Server Time Protocol Overview and Planning Considerations

Presentation notes

- This presentation has been updated (October 2016) to remove most references to the IBM 9037 Sysplex Timer and Mixed-CTN configurations.

Introduction

- **Server Time Protocol (STP), a time synchronization facility for z Systems is designed to provide time synchronization for multiple IBM® servers, and is the follow-on to the Sysplex Timer (9037-002).**

- **This session will describe the**

  - **Key functional capabilities of STP**

  - **Configurations STP is designed to support**

  - **Hardware and software planning considerations required for implementing STP**

Statement of Direction (April 28, 2009)

- **The System z10 will be the last server to support connections to the Sysplex Timer® (9037).**

  – Servers that require time synchronization, such as to support a base or Parallel Sysplex, will require Server Time Protocol (STP). STP has been available since January 2007 and is offered on the System z10, System z9, and zSeries® 990 and 890 servers.

Agenda

- STP Overview

- Hardware Planning

- External Time Source (ETS) Planning

- Software Planning Overview

- Server Role Planning

- Operational Safeguards

- Additional Information

STP Overview

- Designed to provide the capability for multiple servers to maintain time synchronization with each other and form a Coordinated Timing Network (CTN)
  - CTN: a collection of servers that are time synchronized to a time value called Coordinated Server Time (CST)

- IBM Server-wide facility implemented in IBM z13, IBM z13s, IBM® zEnterprise™ EC12 (zEC12), IBM® zEnterprise™ BC12 (zBC12), IBM® zEnterprise™ 196 (z196), IBM® zEnterprise™ 114 (z114), IBM System z10™, IBM System z9™, IBM eServer™ zSeries® 990 (z990), zSeries 890 (z890) Licensed Internal Code (LIC)
  - Single view of "time" to PR/SM™
  - PR/SM can virtualize this view of time to the individual logical partitions (LPARs)

- Message based time synchronization protocol
  - Similar to Network Time Protocol (NTP) – an industry standard
  - Timekeeping information transmitted over Coupling Links supported by machine type.
    - ISC-3 links (Peer mode), ICB-3, ICB-4, PSIFB links and ICA SR.
  - NOT standard NTP

Key Attributes

- Designed to provide improved time synchronization, compared to Sysplex Timer®, for servers in a Sysplex or non-Sysplex configuration

- Can scale with distance
  - Generally, servers exchanging data over fast short links require more stringent synchronization than servers exchanging data over long distances

- Supports a multi-site timing network of up to 200 km over fiber optic cabling
  - Parallel Sysplex® cluster can span up to 200 km
  - RPQ 8P2263 required for distances greater than 100 km

- Potentially reduces the cross-site connectivity required for a multi-site Parallel Sysplex cluster
  - Dedicated links not required to transmit timekeeping information

- Allows
  - Automatic updates of DST offset based on time zone algorithm
  - Adjustment of CST up to +/- 60 seconds

Terminology

- **STP-capable server/CF**
  - z13, z13s, zEC12, zBC12, z196, z114, z10(EC or BC), z9(EC or BC), z990, z890 server/CF
    with STP LIC installed

- **STP-enabled server/CF**
  - STP-capable server/CF with STP Feature Code 1021 installed
  - STP panels at the HMC/SE can now be used

- **STP-configured server/CF**
  - STP-enabled server/CF with a CTN ID assigned
 - STP message exchanges can take place

- **CTN**
  - Collection of servers that are time synchronized to a time value called Coordinated Server Time (CST)

- **CTN ID**
  - Common identifier assigned to Servers / Coupling Facilities (CFs) that make up the same CTN

Terminology (continued)

- STP transmits timekeeping information in layers or Stratums
  - Stratum 1 (S1)
    - Highest level in the hierarchy of timing network that uses STP to synchronize to Coordinated Server Time (CST)
  - Stratum 2 (S2)
    - Server/Coupling Facility (CF) that uses STP messages to synchronize to Stratum 1
  - Stratum 3 (S3)
    - Server/Coupling Facility (CF) that uses STP messages to synchronize to Stratum 2
- STP supports configurations up to Stratum 3

Stratum 1

Stratum 2   Stratum 2

Stratum 3   Stratum 3
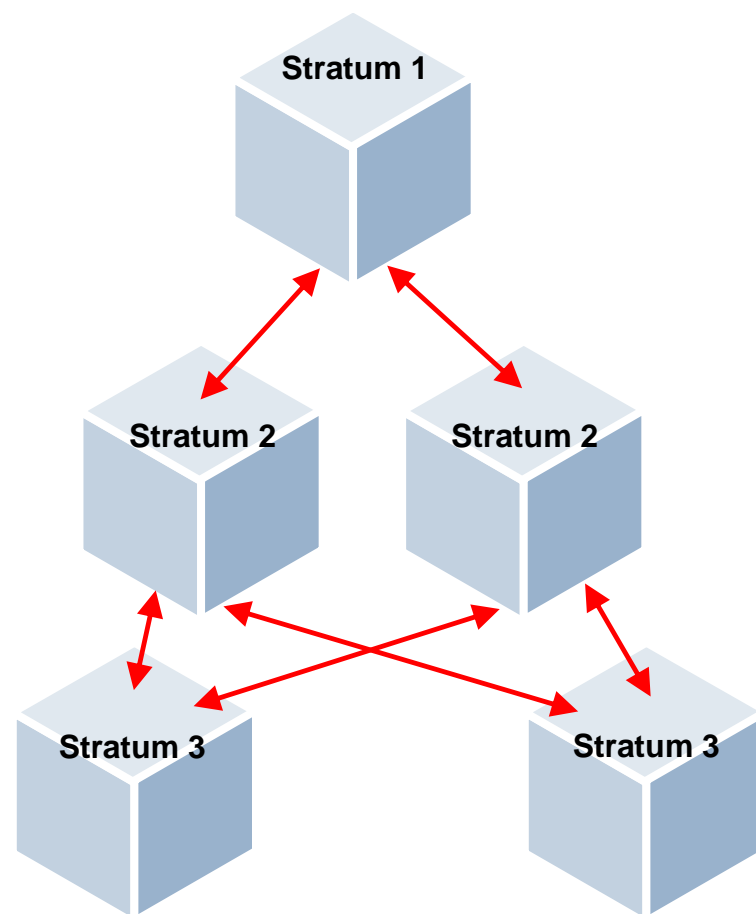
Configuration

- **STP-only CTN**
  - All servers/CFs synchronized with CST
  - Sysplex Timer is NOT required and not part of CTN
  - CTN ID format
    - STP network ID only (ETR network ID field has to be null)

Coordinated Timing Network ID (CTN ID)

- **The CTN ID is an identifier that is used to indicate whether the server has been configured to be part of a CTN. It identifies the CTN.**

- **The CTN ID is made up of two fields**

Timing Network	STP ID	ETR ID	CTN ID
None	Null	Null	
ETR	Null	ETR ID	*15*
Mixed	STP ID	ETR ID	*HMCTEST-15*
STP-Only	STP ID	Null	*HMCTEST*

STP Network ID

Eight characters (A-Z, a-z, 0-9, '-', and '_')

ETR Network ID

00-31

STP Network ID is case-sensitive

HMC4STP: System (Sysplex) Time - Microsoft Internet Explorer

System (Sysplex) Time

Timing Network | Network Configuration | ETR Configuration | ETR Status | STP Configuration | STP Status

Coordinated timing network ID [   ] - [15]

Apply

Refresh   Cancel   Help

STP-only CTN

- All servers/CF's in STP-only CTN have to be STP configured
  - 9037s no longer required and not part of STP-only CTN
- Server/CF roles
  - **Preferred Time Server/CF (PTS)**
    - Server that is preferred to be the S1 server
  - **Backup Time Server/CF (BTS)**
    - Role is to take over as the S1 under planned or unplanned outages, without disrupting synchronization capability of STP-only CTN
  - **Current Time Server/CF(CTS)**
    - S1 Server/CF
      - Only one S1 allowed
      - Only the PTS or BTS can be assigned as the CTS
      - Normally the PTS is assigned the role of CTS
  - **Arbiter**
    - Provides additional means to determine if BTS should take over as the CTS under unplanned outages

STP-only CTN (continued)

- HMC must be used to provide the following functions:
  - Initialize Coordinated Server Time (CST) manually
  - Initialize CST to an External Time Source (ETS)
  - Configure an External Time Source (ETS) to set CST accurately
  - Set Time Zone Offset, Daylight Saving Time Offset, Leap seconds Offset
  - Schedule and change Offsets (Daylight Saving, Leap seconds)
    - Automatic scheduling of Daylight Savings Time based on algorithm
  - Adjust time by up to +/- 60 seconds (currently 9037 allows 4.999 seconds)
  - Define, modify, view the STP-only CTN ID

