SAUDI TELECOM COMPANY

Reference Interconnection Offer (RIO)

Annex C, Attachment 5

STC SYNCHRONISATION SCHEME

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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 Primary Reference Clocks (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 kHz/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 use as the timing reference for SDH equipment.

1.5   The Stratum levels Specs. (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

The following terms are used in this section to specify the requirements to 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 I) and with verification to Universal Time Coordinated (UTC).

c) Global Positioning System (GPS)

System using 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, 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 slave clock when the output signal is controlled by an external input reference such that the clock's output signal has same long-term average frequency as 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 SYNCHRONISATION 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 I.

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 1×10^{-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 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 kHz/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 kHz/s (ITU-T G. 703)
- STM-N interface (ITU-T G.707)

4.2   Reference timing output interface:

- 2048 kHz/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

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

5   NETWORK REQUIREMENT

5.1   Interconnection SDH Equipment

5.1.1   The SDH terminal equipment installed within the exchange offices for interconnection shall use the clock signal derived from the related digital cross connector or from transmission network.

5.2   Timing Mode

5.2.1   External timing mode is the first selection.

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

5.3   Management System

5.3.1   The synchronisation equipment is managed and monitored, and any synchronisation faults shall be immediately reported to the other side.