

## The major interfaces in Digital TV

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For years, people have been talking about broadcast and computer worlds convergence. Seems like it is coming now : broadcast professionals use PC equipments for production, editing, automation ; data networks contribute to broadcast distribution and transmission ; computer networks are seized to accept bit rates as required by digital TV contents ; audio/video file servers are used for on-demand programmes ; voice/data/TV services are delivered to end customers on a single pipe, even listed on the same bill at the end of the month !!...

However, things must be clear : convergence is coming from both market AND technological side. Market drives the technical options adopted by both equipment designers and users. Among them are the Telcos, cable and other operators who want to keep their existing infrastructure, address more and more users and provide them with enhanced services. This leads to the combination of technologies coming from different worlds, and we are at the stage, now, where the frontier between computer and broadcast worlds is less and less straightforward. This leads to some uniformization of their carrying media, i.e. to the coming together of interfaces implemented on equipments that have to interwork.

While typical interfaces conveying MPEG2 or video data in the Digital TV field are based on serial (ASI, SDI...) or parallel (SPI...) formats, computer world uses to exchange multimedia data on more protocol oriented interfaces like Ethernet,

IEEE1394 or USB networks. Convergence smoothly makes all these standards interoperate by the means of appropriate interfaces, converters or bridges. To ease the move, present paper provides an overview on the major data formats co-existing in the digital TV field today (head-ends, studios, equipment manufacturers' labs or customer premises), either used to carry baseband MPEG data or digital video.

Of course, following list is not exhaustive, and only describes those of the most commonly used interfaces. More information (on interfaces, modulation schemes...) are available to the enclosed links or standards references.

Basically, MPEG2 baseband interfaces are designed to carry transport streams either in a synchronous or an asynchronous way. Synchronous way implies that data are transported at a constant rate (one byte sent out periodically), while asynchronous way is more flexible in terms of instantaneous data rate (data is transferred at any rate, up to the total bandwidth available). On top of data repartition within available bandwidth, some MPEG2 interfaces carry data as bit serial stream (serial interface), or as parallel 8-bit stream (parallel interface). Let us start with the most famous interface : ASI.

## **DVB-ASI**

Asynchronous Serial Interface was specified by DVB, dedicated at conveying bit serial MPEG2 transport streams over long distances, high noise tolerant (typically for satellite applications, for example). Using a 75 ohms coaxial cable, ASI standard allows to interconnect two devices more than 100 meters far from each other, with data rate up to 214 Mbps (line transmission rate of 270 Mbps with 8B/10B data encoding).

Two functional modes of ASI do exist : burst mode, or continuous mode. In burst mode (also called packet mode), a complete MPEG2 packet can be sent at maximum rate (214 Mbps), then transfer is paused until the next packet of data is ready to be transmitted. In continuous mode (also called byte mode), data bytes are spread out evenly in time, leading to an instantaneous data rate approaching the average data rate. ASI interface is widely used by broadcasting professionals, since it combines cost effective and easy to use cabling, and large bandwidth.

## **M2S**

Very close to ASI format, M2S is a Divicom™ (now Harmonic™) proprietary asynchronous serial interface that was designed before any interface was standardized by DVB. It uses 50 ohm mini-coax connectors cable (SMA connector for input, SMB for output), transmitting MPEG data at a rate of 100 Mbps over 25 meters distance.

## **DVB-SPI**

Synchronous Parallel Interface, standardized by DVB, conveys byte serial MPEG transport stream.

Based on its electrical interface nature, this parallel interface has either LVDS, TTL or ECL label. SPI transports data at rates up to 108 Mbps over a parallel 25 pins cable, and a drawback of SPI is that short distances only can be reached (no more than a dozen of meters).

## **M2P**

M2P parallel synchronous interface was developed by Divicom before DVB issued a standard for transmitting MPEG2 streams. It is very close to the SPI interface, and additionally made provision for an external clock synchronization.

## **RS-422**

RS-422 is a general purpose serial interface, approved by the Electronic Industries Association (EIA), that still is implemented by some manufacturers (NDS™, Tandberg™) to exchange MPEG2 data. RS422 is the standard differential synchronous serial interface, uses a 15 pins connector cable, and can support up to 18 Mbps data rate over short distances.

## **SMPTE-310 / DVB-SSI**

Synchronous serial interface (DVB-SSI) was designed for unidirectional short connections between the service multiplexer and the RF transmitter input. It supports data rate up to 40 Mbps and is also compliant to SMPTE-310.

SMPTE-310 interface is dedicated to point to point applications in low-noise environments, and its delicate design uses accurately controlled

clocks. The standard only supports two data rates : 19.39 Mbps to match 8-VSB modulation scheme, 38.78 Mbps to feed 16-VSB modulators. SMPTE 310M specifies a 75 ohm coaxial cable with BNC connectors for interconnections, and stands with a hundred meters of cable. Television head end equipment will use the SMPTE 310M interface to carry digital broadcast signal between multiplexers, encoders, decoders, and ATSC modulators.