STP-only CTN example

HMC

Ethernet
Switch

CTS (S1)
PTS

P1

S2
BTS

P2

S2

P3

S2
Arbiter

P4

CTN ID = STPCONFG
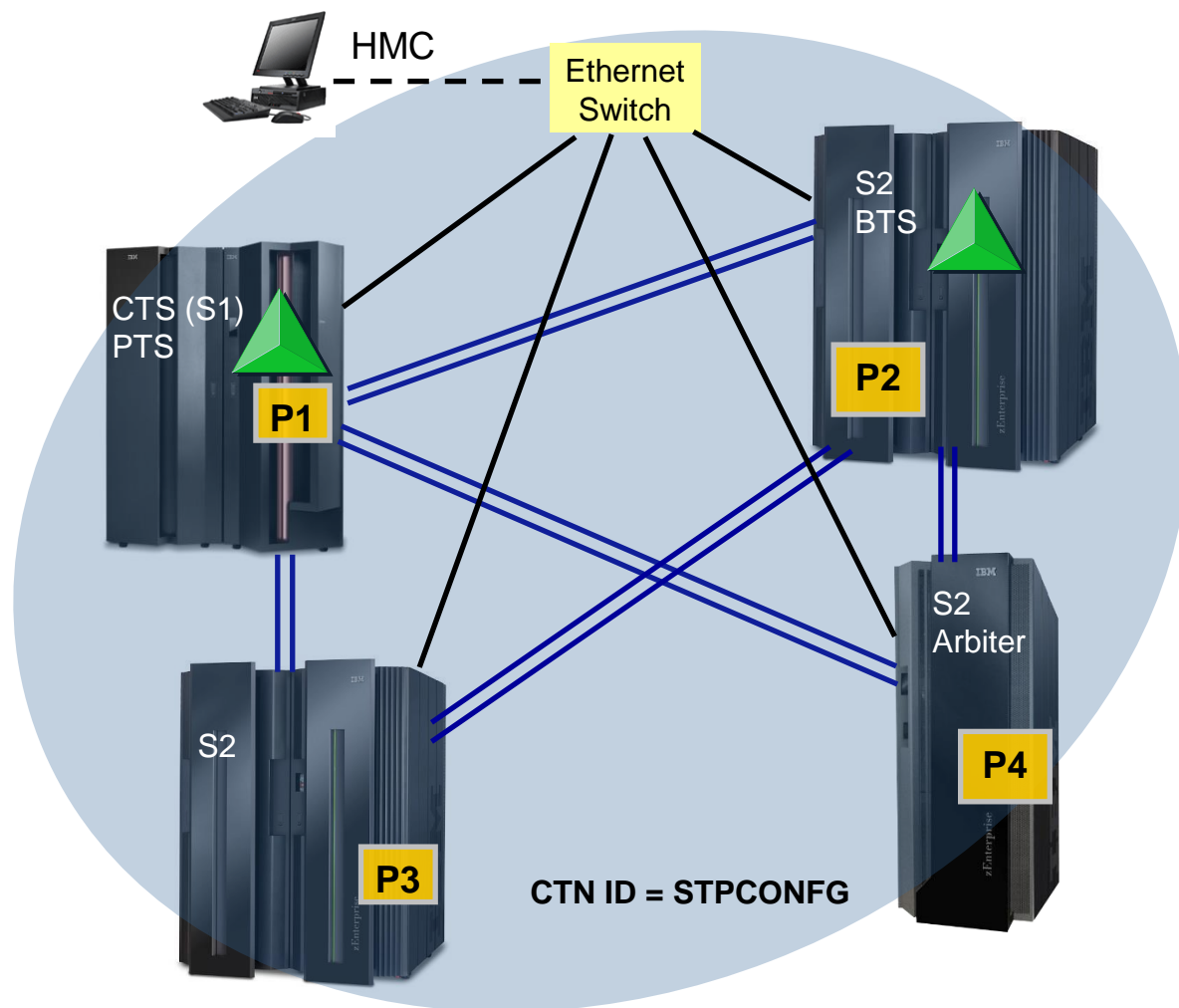
STP can use existing
Coupling links

- Configuration has to be defined
  - Must assign PTS and CTS
  - Optionally assign BTS
    - Strongly recommended to allow near-continuous availability
  - Optionally assign Arbiter
    - Recommended for configurations of 3 or more servers/CFs
    - Can improve recovery

P1, P2, P3, P4 – systems in a Parallel Sysplex

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Agenda

- STP Overview

- **Hardware Planning**

- External Time Source (ETS) Planning

- Software Planning Overview

- Server Role Planning

- Operational Safeguards

- Additional Information

Server/CF Hardware planning

- Concurrently install all of the latest MCLs for each driver
  - IBM z13 at Driver 27
  - IBM z13s at Driver 27
  - IBM® zEnterprise™ EC12 (zEC12) at Driver 15
  - IBM® zEnterprise™ BC12 (zBC12) at Driver 15
  - IBM® zEnterprise™ 196 (z196) at Driver 93
  - IBM® zEnterprise™ 114 (z114) at Driver 93
  - System z10 Driver level 79
  - System z9 server must be at EC Driver level 67L
  - z990 and z890 must be at EC Driver level 55K
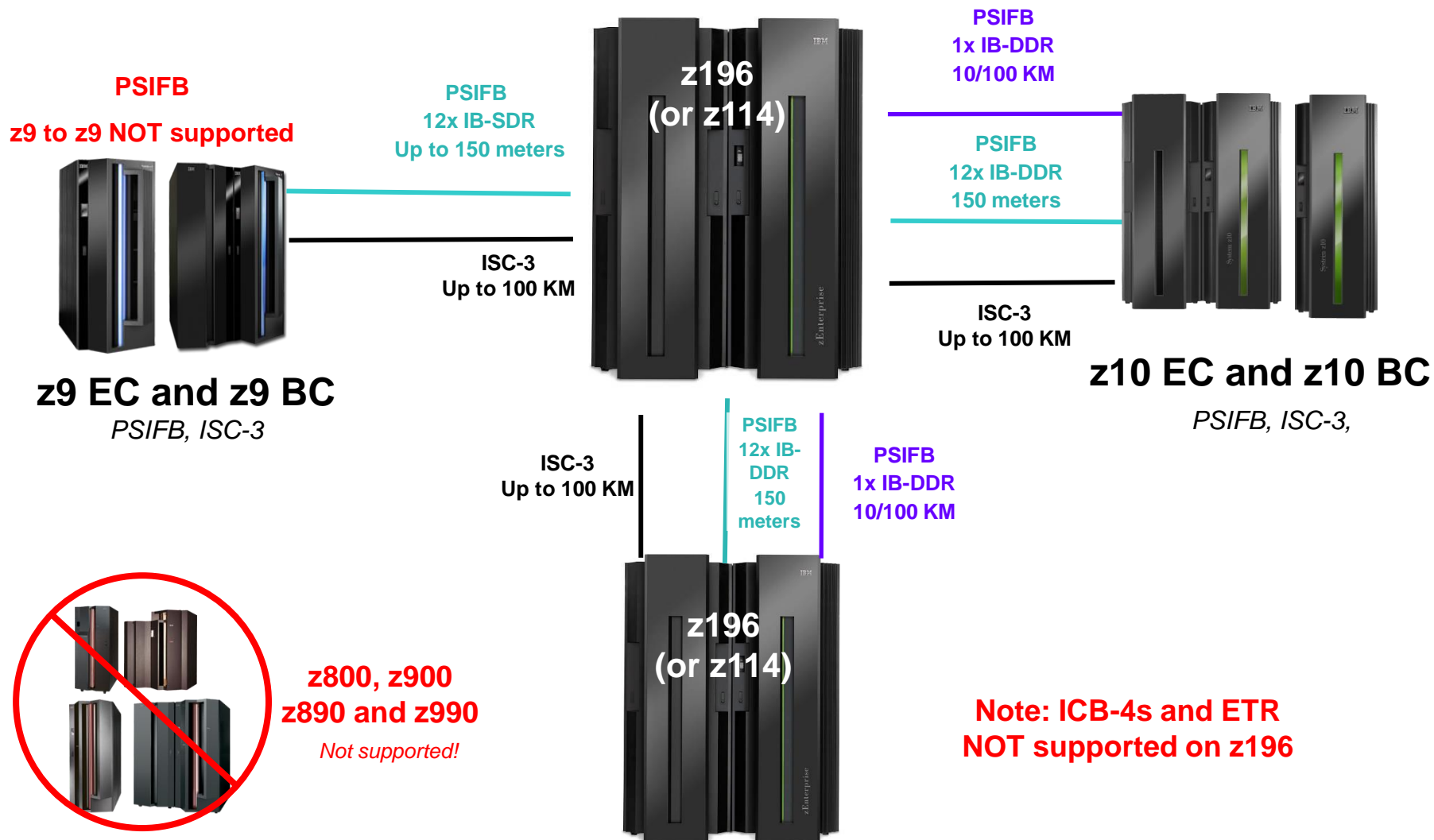- Concurrently install STP Enablement MCL (FC 1021)

Hardware Management Console (HMC) Planning

- HMC Application level must be equal or higher than the level of Support Element consoles it manages.

- All servers and CFs that need role assignment in the STP-only CTN be defined objects to any HMC used to manage the CTN.

- Strongly recommended that all servers and CFs in the STP-only CTN be defined objects to any HMC in order to have the capability for CTN reconfigurations

  - Useful after recovery

  - Even remote HMCs should define all servers and Coupling Facilities in the CTN.

- HMC used to

  - Dial out to External Time Source

  - Provide NTP server function

Coupling Link Planning

- **To transmit timing information, STP can choose any defined coupling link which is online between two z Systems servers**.
  - Transmit/receive Coupling Facility (CF) data
  - Transmit/receive Server Time Protocol (STP) timing information

- **Integrated Cluster Bus (ICB) copper links**
  - ICB-3 (FC 0993)
    - Link data rate of 1 Gigabyte per second (GBps)
    - Used to connect z9 EC, z9 BC, z990, z890, z900, z800 at a distance of 7 meters (m).
    - Not supported on z13, z13s, zEC12, zBC12, z196, z114, z10 EC or z10 BC
  - ICB-4 (FC 3393)
    - Link data rate of 2 GBps
    - Used to connect z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890 at a distance of 7 m.
    - Not supported on z13, z13s, zEC12, zBC12, z196, z114

- **Inter System Channel (ISC) fiber optic links**
  - ISC-3 (FCs 0217, 0218, 0219)
    - Link data rate of 2 Gigabits per second (Gbps)
    - Used to connect z196, z114, z10 EC, z10 BC, z9 EC, z9 BC, z990, and z890, z900, z800 at a distance of 10 kilometers (km) – unrepeated

- **Parallel Sysplex InfiniBand (PSIFB) fiber optic links**
  - 12x IB-DDR (z13, z13s, zEC12, zBC12, z196, z114 or z10 only FC 0163)
  - 12x IB-SDR (z9 to z196 or z10 FC 0167)
  - 1x IB-DDR (z13, z13s, zEC12, zBC12, z196, z114 or z10 to z196 or z10 only FC 0168) – for distance

- **Integrated Coupling Adapter Short Reach**
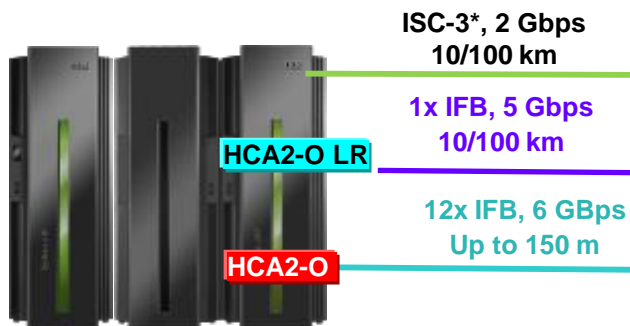 - ICA SR (z13 & z13s only)

