stc

Reference Offer (RO)

Annex C, Attachment 5
stc Synchronisation Scheme

Version number :	Final Version
Version date :	Oct. 2025
Date of original Issue:	10th December 2018
Authority for issue :	GM, Commercial Regulation

Document History & Version Control Record

Name of document	Annex C, Attachment 5 Network Synchronisation Scheme
Author	Director, Regulatory WBU
Authorised Officer	GM, Commercial Regulation
Description of document	Contains information about Synchronisation Scheme
Approved by	CST

Version No.	Version Date	Authorised Officer	Amendment Details
1.0	December, 2018	GM, Regulatory Affairs	
2.0	March, 2020	GM, Commercial Regulation	
3.0	January, 2022	GM, Commercial Regulation	
4.0	November, 2022	GM, Commercial Regulation	
5.0	October, 2025	GM, Commercial Regulation	

Table Of Contents

1 **General**

1.1 This description outlines the requirements for the timing devices used in synchronisation that operates according to the principles governed by Synchronous Digital Hierarchy (SDH).

1.2 The synchronisation network includes active and standby rimary eference locks (PRCs) of Stratum 1 accuracy, and a number of slave clocks (Stratum 2 & 3 clocks). The structure of the synchronisation network will comply with the ITU-T recommendation G 803 section 8.

1.3 Stratum 3 clocks will derive their timing via a 2048 kbit/s link from one of the higher accuracy clocks.

1.4 The Stratum 4 clocks constitute the lowest level in the synchronisation network. Stratum 4 clocks are not to be used as the timing reference for SDH equipment.

1.5 The Stratum levels Specifications. (ANSI & Bellcore)

Clock category	Clock Accuracy	Holdover Accuracy/day	Pull-in Range
Stratum 1	1.0×10^{-11}	N/A	N/A
Stratum 2	1.6×10^{-8}	1.0×10^{-10}	1.6×10^{-8}
Stratum 3	4.6×10^{-6}	3.7×10^{-7}	4.6×10^{-6}
Stratum 4	3.2×10^{-5}	N/A	3.2×10^{-5}

2 **Definitions & Terminology**

2.1 **The following terms are used in this section to specify the requirements for network synchronisation:**

a) Network Synchronisation

A generic concept that depicts the way of distributing a common time and/or frequency to all elements in a network.

b) Primary Reference Clock (PRC)

A reference frequency standard that provides a timing signal of high long-term frequency stability complaint with Recommendation G.811 (Stratum 1) and with verification to Universal Time Coordinated (UTC).

c) Global Positioning System (GPS)

System using a number of satellites circling the earth, used to derive a highly accurate timing source of PRC quality.

d) Slave clock

A clock whose timing output is phase-locked to the timing signal received from a higher accuracy clock.

e) Synchronisation Supply Unit (SSU)

A logic function for frequency reference selection, processing and distribution, having the frequency characteristics given in ITU-T recommendation G.812.

f) Clock Distribution Unit (CDU)

A logic function for frequency reference selection, its distribution having the frequency characteristics given in ITU-T recommendation G.812.

g) Synchronisation Traceability

A series of synchronisation elements and synchronisation trails, normally within a single SDH equipment domain.

h) Free Running Mode

An operation condition of a clock without external control, the output signal of which is strongly influenced by the stability of the internal oscillator.

i) Holdover Mode

An operating condition of a clock which has lost its controlling reference input and is using stored data, acquired while in locked operation, to control its output.

j) Locked Mode

An operating condition of a slave clock when the output signal is controlled by an external input reference such that the clock's output signal has the same long-term average frequency as the input reference.

k) Maximum Time Interval Error (MTIE)

MTIE is the maximum peak-to-peak delay variation of a given timing signal with respect to an ideal timing signal within an observation period.

3 **Synchroniation Equipment**

3.1 **Primary Reference Clock**

3.1.1 The main **stc** (active) Primary Reference Clock (PRC) is located in Riyadh, with Time Interval Error (TIE) meter for performance monitoring. A Global Position System (GPS) receiver is used to compare the accuracy and phase shift with a Universal Time Coordinated (UTC) source.

3.1.2 The main PRC contains Cesium-beam oscillators Stratum 1.

3.1.3 The remaining devices of the PRC, which include power equipment, synthesizers, amplifiers and frequency comparators to derive the synchronising signal distribution, are duplicated.

