Government of India (Bharat Sarkar)
Ministry of Railways (Rail Mantralaya)
(Railway Board)

No. 2005/C&IS/Rly. Data Channel/Pt. New Delhi, dated 03.10.2007

Chief Commercial Managers
All Indian Railways.

Sub: Sample Design of UTS Network expansion under WP 2007-08.
Ref: CRIS's letter No.CRIS/TC/UTS/Net PIII dated 24-9-2007.

SNO:34

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CRIS has worked out a sample design for the UTS network expansion under Works Programme 2007-08. A copy of the same is enclosed for guidance and necessary action for designing of data comm. network for unification of UTS/PRS as well as UTS expansion. Any queries or objections in this regard may please be forwarded to CRIS directly with a copy of the letter endorsed to C&IS dte.

(Chhatrasal Singh)
Director (C&IS)

DA: As above.

CENTRE FOR RAILWAY INFORMATION SYSTEMS

Chanakyapuri,
New Delhi.

No.CRIS/TC/UTS/Net PIII

Dated: 24.09.2007

Addl. Member/IT,
Railway Board,
Rail Bhavan,
New Delhi.

Sub: **Sample Design of UTS Network expansion under WP 2007-08.**

Ref: **Railway Board's letter No. 2006/C&IS/WP 2007-8/AZR/UTS/10 dated 03.09.2007.**

As advised by the Railway Board, a sample design for the UTS network expansion under 2007-08 has been worked out on the basis of the directives given in the above referred letter. The same is annexed herewith for further action in the matter please.

(V.A. Chopra)
Group General Manager/PSA

Encl: As above.

Sample Network Design for UTS Expansion under WP 2007-08 for a given zonal Railway

1. UTS Application Characteristics

(i) The UTS application is an On-line Transaction processing (OLTP) Application and is based on a CUI (Character User Interface) based client terminal. The Application/Database servers have been deployed at central datacenter locations. The entire country has been covered by implementing 09 datacenters located in Delhi, Mumbai, Chennai, Kolkata, Secunderabad, Patna & Gorakhpur. The application/database servers are UNIX based with RISC based hardware. The database is implemented using Sybase. The application and database servers are configured in High Availability (HA) mode using OS/RDBMS clustering mechanisms.

(ii) Clients login to the Application Server using 'Telnet' services. The client software resides in the application Server. As is evident, the application is highly interactive in nature and therefore 'Round Trip Time' (RTT) has a very significant bearing on the comfort level of User/Client. It has been observed that the RTT between client terminal and the Server should be of the order of about 130-150 ms for comfortable user experience and smooth ticketing operations.

(iii) The application is non-tolerant to erroneous links or packet loss in the network. However, the application is relatively lax on bandwidth requirement as each terminal requires about 2-3 Kbps bandwidth with number of clients ranging from 2 to 10 at each location.

(iv) UTS provides unreserved ticketing service at stations on 24 by 7 basis through out the year. Unreserved ticketing service through Automatic Ticket Vending Machines (ATVMs) is also being rolled out shortly.

(v) UTS presently supports revenue generation of about Rs. 18.5 crores (i.e. Rs. 185 million) on daily basis. A high network availability of the order of 99.8 or higher is essential to prevent not only ticket-less travel but also revenue leakage in the system.

2. Network Architecture

IR operates Unreserved Ticketing System (UTS) over all 16 zonal railways spanning the entire country. The network presently covers about 875 stations and is being extended over 800 additional stations during the

current year. This network shall be further spread to cover 4724 more stations in next 2-3 years time as part of the work sanctioned under WP 2007-08. The UTS network is based on the TCP/IP suite of protocols and utilizes IP Routers for implementing adaptive routing. The routing domain is based on OSPF (Open Shortest Path First) protocol.

The UTS Application/Database servers have been deployed at the 09 datacenters located in the cities specified above. Each of these datacenter provides services to the terminal clients in a well defined geographical territory. The WAN Topology of UTN is best described as "Inverted Tree with Partial Mesh". The network topology follows a multi-tier hierarchy. The central datacenter as well as divisional headquarters and other strategically important locations (Tier-1 locations), have been deployed with 1:1 redundant Routers in order to ensure the network availability of a high order. Besides catering to the local booking office, the Tier-1 locations act as traffic aggregation points for multiple Tier-2/3/4 locations.