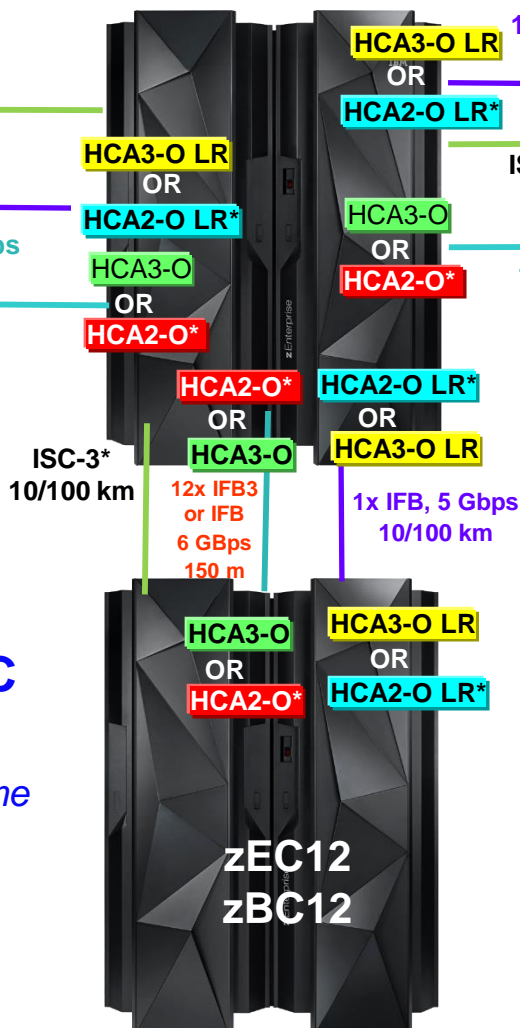# z196 Parallel Sysplex® coexistence of Servers/CFs and coupling connectivity

PSIFB
12x IB-SDR
Up to 150 meters

z196 (or z114)

PSIFB
1x IB-DDR
10/100 KM

PSIFB
12x IB-DDR
150 meters

PSIFB

z9 to z9 NOT supported

ISC-3
Up to 100 KM

ISC-3
Up to 100 KM

z9 EC and z9 BC

PSIFB, ISC-3

z10 EC and z10 BC

PSIFB, ISC-3,

ISC-3
Up to 100 KM

PSIFB
12x IB-DDR
150 meters

PSIFB
1x IB-DDR
10/100 KM

z196 (or z114)

z800, z900 z890 and z990
Not supported!

Note: ICB-4s and ETR NOT supported on z196

zEC12/zBC12 Parallel Sysplex Coupling Connectivity

z13 Parallel Sysplex Coupling Connectivity

z196 and z114

12x IFB, 12x IFB3, 1x IFB

z13

zEC12 and zBC12

12x IFB, 12x IFB3, 1x IFB

| HCA3-O LR | | 1x IFB, 5 Gbps 10/100 km | HCA3-O LR | | HCA3-O LR | 1x IFB, 5 Gbps 10/100 km | | HCA3-O LR |

HCA2-O LR

HCA2-O LR

| HCA3-O | | 12x IFB, 6 GBps Up to 150 m | HCA3-O | | HCA3-O | 12x IFB, 6 GBps Up to 150 m | | HCA3-O |

HCA2-O

HCA2-O

ICA SR

HCA3-O LR   HCA3-O

Integrated Coupling Adapter (ICA SR)

8 GBps, up to 150 m

z13 to z13 Connectivity ONLY

1x IFB

5 Gbps

10/100 km

12x IFB

6 GBps

Up to 150 m

HCA3-O LR   HCA3-O

ICA SR

z13

z10, z9 EC, z9 BC,

z890, z990

Not supported in same

Parallel Sysplex

or STP CTN with z13

IC (Internal Coupling Link):
Only supports IC-to-IC connectivity

HCA2-O and HCA2-O LR are NOT supported on z13 or
future High End z enterprises as Per SOD

ISC-3 is not supported on z13 even if I/O Drawer is Carried
Forward for FICON Express8

Note: The link data rates in GBps or Gbps, do not represent

the performance of the links. The actual performance is dependent

upon many factors including latency through the adapters, cable

lengths, and the type of workload.

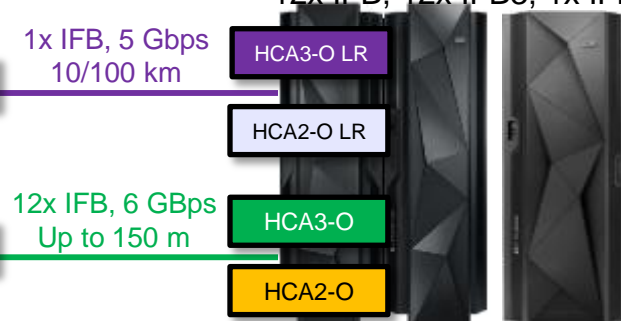# z13s and z13 GA2 Parallel Sysplex Coupling Connectivity
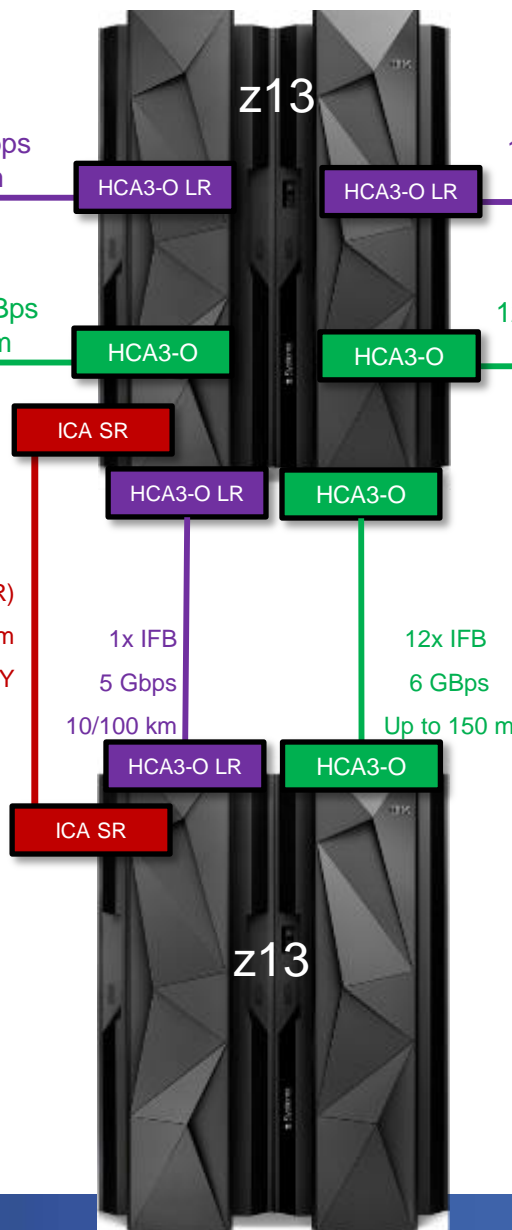
z196 and z114
12X IFB, 12X IFB3 & 1x IFB

zEC12 & zBC12
12 X IFB, 12x IFB3 & 1x IFB

1x IFB, 5 Gbps 10/100 km

| HCA3-O LR |
| HCA2-O LR |

HCA3-O LR

z13s

1x IFB, 5 Gbps 10/100 km

HCA3-O LR

| HCA3-O LR |
| HCA2-O LR |

| HCA3-O |
| HCA2-O |

HCA3-O

12x IFB/IFB3, 6 GBps Up to 150 m

HCA3-O

12x IFB/IFB3, 6 GBps Up to 150 m

| HCA3-O |
| HCA2-O |

NOTE: ICA-SR is z13 and z13s ONLY

| ICA-SR | HCA3-O | HCA3-O LR |

ICB over PCIe (ICB-P) PCIe Gen3 x8 8GBps, 150m

12x IFB3 6 GBps 150 m

1x IFB, 5 Gbps 10/100 km

| ICA-SR | HCA3-O | HCA3-O LR |

z10 EC, z10 BC, z9 EC, z9 BC
Not supported in same Parallel Sysplex or STP CTN with z13

z13

*HCA2-O, HCA2-O LR, & ISC-3 are **NOT** supported on z13, z13s or on future z Systems servers

Note: The InfiniBand link data rates do not represent the performance of the link. The actual performance is dependent upon many factors including latency through the adapters, cable lengths, and the type of workload.

IC (Internal Coupling Link):
No HW loopback exploitation.

