



Synchronization in (telecom) networks is the process of aligning the time scales of transmission and switching equipment so equipment operations occur at the correct time and in the correct order. Synchronization requires the receiver clock to acquire and track the periodic timing information in a transmitted signal.

The transmitted signal consists of data that is clocked out at a rate determined by the transmitter clock. Signal transitions between zero and peak values contain the clocking information and detecting these transitions allows the clock to be recovered at the receiver. The recovered clock is used to write the received data into a buffer, also called elastic store or circular shift register, to reduce jitter. The data is then read out of the buffer onto a digital bus for further multiplexing or switching.

### Synchronization Standards

Within the synchronization architecture a vast number of standards have been defined.

- ITU standards for SONET/SDH/OTN
- IEEE1588 standard for PTP ToD synchronization
- ITU-T G.826x for frequency synchronization
- ITU-T G.827x for Time of Day synchronization

### Synchronization in AimValley

Synchronization is a fundamental technology building block within AimValley for many years already. Practically every service provider network requires it. Not because networks require the synchronization but mainly to provide, at the edge of the network, a frequency or phase/ToD synchronization signal to end customers.

The performance of the traditional wired T1/E1, SONET, and SDH networks are based upon constrained clock control theory and PLL design and deliver a frequency synchronization to the edge of the network. Also Circuit Emulated Services (CES) require frequency synchronization at the edge of the network to recover the emulated service via Differential Clock Recovery (DCR) methods.

In today's networks end-equipment, like 4G and 5G base stations, require Time of Day (ToD) synchronization which allows to synchronize all base-stations to a common wall-clock. Also standards like Audio Video Bridging (AVB) and Time Sensitive Networking (TSN) require ToD synchronization at the edge of the network to overcome Packet Delay Variation (PDV) and recover signals based on a provisioned "presentation time".

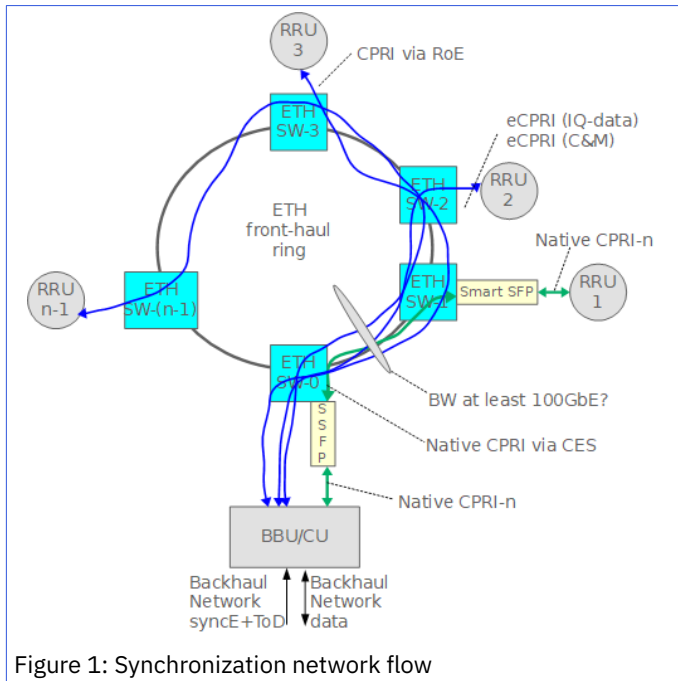


Figure 1: Synchronization network flow

The synchronization signal is disciplined by electronic circuits to provide the frequency accuracy, stability, phase movement control, wander filtering and edge jitter (phase noise) levels specified in volumes of various standards documents. Each “end customer service” has a specific set of performance requirements detailed in these documents. This performance is defined by the various international standards bodies and is well understood.

### AimValley Synchronization Expertise

AimValley provides a wide range of expertise regarding synchronization. From helping you to interpret and understand the various Standards, to architectural support for:

- setting up the sync architecture requirements
- review an existing architecture
- define and calculate PLL bandwidth
- bring up and measurements
- interpretation of the measurements

AimValley KeyNote Speaker on Sync Conferences  
ITSF 2014, ITSF 2015, WSTS 2015

## Synchronization in SONET/SDH/CES/CEP transmission technologies

### Legacy Technologies

- Timing Architecture of various systems
- Core ASICs used in various systems

### Current Technologies

- SEC/Stratum-3 built into AimValley ASICs (Maximux, Matterhorn)
- IP blocks with Circuit Emulation Services (FPGA)
- Smart SFPs with Circuit Emulation Services (E1, DS1, 155Mb/s, 622Mb/s and 2488Mb/s)
- Circuit Emulation over Packet of CPRI and video signals

## Synchronization in Ethernet Switches

### Architecture and implementation of products

- EEC-1/EEC-2 clocks
- SyncE
- IEEE1588 TC, BC, BMC, etc.
- Calculation of PLL Bandwidth for Synchronization function.

## Synchronization in Audio Video Bridging (AVB) and Time Sensitive Networking (TSN)

Various specific standards apply to Audio Video Bridging and Time Sensitive Networking.

- **Standard 802.1AS**, new revision, p802.1AS-rev. Definition of the gPTP implementation (profile of IEEE1588-2008). gPTP is a protocol which allows to distribute Time of Day (ToD) through a network and defines if a network is AVB capable (together with SRP).
- **Standard 802.1Qat**, new revision, 802.1Qcc. Definition of Stream Reservation Protocol (SRP), which will become amendment 14 of IEEE802.1Q
- **Standard 802.1Qav** has 2 new revisions; 802.1Qbu and 802.1Qbv. Definition of forwarding and queuing traffic for Time Sensitive Networks, which will become amendment 12 of IEEE802.1Q

## Why AimValley?

AimValley is a reliable provider of synchronization technology since 2003, delivering solutions for:

- High speed data processing applications
- Complex FPGA-based accelerated systems
- High speed, low power hardware equipment
- Robust embedded software
- Early adopter of Acceleration Technology

AimValley understands the full complexities as well as the subtle nuances of designing great edge solutions. We excel in building complex systems that are part of your product in the fields of Industry 4.0, Big Data, Healthcare and Transportation markets. Our combined skills represent all the important aspects required for the development of end-to-end systems.

Our customers enjoy the benefits of working with a strong team with more than 2 000 years engineering experience. AimValley is a trusted partner of Tier 1 customers in Telecom and Industrial markets and has shipped more than 100 000 products.

## Quality Focus

- Outstanding track record of on-time delivery
- Best in Class Designs – Time, Budget & Quality
- ISO9001, ISO140001, EcoVadis Platinum CSR