Table 8. Example AS<1:0> Settings for Backward Compatibility Requirement

Application	AS1	AS0	Comment
1G FC	0	0	Per INF-8074: AS0 matches rate_select=LOW definition, AS1 matches VeeR definition
2G FC	0	1	Per INF-8074: AS0 matches rate_select=HIGH definition, AS1 matches VeeR definition
4G FC	*	1	Per SFF-8079: AS0 matches rate_select=HIGH in Extended RateSelect for 1G/2G/4G FC; *module must function at 4G with AS1 Low per Extended RateSelect for 1G/2G/4G FC, but may optimize 4G performance with AS1 High
8G FC	1	0	Remaining unique value set for AS0 and AS1 to select 8G FC performance; impossible state in legacy host, but legacy host will not operate at this speed anyway; 8G host should not assert this state with a legacy module

For this particular example, AS<1:0> should control only the receiver (typically bandwidth). Specifically, to operate with Fibre Channel automatic speed negotiation, where transmitter and receiver speeds are independent, control of AS<1:0> from the host must be slaved with the receiver date rate. It is assumed that transmitter control is not required for this example.

5.3 A2h Page Memory Utilization and Rationale

SFP transceiver modules that are SFF-8472 compliant have a A2h page that is used for software control by the host. The following new definitions modify the data addresses reserved in INF-8074 and SFF-8472:

Table 9. New Definitions in A2h Page (read/write, volatile)

Page	Data Address	Bit range	Description
A2h	110	5	AS1 state, written by module
A2h	111	{7:0}	ApplicationSelect Mode & Control, written by host

5.3.1 A2h memory Description

Table 10. Memory Description of the A2h Page

Data Address	Bits	Name of Field	Description
110	5	AS1 state	Digital state of the AS1 input pin (HW pin #9). Updated within 100 ms of change of pin.
110	4	rate_select state/AS0 state	Digital state of the rate_select input pin (HW pin #7). Renamed as AS0 in this document. Updated within 100 ms of change of pin.
111	{7:6}	Control Mode	ApplicationSelect Control Mode
111	{5:0}	Table Select, TS	For soft_application_select. A 6-bit binary number, TS, that represents the sequence of an Application Code in the AST. Written by the host to select module behavior.

5.3.2 Control Mode and Table Select

The Control Mode and Table Select fields are set by the host by writing into A2h page, byte 111, as shown below.

Table 11. Detailed Description of A2h, Byte 111

A2h Page Data Address 111							
7	6	5	4	3	2	1	0
Control Mode		Table Select, TS					

Description:

Control Mode: Defines the ApplicationSelect control mode.

Table Select: Selects module behavior from the AST among 63 possibilities (000000 …… 111110). Note that (111111) is invalid.

5.3.2.1 Detailed Description of Control Mode

Table 12. Description of Control Mode (A2h page, Byte 111{7:6})

Bit 7	Bit 6	Function	HW Control	A2h 110{3} Control	A2h 111{5:0} TS Control	Timing requirements
0	0	RateSelect or Extended RateSelect emulation mode	HW pin 7 has control; AS1 is ignored	A2h, byte 110{3} enabled per SFF-8472 Rev 9.3.	TS field is ignored	HW timing, if used, shall be in agreement with INF-8074. SW timing, if used, shall be in agreement with SFF-8472.
0	1	HW application select mode	Both AS0 and AS1 have control	A2h, byte 110{3} ignored	TS field is ignored	Time from edge of AS<1:0> input until the module is in conformance with the appropriate specification shall be within 1 msec.
1	x	SW application select mode	Both AS0 and AS1 are ignored	A2h, byte 110{3} ignored	TS field is has control	Time from writing into byte 111 until the module is in conformance with the appropriate specification shall be within 100 msec.

5.3.2.2 Detailed Description of Table Select (soft_application_select)

The module’s AST lists the applications it can support. The host can read from the AST, calculate and write back a sequence code, TS, into address A2h, byte 111, bits {5:0} to choose the desired operating behavior for the module.

TS is a binary number that represents the sequence of the desired Application Code in the AST. TS is valid when between 0 and the value of TL and is calculated as (starting_memory_location – 130)/2. If TS > TL, then the module responds as if TS=0.

Mode and Table Select (A2h, byte 111), as is legacy soft_rate_select (A2h, byte 110, bit 3), are volatile memory locations and revert to factory defaults when module power is cycled. Default values are vendor specific.

Note that the timing specifications for soft_application_select do not satisfy the automatic speed negotiation timing requirements for Fibre Channel.

6.0 Notes

At the writing of this document, the following important notes are given:

i. In FC-PI-2, 4.25 Gb/s Fibre Channel requires that the maximum voltage out of the module’s receiver shall not exceed 1600 mV pk-pk, differential. For this data rate, the 1600 mV requirement shall take priority over the 2000 mV specification in INF-8074.

ii. If registers are not defined in SFF-8079, they are beyond the scope of SFF-8079, and the vendor must use them either per the instructions of other compatible documents (such as INF-8074 and SFF-8472) or at his/her own risk.

iii. SFF-8079 does not independently control both Tx and Rx applications, such as required for automatic speed negotiation in Fibre Channel. If independence is required, only the receiver (or transmitter) must be associated with SFF-8079 control, and the industry optical/electrical specifications must have adequate overlap of specifications for the module’s transmitter (or receiver) to intersect them without control.

iv. For future application selection (e.g., speed negotiation) algorithms, it is recommended that allowed switching times be longer to enable 2-wire interface switching such as soft_rate_select and soft_application_select. It is also recommended that independent transmitter and receiver controls are not required.