Timing-only Links

HMC
S1 (CTS/PTS)
S2 (BTS)

P1
P2
P3
P4

S2
z10 BC, S3
z9 BC, S2 (Arbiter)

Timing-only Links
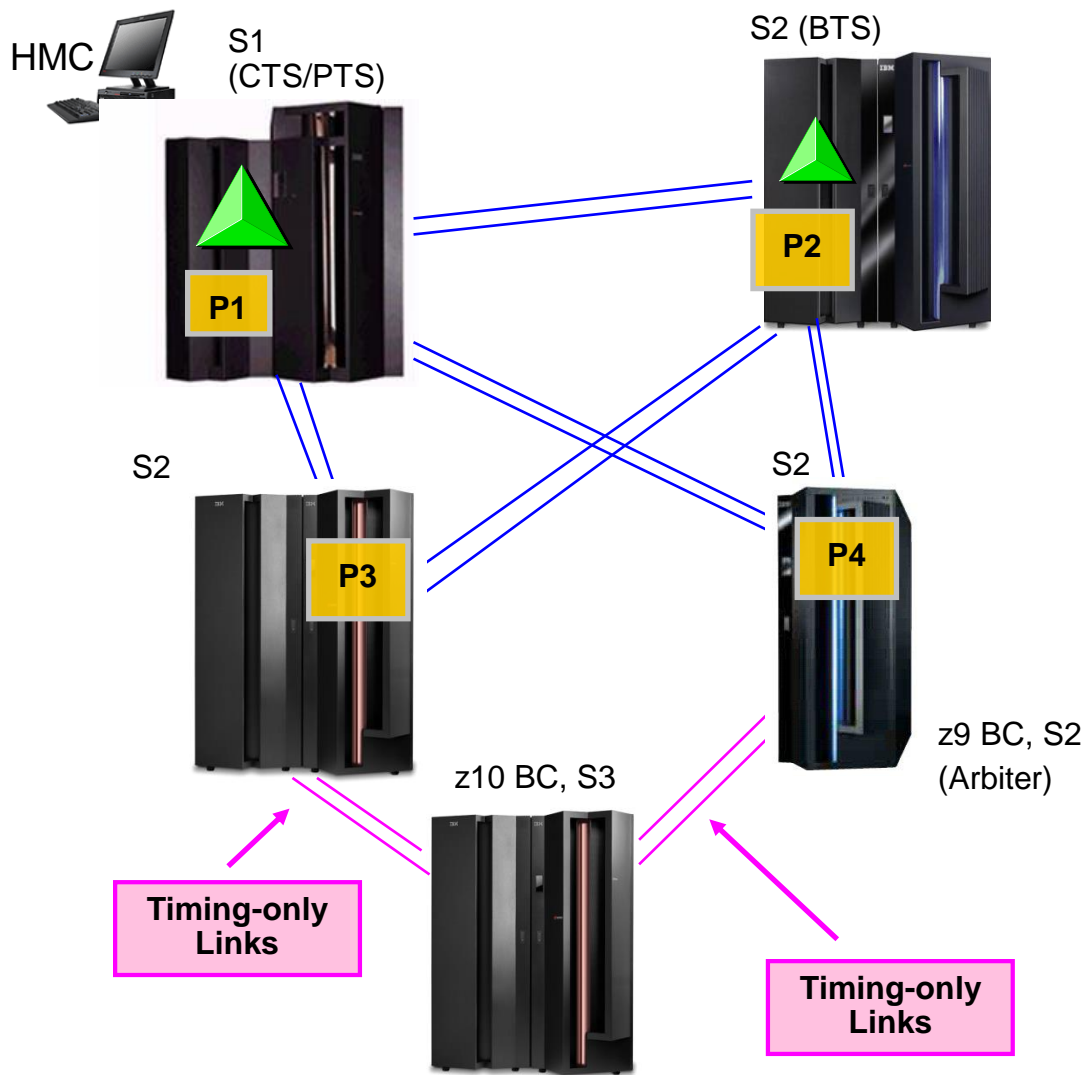
Timing-only Links

- Coupling links that allow two servers to be synchronized when a CF does not exist at either end of link
  - Typically required when servers requiring synchronization not in a Parallel Sysplex (for example XRC)
- HCD enhanced to define Timing-only links
- Can be defined in either Mixed CTN or STP-only CTN
- Timing-only links used to transmit STP messages only

May require purchase of additional CF links

P1, P2, P3, P4 – systems in a Parallel Sysplex

Hardware Configuration Dialog: Timing-only links

```
                Connect to CF Channel Path

Specify the following values.

Source processor ID.. . . . : SCZP901
Source channel subsystem ID  . : 0
Source channel path ID . . . . : 06
Source channel path type . . . : CFP

Destination processor ID . . . . . . SCZP101  +
Destination channel subsystem ID . . 0    +
Destination channel path ID  . . . . 02  +

Timing-only link . . . . . . . . . . Yes
```

Supported by HCD and HCM

- A timing-only link is established via HCD CF Channel Path Connectivity List panel

  – Like coupling links, timing-only links can be defined as dedicated, reconfigurable, shared, or spanned.

- The default for the *Timing-only link* field is **No**

  – If the user selects a timing-only link, HCD generates an STP control unit on each side of the connection, and no devices.

Note: The addition of timing-only links is fully supported by the Dynamic I/O Reconfiguration process so they can be added non-disruptively.

Hardware Configuration Dialog: Timing-only links

- **For a timing-only link, HCD performs the following checks:**

  - CHPIDs of a timing-only link must belong to different servers.

    - A timing-only link cannot be looped back into the same server.

  - If a CF connection already exists between two servers,

    - HCD does not allow defining a timing-only connection between these servers.

  - Also, if a timing-only link already exists between two servers, HCD will not allow defining a CF connection between these servers

Rule of thumb
  - If there is an ICF or CF at either end of the definition, define a coupling link in HCD
  - This will provide better positioning in case link needed for CF data in the future

Multi-Site Sysplex planning

- **IBM supports only those DWDM products qualified by IBM for use in multi-site sysplex applications, such as GDPS®**

- **The latest list of qualified DWDM vendor products can be found on the Resource Link™ Web site at:**

  - **https://www.ibm.com/servers/resourcelink/**

    - They are listed under the Hardware Products for Servers on the Library page

- **Plan for redundant, diverse fiber routes between sites to help avoid a single point of failure of the fiber trunk**

- **Please ensure that the vendor qualification document is <u>inspected carefully by a DWDM technical expert</u>.**

  - The document is written to be very specific (unit number, version number, applicable features that are qualified for STP). Time Division Multiplexing (TDM) may (or may not) be qualified, depending on the vendor.

Multi-Site Sysplex planning (continued)

- To transmit timing information, STP can choose any defined coupling link which is online between two z Systems servers.

- If coupling links are configured over DWDM equipment, *all* coupling links must use specific DWDM hardware (optical modules, transponders, TDM modules) with interface cards qualified by IBM for STP.
  - Cannot configure the links over a mixture of qualified and unqualified equipment,
  - STP may choose a coupling link configured over an unqualified connection.
  - May result in timing problems where servers may become unsynchronized without your knowledge.

- Only specific vendor models at specific releases have been qualified to TDM coupling links when used for STP message exchanges
  - **Example:** Cisco has a qualified 10G Muxponder module that is qualified for ISC-3 links when transferring CF data but **NOT QUALIFIED** for ISC-3 links when also exchanging STP messages

Selection of qualified DWDM

- **Selecting qualified WDM vendor does not mean that WDM model selected is qualified**

  – Vendors do not qualify all models

- **Selecting qualified WDM model does not mean that specific Release level is qualified**

  – Vendors do not qualify all release levels

- **Ensure that the vendor qualification letter is <u>inspected carefully by a DWDM technical expert</u>.**

  – Letter specifies model number, release level, interface modules qualified, protocols, application limitations, etc

Agenda

- STP Overview

- Hardware Planning

- **External Time Source (ETS) Planning**

- Software Planning Overview

- Server Role Planning

- Operational Safeguards

- Additional Information

External Time Source Options

- **Dial-out from HMC to time services (available on z196, z114, z10, z9, z990, z890)**
  - NIST Automated Computer Time Service (ACTS)
  - NRC Canadian Time Service (CTS)
  - IEN Telephone Date Code (CTD)
  - Scheduling of periodic dial-outs to time services so that CST can be gradually steered to time provided by dial-out time service
  - Time accuracy +/- 100 ms of time provided by dial-out time service
  - Modem support not available on the z13, z13s, zEC12/zBC12 (Driver 12 or higher HMC)

- **NTP server (available on z13, z13s, zEC12, zBC12, z196, z114, z10 and z9)**
  - Addresses the requirements of customers who want time accuracy across heterogeneous platforms (z Systems and non-z Systems)
  - Time accuracy +/- 100 ms of time provided by NTP server

- **NTP server with Pulse per second (PPS) output (available on z13, z13s, zEC12, zBC12, z196, z114, z10 and z9)**
  - Pulse per second (PPS) provides enhanced accuracy
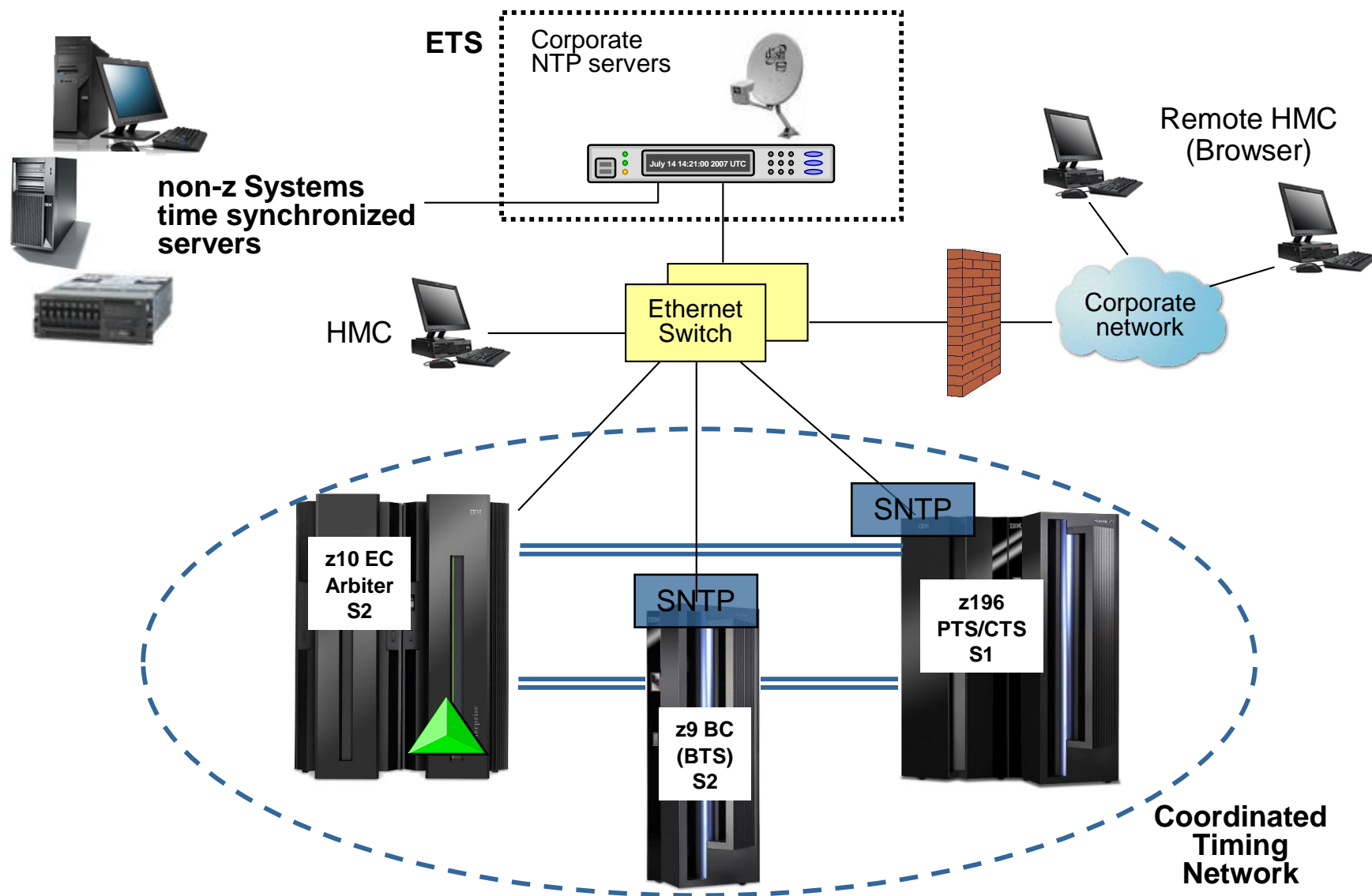   - 10 microseconds vs 100 milliseconds