3.1.4 The long-term frequency departure of the PRC clock (defined in ITU-T recommendation G.811, Section 2.1) is less than 1 x 10 -11 with reference to UTC.

3.1.5 The phase stability of the PRC complies with the requirements of G.811, Section 2 with respect to phase discontinuities, long-term phase variations and short-term phase variations. (The requirement is G.811 Section 2.2).

3.1.6 To achieve the required reliability, only one of the PRC Cesium-beam oscillators shall be used at any given time. The clock shall switch to an un-degraded oscillator before the maximum time interval error (MTIE) specification (G.811, Section 3) is exceeded, and provide appropriate indication.

3.1.7 The only planned maintenance activity shall be replacement of oscillators.

3.2 **Standby PRC**

3.2.1 A stand-by PRC is located in Jeddah.

3.2.2 The stand-by PRC shall be automatically selected by the SDH equipment in the event of a catastrophic failure of the PRC in Riyadh or interruption of the links distributing timing reference signals from the PRC.

3.3 **Slave Clocks**

3.3.1 Stratum 2 clocks shall, in general, be in compliance with ITU-T recommendation G.812.

3.3.2 The phase stability of a slave clock shall comply with G.812 Section 2 with respect to:

- Phase Discontinuity (Section 2.1)
- Long-term phase variation (Section 2.2)
- Short-term phase variation (Section 2.3)

3.3.3 The Slave clock chooses the incoming 2048 kbit/s clock source from which to synchronise according a pre-assigned ranking. The highest-ranking source shall normally be used.

3.3.4 In holdover operation, as defined in G.812 Section 2.2.3, the slave clocks maintain synchronism on 64 kbit/s timeslots in connections through an exchange according to the requirements of Q.541, and shall have a bit rate accuracy of at least 50 ppm.

3.3.5 The Slave clock SSU has remote access through management systems to the Transmission National Operation Central (TNOC)

3.3.6 The Slave clock shall be the timing signal source for the entire network.

4 Timing Interface

4.1 Reference timing input interface:

- 2048 kbit/s (ITU-T G. 703)
- STM-N interface (ITU-T G.707)

4.2 Reference timing output interface:

- 2048 kbit/s (ITU-T G. 703)
- STM-N interface (ITU-T G.707)

4.3 The SDH transmission network transports the clock signal within the network, and is used as the clock source in case there is no slave synchronisation equipment.

4.4 Generating, evaluation and processing of the Synchronisation Status Message (SSM). It is the S1 byte in ITU-T G. 707.

4.5 The output impedance should be 120 Ohm and 75 Ohm 9 pin connector (DB9).

4.6 The SDH elements should accept the external 2048 kHz interface-timing signal and 2048 kbit/s framed signal.

5 Network Equipment

5.1 Timing Mode

5.1.1 External timing mode is the first selection.

5.1.2 Tributary mode should be avoided for the PDH interface, unless it is retimed for the synchronisation signal.

5.2 Management System

5.2.1 The synchronisation equipment is managed and monitored, and any synchronisation faults shall be immediately reported by **stc** to the Other Licensed Operator.

6 Percision-Time-Protocol (PTP).

6.1 PTP was defined in the IEEE 1588 standard that describes a master-slave architecture for timing distribution across Ethernet / IP packet network.

6.2 The standard offers some key advantages to manufacturers and operators that can deploy PTP compliant equipment and avoid the cost of TDM and potential jamming, operational issues that come with deploying GPS receivers at every base station.

6.3 The Precision Time Protocol (PTP) is a protocol used to synchronize clocks throughout a computer network.

6.4 On a local area network, it achieves clock accuracy in the sub-microsecond range making it suitable for measurement and control systems.

6.5 PTP was originally defined in the IEEE 1588-2002 standard, officially entitled "Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems" and published in 2002, also known as PTP Version 2.

6.6 It improves accuracy, precision and robustness but is not backward compatible with the original 2002 version.

6.7 "IEEE 1588 is designed to fill a niche not well served by either of the two dominant protocols, NTP and GPS. IEEE 1588 is designed for local systems requiring accuracies beyond those attainable using NTP. It is also designed for applications that cannot bear the cost of a GPS receiver at each node, or for which GPS signals are inaccessible