The network architecture for expansion of UTS sanctioned under WP 2007-08 is detailed below:

i) In addition to the existing Tier-1 locations, zonal railways shall identify some more important locations from the existing Network which would be directly connected to the Central Datacenter Location (i.e. Tier-1 locations). The selection can be done while keeping in view the transactional load, commercial importance of the station as well as strategic importance from the communication infrastructure stand point. As a general guideline, it is recommended that total number of Tier-1 locations should be about 4 – 5 % of the total locations in the entire network. This is required to be done in order to confine the number of Router hops between stations and the central datacenter to an acceptable limit.

ii) Kindly refer Annexure-1 which shows the network architecture of the core layer network for a given zonal Railway.

iii) At all Tier-1 locations, two Routers shall be installed in High Availability (HA) Mode.

iv) All Tier-1 locations shall be connected to the central datacenter Location using 02 x 02 Mbps communication channels sourced from diverse service providers. Each Tier-1 location should be connected to at least one other Tier-1 location using a 02 Mbps communication channel.

v) The network shall utilize SDH based communication channels only.

vi) The Backbone OSPF Area (i.e. Area-0) is required to be very stable w.r.t. transitions in the Routing Database and /or Routing table. Therefore, as depicted in the schematic at Annexure-1, the OSPF Area-0 shall be limited within the central datacenter. Thus the central Routers will act as Area Border Routers (ABRs) for all the OSPF Areas.

vii) The remaining network shall be divided into multiple Areas. The number of locations that can be configured in one OSPF Area is dependent of many factors such as the stability of the communication channels, processing capacity of the Routers etc. On the basis of the past experiences, as a general guideline, we may go upto a maximum of 70 locations in one area.

viii) Each OSPF Area shall have at least 02 Tier-1 locations, so that there are adequate uplinks available to the central datacenter location. It is however, desirable to have more than two Tier-1 locations in one Area provided the no. of Tier-1 locations are confined within 4 – 5 % of the total no. of locations within the Area.

ix) It is essential to preserve the OSPF Area boundaries in order to ensure acceptable Route Convergence Time (i.e. time required to utilize the alternate path in the event of primary path failure) and scalability in the Network. Therefore, no communication channel shall traverse two different OSPF Areas.

x) Once the backbone network topology has been evolved, i.e. (Network connecting Central Datacenter and Tier-1 locations), all other stations should be connected below the tier-1 locations by using a mix of 'inverted tree' and 'partial mesh' topology.

xi) Kindly refer schematic enclosed as Annexure-2 which depicts the topology for the network below the Tier-1 level for a given OSPF Area. Other OSPF Areas in the Zonal Railway will follow the same design principles.

xii) Each location shall be provided with a minimum of one alternate path to reach the central datacenter location.

xiii) It has been observed that if the alternate path is provided using same service provider, the local lead from location to the nearest exchange of the carrier, remains the same. Whenever the local lead fails, it results in failure of both primary and alternate links. Hence, to the extent possible, the two links providing the primary

and the secondary path for a given location shall be build using channels provided by different service providers (i.e. service provider diversity).

xiv) The nature of UTS Application is such that the 'Round Trip Time' (RTT) has a very significant bearing on the comfort level of User/Client. It has been observed that the RTT between client terminal and the Server should be of the order of about 130-150 ms for comfortable user experience. Therefore, the maximum number of hops between the booking location and the central location (i.e. UTS Datacenter) for the primary and alternate paths shall be limited to 4 and 5 respectively. If all communication channels that constitute an end to end path are of 02 Mbps capacity, we may go up to 6 hops in the alternate path.

xv) While configuring comm. channels in the network, the ring protection available at the physical/media level in the service provider's network shall be kept in view.

xvi) In the network below the Tier-1 level, communication channels build using Railway owned OFC shall preferably be of 02 Mbps capacity. However, channels hired from BSNL or any other service provider may be of 64 Kbps below the Tier-1 level.