Network Time Protocol (NTP) client support

- **Purpose of this function is to allow the same accurate time across an enterprise comprised of heterogeneous platforms**

- Simple Network Time Protocol (SNTP) client support added to Support Element (SE) code of z13, z13s, zEC12, zBC12, z196, z114, z10 and z9 servers/CFs to enable interfacing with Network Time Protocol (NTP) servers

- NTP server becomes the single time source (External Time Source (ETS)) for STP, as well as other non-z Systems servers (UNIX®, Windows NT®, other) that have NTP clients

- Time reference for NTP server can be GPS, dial-out, DCF-77 etc.

- **Accuracy is within +/- 100 ms of the time provided by an NTP Server**
  - Actual time accuracy, relative to UTC, is dependent on how accurate the NTP server time is with respect to UTC.

- **Only the Current Time Server (CTS) steers the time based on:**
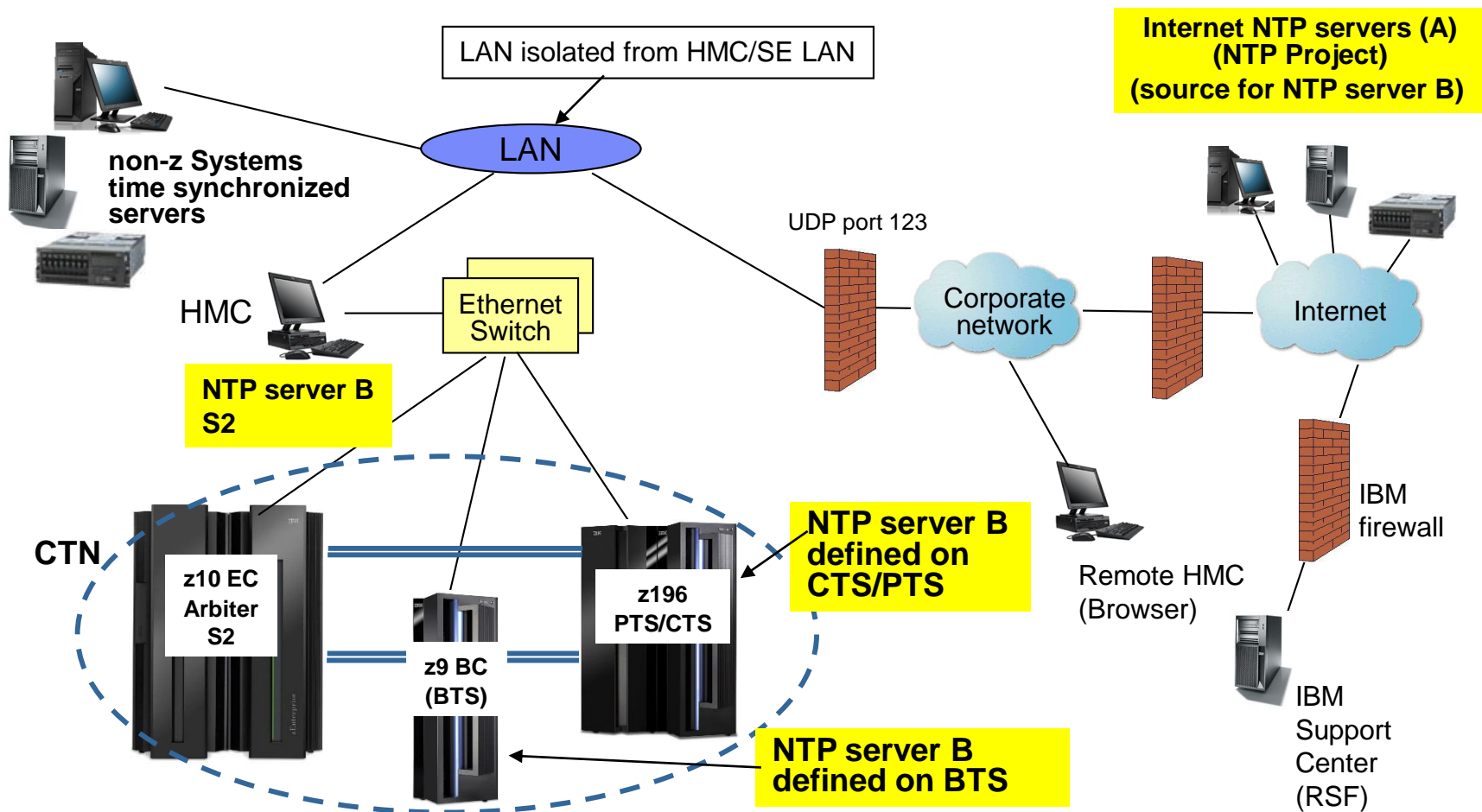 - Timing information sent by Support Element (SE) code

NTP Server Planning

- NTP/SNTP server can be :
  - An external device available from several vendors
  - NTP server on the HMC
  - A local workstation (example, UNIX, Linux, Windows) running the NTP/SNTP server code
    - HMC or workstation may use an internet NTP server for its time source

- NTP server should be directly connected to the SE LAN
  - SE LAN considered to be a private dedicated LAN
    - Isolated from the corporate and public networks

- NTP server on HMC addresses security concerns
  - Provides LAN isolation for SE NTP Client
  - The HMC has two LAN ports, physically isolated:
    - HMC/SE LAN used by NTP client code
    - Second LAN used by HMC to access an NTP time server to set its time

LAN Example 1 (NTP server available from vendors)

ETS

Corporate NTP servers

July 14 14:21:00 2007 UTC

non-z Systems time synchronized servers

Remote HMC (Browser)

HMC

Ethernet Switch

Corporate network

SNTP

z10 EC Arbiter S2

SNTP

z196 PTS/CTS S1

z9 BC (BTS) S2

Coordinated Timing Network

NTP Server as ETS (example 2 – HMC)

LAN isolated from HMC/SE LAN

**Internet NTP servers (A)
(NTP Project)
(source for NTP server B)**

non-z Systems
time synchronized
servers

LAN

UDP port 123

HMC

Ethernet
Switch

Corporate
network

Internet

**NTP server B
S2**

CTN

z10 EC
Arbiter
S2

z9 BC
(BTS)

z196
PTS/CTS

**NTP server B
defined on
CTS/PTS**

Remote HMC
(Browser)

IBM
firewall

**NTP server B
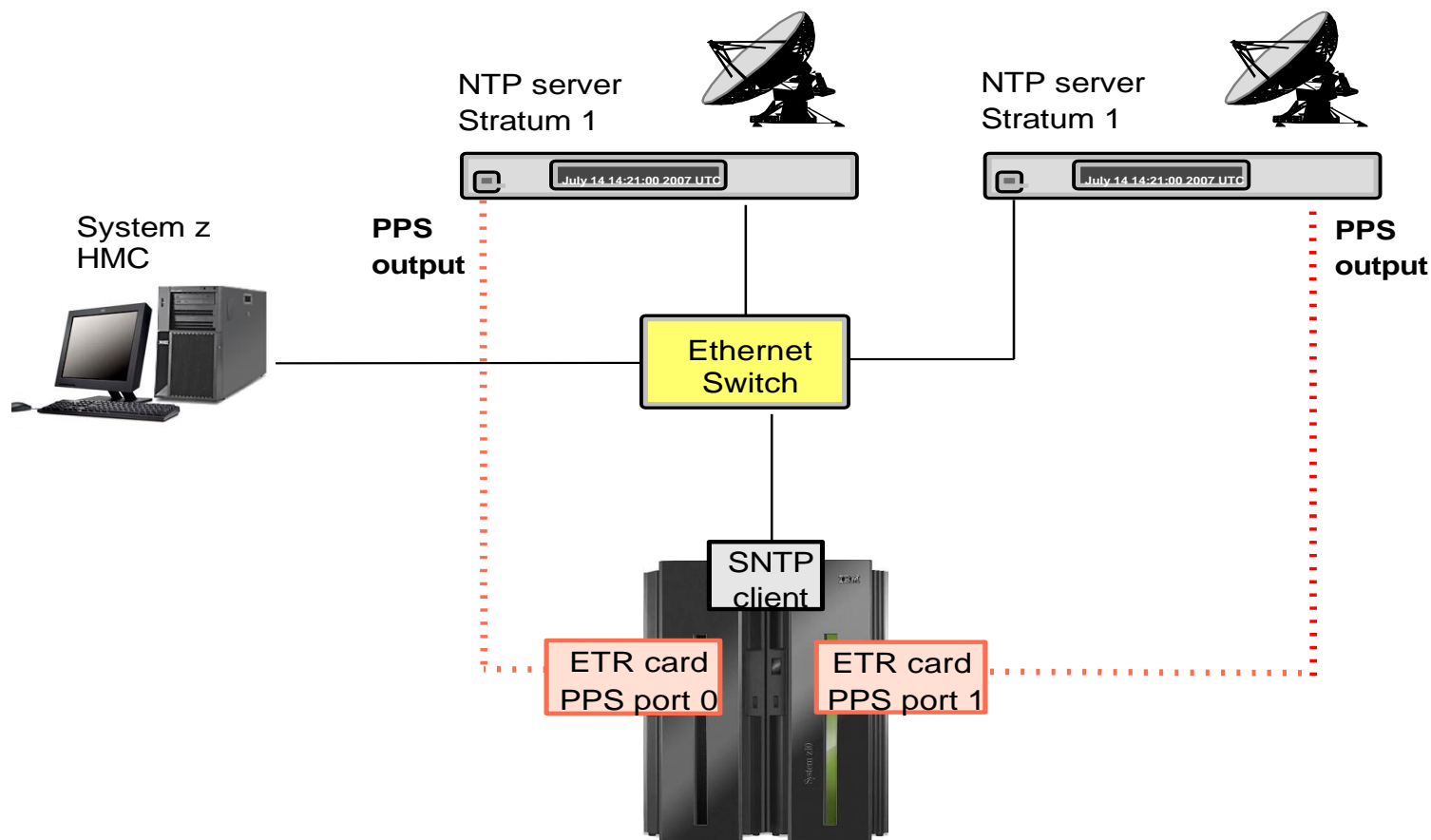defined on BTS**

IBM
Support
Center
(RSF)