## **SDI**

The Serial Digital Interface transmits uncompressed digital video between equipment in studio and pro-video applications (devices separated by more than 300 meters over coax cable). Around SDI, there exist many related SMPTE and ITU standards describing video transportation standards, and methods to carry audio or other data during blank intervals of video stream (which eliminates the need for a separate audio interface and additional control signals). SDI maximum data rate is 270 Mbps (electrically similar to ASI but uses a different channel coding). Also known as ANSI/SMPTE 259M or ITU-R BT.656, SDI is used in broadcasting chain to connect digital cameras to MPEG encoders, to VTRs, video servers, editing stations...

## **DHEI**

The Digital Headend Expansion Interface is a synchronous serial ECL interface, formerly proposed by General Instrument™ (now Motorola™), then adopted by Society of Cable Telecommunications Engineers (SCTE). DHEI

comes in two versions : DHEI's simplex version is a unidirectional point to point link between broadcast equipments (DB-9 connector). Less popular, the duplex version handles a bi-directional synchronous link (DB-15 connector).

Maximum achievable data rate is 40 Mbps over a few meters of cable length.

## **IEEE1394**

Also called FireWire™, or i.Link™, IEEE1394 is a fast serial bus that supports data transfers rates of up to 400 Mbps with a maximum cable length of 4.5 meters between devices (IEEE1394-1995). It is the leader interface for consumer electronics and AV peripherals, and now is well settled in professional broadcasting applications. IEEE1394 supports peer to peer exchange (no computer required), hot plugging, flexible bus architecture (no hub needed, free-formed connections with mixing branches and daisychains).

On top of these functionalities, FireWire supports both asynchronous and isochronous data transfers, with guaranteed delivery of time-critical data. Keeping in mind that standardization of 800Mbps, 1.6 and 3.2 Gbps (over hundred meters) is ongoing with IEEE1394b, this interface is the promising candidate for a discontinuous use by broadcasting professionals.

ENENSYS Technologies proposes a complete range of interface converters, adapting data from one format to another. This line of products fully leverages the diversity of industry standards by enabling all broadcasting devices to interwork while extending life of expensive equipments.

All existing interfaces have their own history and reason to be : it must be taken advantage of each of these in their precise field of application - and open them to new technologies in order to protect recurring investments.

Interconnecting two devices with different interfaces must not be an obstacle or a trigger-to-replace one out of the two devices ! Operating expenses should not suddenly increase each time a brand new device is added to the broadcasting chain. ENENSYS Technologies' products line makes the link between disparate interfaces used in legacy devices, in current broadcasting equipments, and emerging interfaces embedded in forthcoming products.

## **GLOSSARY**

ASI : Asynchronous Serial Interface (*EN50083-9 , DVB document A10 rev 1.0*).

ATSC : Advanced Television Systems Committee (<http://www.atsc.org>).

DHEI : Digital Headend Expansion Interface (*SCTE/DVS110 Cable Headend and Distribution systems*).

DVB : Digital Video Broadcasting (<http://www.dvb.org>).

EIA : Electronic Industries Alliance (<http://www.eia.org>).

IEC : International Electrotechnical Commission (<http://www.iec.ch>).

### **ENENSYS Technologies**

2 rue Châtaigneraie  
Rennes Atalante  
35510 Cesson Sévigné  
FRANCE

Office (+33) 2 99 12 79 06  
Fax (+33) 2 99 12 xx xx  
[contact@enensys.com](mailto:contact@enensys.com)  
[www.enensys.com](http://www.enensys.com)

IEEE : Institute of Electrical and Electronic Engineers (<http://www.ieee.org>).

IEEE1394, FireWire : <http://www.1394ta.com>.

ISO : International Organization for Standardization (<http://www.iso.org>).

ITU :International Telecommunication Union (<http://www.itu.int>)

LVDS : Low Voltage Differential Swing.

M2P : MPEG2 Parallel (*Application Note: 0001, September 1999*).

M2S : MPEG2 Serial (*Application Note: 0002, September 1999*).

MPEG : Moving Picture Experts Group (joint group of ISO and IEC: <http://www.mpeg.org>).

SCTE : Society of Cable Telecommunications Engineers (<http://www.scte.org>).

SDI : Synchronous Digital Interface (*ITU-R BT.656 or SMPTE 259M*).

SMPTÉ : Society of Motion Picture Television Engineers (<http://www.smpte.org>).

SPI : Synchronous Parallel Interface (*EN50083-9*).

SSI : Synchronous Serial Interface (*EN50083-9*).

USB : Universal Serial Bus (<http://www.usb.org>).

VSB : Vestigial Side Band modulation (8-VSB= 8-level vestigial side band).