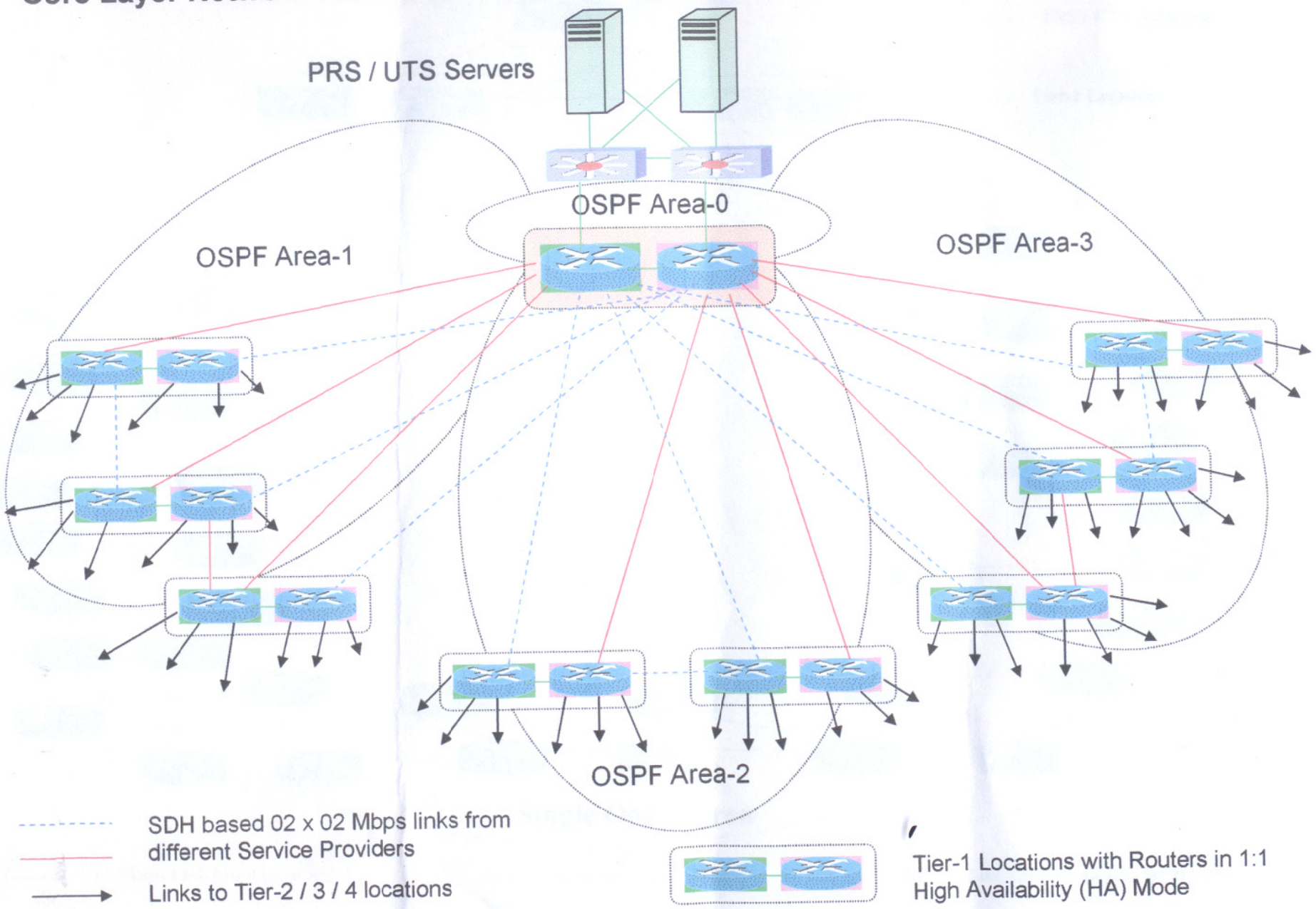
xvii) A Hierarchical IP Address Plan would be an essential pre-requisite for implementing a scalable Routing domain detailed above. This shall be provided by CRIS at the time of implementation.

xviii) In case of ECR & NER, where the UTS & PRS Datacenters are at different locations, the additional considerations for addressing the requirement of connectivity to the PRS datacenter are as under:

a. One 02 Mbps link from each Tier-1 location to the PRS Datacenter location sourced from different service providers, i.e. if one of the channels from the PRS Datacenter to a given Tier-1 location (say X) is sourced from Service Provider-A, then the channel interconnecting PRS Datacenter to the neighboring Tier-1 location (say Y) (i.e. the one which is inter-connected with the Tier-1 location X) shall be sourced from another Service provider (say Service Provider-B).

b. 02 x 02 Mbps communication channels between the UTS Datacenter location and PRS Datacenter location sourced from different service providers. This linkage will not only serve the PRS terminals at the station / location where UTS datacenter is located, but shall also provide alternate path for PRS connectivity to all locations in the network.

Core Layer Network Architecture & Area Organization in the OSPF Routing Domain



Topology for the Network below Tier-1 level

Annexure-2