Enhanced Accuracy to an External Time Source (ETS)

- **Some NTP servers also provide a highly stable, accurate "Pulse per second" (PPS) output**
  - PPS capability exists on the z13, z13s, zEC12, zBC12, z196, z114, z10 EC, z10 BC, z9 EC and z9 BC

- **STP utilizes the PPS signal to provide additional accuracy**
  - Accuracy to PPS – 10 microseconds

- **Only the Current Time Server (CTS) steers the time based on:**
  - Timing information sent by Support Element (SE) code
  - PPS signal received by PPS port on ETR/OSC card

Enhanced Accuracy to an External Time Source (ETS)
- ETS redundancy on same server (PTS/CTS) example

NTP server
Stratum 1

NTP server
Stratum 1

July 14 14:21:00 2007 UTC

July 14 14:21:00 2007 UTC

System z
HMC

PPS output

PPS output

Ethernet Switch

SNTP client

ETR card
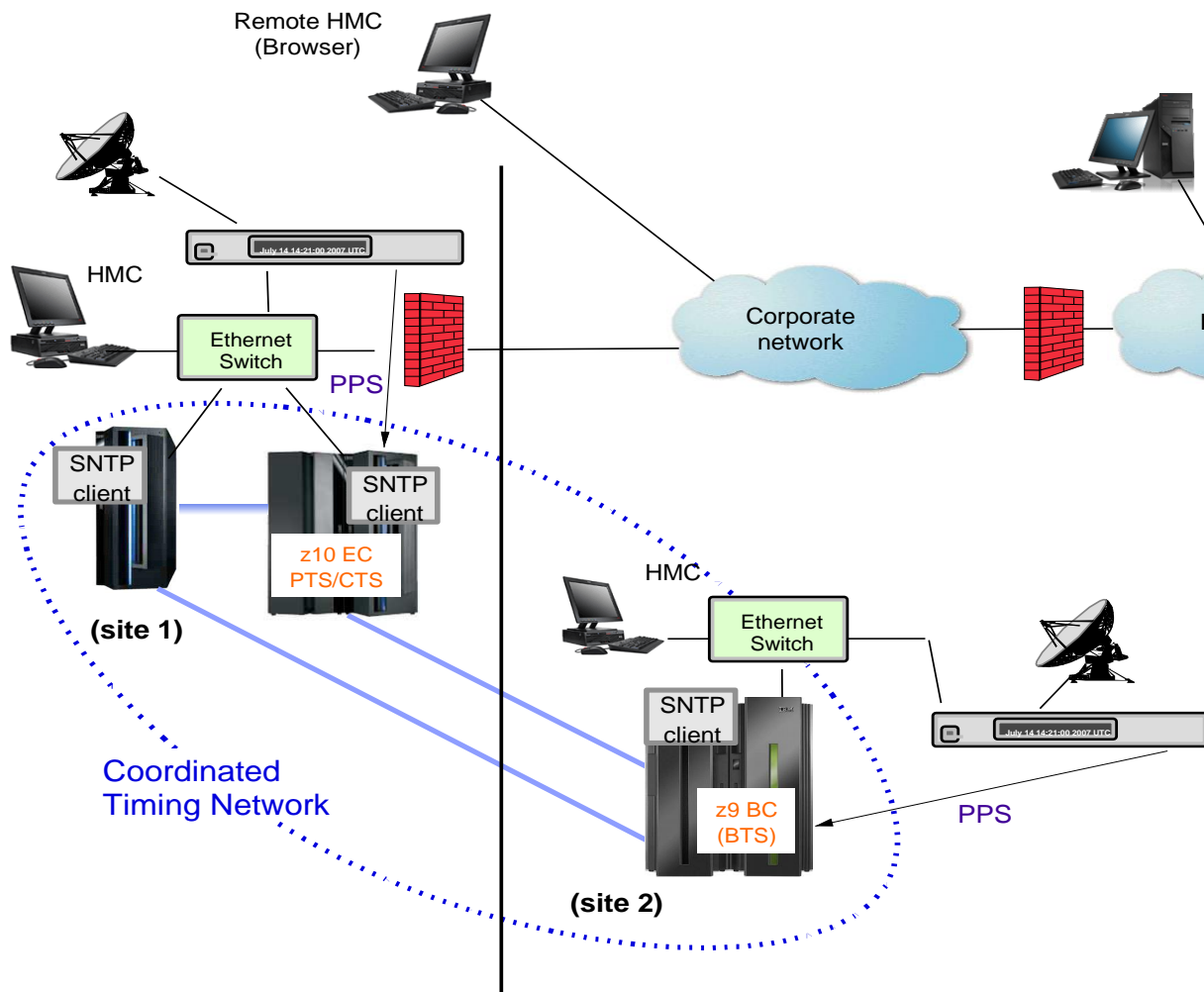PPS port 0

ETR card
PPS port 1

NTP Server Redundancy Recommendations

- **At least one NTP server must be configured on the PTS/CTS**
  - Only the Current Time Server (CTS) makes time adjustments based on information from the NTP Server

- **Also recommended to configure at least one NTP server on the BTS**
  - Allows continuous NTP server access when BTS becomes the CTS
  - Time adjustments to the STP-only CTN when the PTS/CTS cannot access any of its NTP servers

- **STP allows two NTP servers to be configured for every z System server in the STP-only CTN**
  - When two NTP servers are configured on the server that has the PTS/CTS role, STP will automatically access the second NTP server configured on the PTS/CTS if the selected NTP server fails.
  - For best availability, configure two NTP servers for both the PTS and the BTS

- **NTP servers can also be configured for all servers in the STP-only CTN**
  - Provides access to NTP servers if server roles reassigned

Recommendations apply when using NTP servers with or without PPS

Continuous Availability of ETS - two site example

Remote HMC
(Browser)

HMC

Ethernet
Switch

PPS

SNTP
client

SNTP
client

z10 EC
PTS/CTS

(site 1)

Coordinated
Timing Network

Corporate
network

Internet

HMC

Ethernet
Switch

SNTP
client

z9 BC
(BTS)

PPS

(site 2)

- BTS transmits adjustment information to PTS/CTS based on its NTP/PPS data

- When PTS/CTS detects failures associated with its NTP/PPS data

- PTS/CTS switches to using NTP/PPS data from BTS

- CTS role DOES NOT switch to BTS

Applicable when using NTP servers with or without PPS

Agenda

- STP Overview

- Hardware Planning

- External Time Source (ETS) Planning

- **Software Planning Overview**

- Server Role Planning

- Operational Safeguards

- Additional Information

Software Prerequisites

- **z/OS 1.7 and higher**

- **Additional PTFs may be required**

  - Maintenance can be applied using "rolling IPL" process

- **Check Preventive Service Planning (PSP) buckets**

- **To simplify identification of PTFs for STP, functional PSP bucket created**

  - SMPe 3.5

Note: Upgrade z/OS to the latest supported version/releases.

Update CLOCKxx statements

- OPERATOR PROMPT|NOPROMPT

- TIMEZONE W|E hh.mm.ss

- ETRMODE YES|NO

- ETRZONE YES|NO

- SIMETRID nn
  - nn = 0 – 31

- **STPMODE[*] YES|NO**
  - **Specifies whether z/OS is using STP timing mode**
  - **STPMODE YES default**

- **STPZONE[*] YES|NO**
  - **Specifies whether the system is to get the time zone constant from STP**

- ETRDELTA ss | **TIMEDELTA[*] ss**
  - **ss = 0 – 99 seconds**

[*] New statements for STP

IPL Requirements

When required?	Comments	
z/OS Maintenance	If z/OS STP maintenance needs to be applied, a re-IPL is required to enable the maintenance.	Maintenance being installed on the z/OS system image can be done using the "rolling IPL" process, which avoids a sysplex-wide outage.
Feature code 1021 MES	If feature code 1021 (STP) was installed as an MES with running z/OS systems, you will need to re-IPL z/OS after STP is installed.	An IPL is required after the STP related maintenance is applied. If the z/OS maintenance is applied before installing the STP feature, z/OS must be re-IPLed after the STP feature is installed.
CLOCKxx modifications	Any CLOCKxx changes require a re-IPL before the changes can take affect.	Note: With proper planning the above z/OS re-IPL requirements can be combined.

With proper planning, only one IPL is required if FC1021 is installed <u>as an MES</u>.

One IPL:

a) Concurrently install FC1021

b) Apply STP maintenance

c) Modify CLOCKxx if necessary

d) IPL

Two IPLs:

a) Apply STP maintenance

b) Modify CLOCKxx if necessary

c) IPL

d) Concurrently install FC1021

e) IPL

Agenda

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Server role planning

- **Preferred Time Server (PTS) / Current Time Server (CTS)**

  - **Location**
    - Most important site if multi-site configuration
    - Recovery considerations as to which site or server survives after outage
      - Note: For a two site CTN, recommendation is to locate Arbiter in same site as PTS/CTS

  - **Technology**
    - Enhancements may be available only on latest server technology

  - **Maintenance**
    - Server requiring frequent maintenance may not be best choice
    - STP will block disruptive actions on server assigned CTS

  - **Connectivity**
    - Must have connectivity to both the BTS and the Arbiter
    - Standalone CFs may provide best connectivity, but ......
      - Will not produce z/OS messages for operations or interception by automation routines.
      - CTN information will be available from z/OS images on other servers

Server role planning (continued .....)

- **Backup Time Server (BTS)**
  - Must have connectivity to PTS and Arbiter
  - Should have at least the same connectivity to other servers as the PTS
    - BTS can become CTS (recovery)

- **Consider reassigning special roles when STP recovery results in one of the "normal" special role servers to be down (planned or unplanned)**
  - For example, if PTS/CTS down, and BTS has taken over as CTS
    - BTS is now a potential Single Point of Failure (SPOF)
    - No other server can now take over as CTS if second failure follows

Agenda

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- **Operational Safeguards**

- Additional Information

Operational Safeguards

- **To prevent against operational error, safeguards have been added:**

  - **Execution of a disruptive task on a server that has STP blocked**

    - Disruptive tasks such as: activate, deactivate, power off, power-on reset, disruptive switch to alternate SE are not permitted
    - The role has to be assigned to another server or not-configured prior to disruptive action being allowed

  - **Accidental deconfiguration of the last timing link between any two servers rejected**

    - If last timing link condition is detected, explicit CHPID reconfiguration attempts on z/OS® V1R7 or higher servers are rejected
      - CF CHP(xx),OFF
      - CF CHP(xx),OFF,FORCE
    - Must now use either the HMC or the SE to reconfigure the Channel Path off for this "last timing link"

Agenda

- STP Overview

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- External Time Source (ETS) Planning

- Software Planning Overview

- Server Role Planning

- Operational Safeguards

- **Additional Information**

Additional Information

- **Redbooks®**
  - Server Time Protocol Planning Guide SG24-7280
  - Server Time Protocol Implementation Guide SG24-7281
  - Server Time Protocol Recovery SG24-7380

- **Education**
  - Introduction to Server Time Protocol (STP)
    - Available on Resource Link™
    - www.ibm.com/servers/resourcelink/hom03010.nsf?OpenDatabase

- **STP Web site**
  - www.ibm.com/systems/z/pso/stp.html

- **Systems Assurance**
  - The IBM team required to complete a Systems Assurance Review (SAPR Guide SA06-012) and complete Systems Assurance Confirmation Form via Resource Link
    - http://w3.ibm.com/support/assure/assur30i.nsf/WebIndex/SA779

- **Techdocs and WSC Flashes**
  - http://www.ibm.com/support/techdocs/atsmastr.nsf/Web/Techdocs
    - Search on "STP"

IBM Server Time Protocol (STP)

IBM Announces –
IBM Implementation Services for z Systems – Server Time Protocol

Implementation of STP for improved availability and performance

Offering

Assist clients to quickly and safely implement Server Time Protocol within their existing environments. IBM helps clients identify various implementation models and engage in the appropriate configuration required to effectively support STP for driving a more responsive business and IT infrastructure

Customer Value:

- Improves multi-server time synchronization without interrupting operations
- Enables integration with next generation of z Systems infrastructure
- Swift and secure implementation of STP for improved availability, integrity, and performance
- Reduces hardware maintenance and power costs while eliminating intermediate site requirements for Sysplex Timer
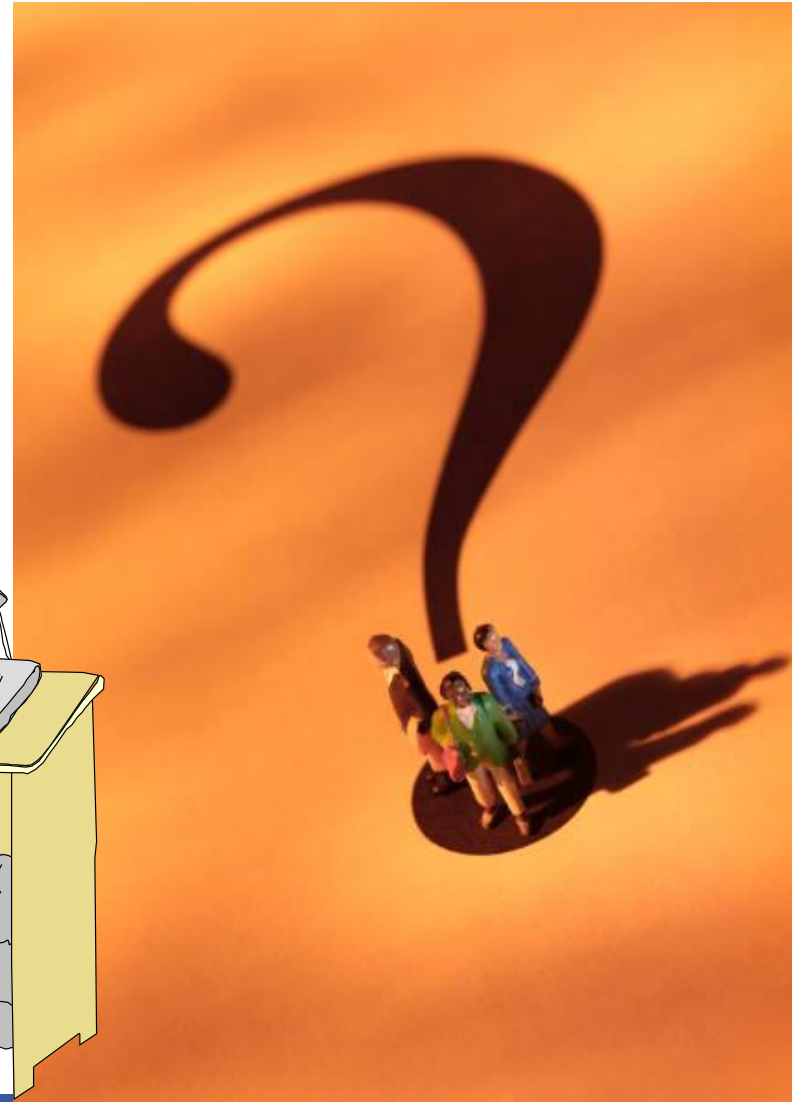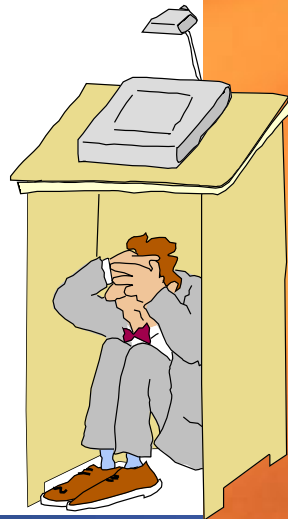
Leverages IBM's knowledge and best practices to help implementation of Server Time Protocol

Reference Material - Terminology

- APAR — Authorized Program Analysis Report
- ARB — Arbiter
- BTS — Backup Time Server
- CF — Coupling Facility
- CTS — Current Time Server
- CTN — Coordinated Timing Network
- DWDM — Dense Wave Division Multiplexer
- ETR — External Time Reference
- ETS — External Time Source
- FC — Feature Code
- HMC — Hardware Management Console
- HCA — Host Channel Adapter
- ICB — Integrated Cluster Bus
- IPL — Initial Program Load
- ISC — InterSystem Coupling Channel
- LAN — Local Area Network
- LIC — Licensed Internal Code
- LPAR — Logically Partition

- NTP — Network Time Protocol
- PR/SM — Processor Resource / Systems Manager
- PSIFB Infiniband — Parallel Sysplex
- PTF — Temporary Program Fix
- PTS — Preferred Time Server
- SW — Software (programs and operating systems)
- SE — Support Element
- TPF — Operating System
- UTC — Coordinated Universal Time
- zVM — Operating System
- zVSE — Operating System
- z/OS — Operating System
- z/VM — Operating System

Questions?

- **What are your questions?**

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BACKUP SLIDES

PTS/CTS role planning

- **Location**
  - Most important site if multi-site configuration
  - Recovery considerations as to which site or server survives after outage
    - Note: For a two site CTN, recommendation is to locate Arbiter in same site as PTS/CTS

- **Technology**
  - Enhancements may be available only on latest server technology
  - Examples of functions not available on z990, z890
    - NTP Client support
    - Restore STP configuration for two server CTN

- **Maintenance**
  - Server requiring frequent maintenance may not be best choice
  - STP will block disruptive actions on server assigned CTS
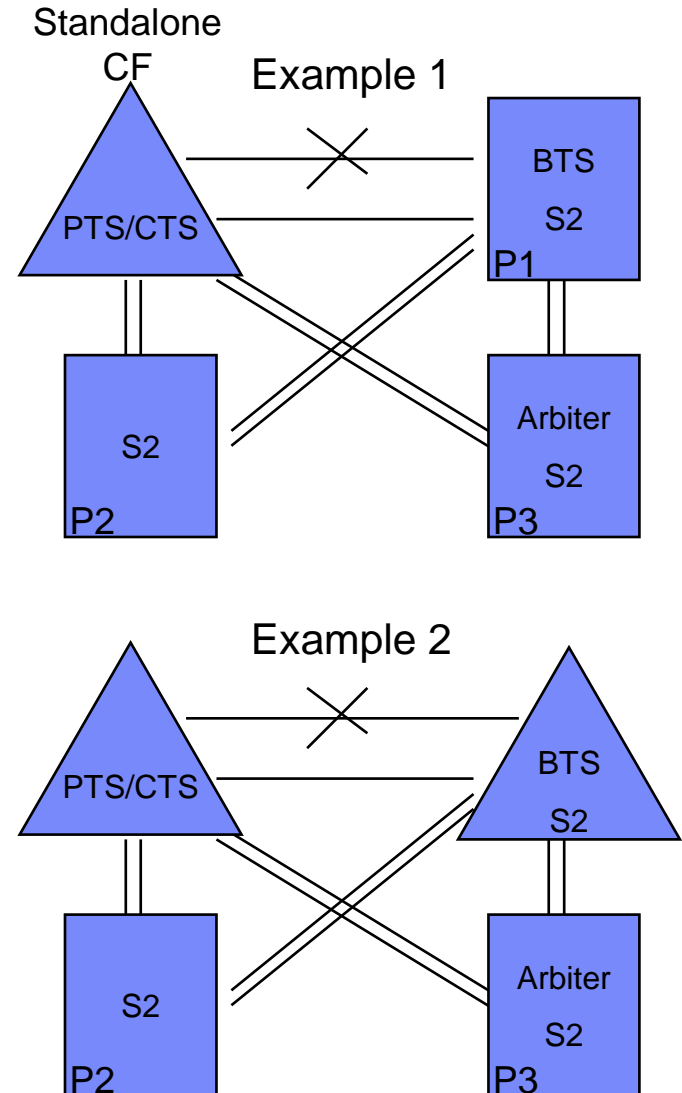
PTS/CTS role planning (continued)

- **Connectivity**

  - Standalone CFs will typically provide best connectivity to other servers requiring time synchronization
  - Existing coupling link connectivity can be used to exchange STP messages, but ....
    - What additional connectivity do you need to follow connectivity rules and best practices recommendations for reassigning roles?

  - Standalone CFs will not produce z/OS messages for operations or interception by automation routines

    - Information messages at IPL or interrupt time may not be displayed
      - IEA380I THIS SYSTEM IS NOW OPERATING IN STP TIMING MODE.
      - IEA381I THE STP FACILITY IS NOT USABLE. SYSTEM CONTINUES IN LOCAL TIMING MODE

    - Warning messages identifying a condition being associated for a given server.
      - If the condition being raised relates to connectivity between two servers, the information might be available to a z/OS system image at the other end of the link.
      - However, if both ends of the link are CF partitions, no warning message is available to the user.

Examples of z/OS warning messages

- If the condition being raised relates to connectivity between two servers, the information might be available to a z/OS system image at the other end of the link.

  - Example 1: If one of the two coupling links between PTS/CTS and BTS fails,

    - z/OS image P1 will still report
      - **IEA382I** THIS SERVER HAS ONLY A SINGLE LINK AVAILABLE FOR TIMING PURPOSES

  - Example 2: If both ends of the link are CF partitions, no warning message is available to the user on the z/OS console

    - HMC will post a hardware message related to the link failure, but not a warning message that you have a potential SPOF

      P1, P2, P3 – z/OS images in a Sysplex

Standalone CF

Example 1

PTS/CTS

BTS
S2
P1

S2
P2

Arbiter
S2
P3

Example 2

PTS/CTS

BTS
S2

S2
P2

Arbiter
S2
P3

PTS/CTS role planning - z/OS Messages

- There are many IEAxxx and IXCxxx messages which report current and changed timing status.

- As an example, the following reports the result of a successful migration from a mixed CTN to an STP-only CTN.

  IXC438I COORDINATED TIMING INFORMATION HAS BEEN UPDATED

  FOR SYSTEM: sysname

  PREVIOUS CTNID: IBM_NET1-15
  CURRENT CTNID: IBM_NET1

- Question: Is it significant that these IEAxxx and IXCxxx messages are not displayed if the Standalone CF is assigned the role of

  PTS/CTS?

For a list of Supervisor, XCF/XES messages related to STP see Backup Slides

PTS/CTS role planning - z/OS Messages (contd)

- **In general, there are no z/OS messages that are posted *only* on the PTS, BTS, or Arbiter.**

- **Certain messages will not appear on the CTS since it is the time source**
  - IEA382I THIS SERVER HAS ONLY A SINGLE LINK AVAILABLE FOR TIMING PURPOSES.
  - IEA383I THIS SERVER RECEIVES TIMING SIGNALS FROM ONLY ONE OTHER NETWORK NODE.
  - IEA281I STP SYNC CHECK THRESHOLD EXCEEDED. CPC CONTINUES IN LOCAL MODE.
  - IEA390I TOD CLOCKS DYNAMICALLY ADJUSTED TO MAINTAIN STP SYNCHRONISM.

- **Following message may not appear on some special role servers**
  - IEA388I THIS SERVER HAS NO CONNECTION TO THE nnnnnnnnnn
    - Where nnnnnnnnnnnn = 'PREFERRED '| 'BACKUP '| 'ARBITER '
  - For example,
    - IEA388I THIS SERVER HAS NO CONNECTION TO THE BACKUP will never appear on a z/OS system running on the BTS.

> Need to examine complete list of STP z/OS messages before deciding significance of Standalone CF not displaying STP messages

Summary – Server role planning

- After deciding which server assigned PTS/CTS, similar review should be made for the BTS
  - If multi-site sysplex, Arbiter should be placed in same site as PTS/CTS

- Many considerations to evaluate before deciding which servers assigned special roles
  - Location, Technology, Maintenance
  - Connectivity
  - Stand alone CF
  - z/OS message automation

- Consider following best practices recommendations for reassignment of roles

- Every customer needs to do their own assessment
  - No single recommendation fits all configurations

STP ETR Messages - Supervisor

- **IEA031I** STP ALERT RECEIVED. STP ALERT CODE = nn
  - Alert code is x'01' to x'84'
- **IEA380I** THIS SYSTEM IS NOW OPERATING IN STP MODE.
- **IEA381I** THE STP FACILITY IS NOT USABLE. SYSTEM CONTINUES IN LOCAL MODE.
- **IEA382I** THIS SERVER HAS ONLY A SINGLE LINK AVAILABLE FOR TIMING PURPOSES.
- **IEA383I** THIS SERVER RECEIVES TIMING SIGNALS FROM ONLY ONE OTHER NETWORK NODE.
- **IEA384I** SETETR COMMAND IS NOT VALID IN STP TIMING MODE.
- **IEA385I** CLOCKxx ETRDELTA & TIMEDELTA BOTH SPECIFIED. yyyyyyy IGNORED.
- **IEA387I** STP DATA CANNOT BE ACCESSED. SYSTEM CONTINUES IN yyyyy TIMING MODE.
- **IEA388I** THIS SERVER HAS NO CONNECTION TO THE nnnnnnnnnn
- **IEA389I** THIS STP NETWORK HAS NO SERVER TO ACT AS nnnnnnnnnn
- **IEA392I** STP TIME OFFSET CHANGES HAVE OCCURRED.
- **IEA393I** ETR PORT n IS NOT OPERATIONAL. THIS MAY BE A CTN CONFIGURATION CHANGE.
- **IEA394A** THIS SERVER HAS LOST CONNECTION TO ITS SOURCE OF TIME.
- **IEA395I** THE CURRENT TIME SERVER HAS CHANGED TO THE cccccccccccc
  - (where cccccc is BACKUP or PREFERRED)

STP ETR Messages - XCF

- **IXC434I** SYSTEM sysname HAS TIMING DEFINITIONS THAT ARE NOT CONSISTENT WITH THE OTHER ACTIVE SYSTEMS IN SYSPLEX sysplex-name.
  - EFFECTIVE CLOCK VALUES ARE NOT CONSISTENT
  - SYSTEM: sysname IS RUNNING IN LOCAL MODE
  - SYSTEM: sysname IS USING ETR NET ID: xx
  - SYSTEM: sysname IS USING CTN ID: yyyyyyyy-xx
  - SYSTEM: sysname IS USING CTN ID: yyyyyyyy
  - where:
    - xx = ETR NET ID in use by system sysname
    - yyyyyyyy = CTN ID in use by system sysname
    - yyyyyyyy-xx = CTN ID in use by system sysname

- **IXC435I** ALL SYSTEMS IN SYSPLEX sysplexname ARE NOW SYNCHRONIZED TO THE SAME TIME REFERENCE.
  - SYSTEM: sysname IS USING ETR NETID: ee
  - SYSTEM: sysname IS USING CTNID sssssss-ee
  - SYSTEM: sysname IS USING CTNID sssssss

STP ETR Messages – XCF (continued)

- **IXC437I** - SYSTEMS CAN NOW ENTER THE SYSPLEX USING
  - COORDINATED SERVER TIME CTNID=ssssssss-ee
  - COORDINATED SERVER TIME CTNID=ssssssss

- **IXC438I** COORDINATED TIMING INFORMATION HAS BEEN UPDATED FOR SYSTEM: sysname
  - PREVIOUS ETR NETID: ee
  - PREVIOUS CTNID: ssssssss-ee
  - PREVIOUS CTNID: ssssssss

  - CURRENT ETR NETID: ee
  - CURRENT CTNID: ssssssss
  - CURRENT CTNID: ssssssss-ee
  - CURRENT TIMING: LOCAL

- **IXC439E** ALL SYSTEMS IN SYSPLEX sysplexname ARE NOT SYNCHRONIZED TO THE SAME TIME REFERENCE.
  - SYSTEM: sysname IS USING ETR NETID: ee
  - SYSTEM: sysname IS USING CTNID ssssss-ee
  - SYSTEM: sysname IS USING CTNID ssssss
  - SYSTEM: sysname IS RUNNING IN LOCAL MODE

- **IXC468W** XCF IS UNABLE TO ACCESS THE CTN AND HAS PLACED THIS SYSTEM INTO NON-RESTARTABLE
  - WAIT STATE CODE: 0A2 REASON CODE: 158

STP ETR Messages – XES

- **IXL160E** CF REQUEST TIME ORDERING: REQUIRED AND NOT-ENABLED
  - COUPLING FACILITY SIMDEV.IBM.EN.CF0100000000
    - PARTITION: 00 CPCID: 00
  - REASON: ETR NETID MISMATCH - CF ETR NETID: 0F
  - REASON: ETR NOT CONNECTED TO COUPLING FACILITY
  - REASON: MESSAGE TIME ORDERING FUNCTION FAILURE

  - REASON: TIME ORDERING FUNCTION NOT INSTALLED ON THE CF
  - REASON: TIME ORDERING FUNCTION NOT INSTALLED ON THIS SYSTEM
  - REASON: CF IS OUT OF SYNC WITH TIMING NETWORK
  - REASON: CTNID MISMATCH - CF CTNID: CTNNET01 0F

- **IXL162E** CF REQUEST TIME ORDERING: REQUIRED AND WILL NOT BE ENABLED
  - COUPLING FACILITY SIMDEV.IBM.EN.CF0100000000
    - PARTITION: 00 CPCID: 00
  - REASON: CTNID MISMATCH - CF CTNID: CTNNET01 0F