32nd ADVANCED PROFESSIONAL PROGRAMME IN

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DISSERTATION

ON

PASSENGER RESERVATION SYSTEM

SPECIAL REFERENCE TO

UNRESERVED TICKETING SYSTEM

BY

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CERTIFICATE

I have the pleasure to certify that Mrs. Tarni Baswal has perused her research and prepare the present dissertation entitled "**Passenger Reservation System special reference to (UTS) Unreserved Ticketing System**" Under my guidance and supervision the dissertation is the result of her own research and to the best of my knowledge, no part of it has comprised any other monograph, dissertation or book. This is being submitted to **Indian Institute of Public Administration for the Master's Diploma in Public Administration (MDPA)** in partial fulfillment of the requirement for the Advance Professional Programme in public Administration (APPPA).

I recommend that the dissertation of Smt. Tarini Baswal is worthy of consideration for the award of **MDPA** of IIPA.

Girish Kumar
27/02/2007

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PREFACE

Even after 32nd APPPA course was progressing at I.I.P.A. liberalization of Indian Sector was making headlines in newspaper almost every day. Cost reductions, increase in productivity, computerization etc. are becoming buzz words in every organization. Indian Railways has been taking steps towards computerization in different fields such as payroll, inventory control, cash book and journal, budget allocation etc.

Passenger Reservation System of Indian Railways is one facet which has come in focus being an area of direct public interaction. Even the unreserved ticketing system has been computerized which is immensely benefiting Indian Railway and public.Thus, when given the requirement of undertaking a research work and writing a dissertation the choice of subject came readily.

I am deeply indebted to **Professor Girish Kumar**, Indian Institute of Public Administration, who despite heavy preoccupation found time and rendered valuable guidance at all stages during the course of study.

I would like to sincerely thank a large number of colleagues in Railway Board, Centre for Railway Information System New Delhi, Northern Railway Headquarters and passenger reservation office for giving suggestions, opinion, producing useful material and above all sparing valuable time for discussions and clarifications.

In the end , I would like to thank my husband Dr. Dinesh and my children Dharini and Danish for being a constant source of support and for standing by me during the long hours work.

INTRODUCTION

Until 1985 railway reservations was handled manually by railway staff . With the introduction of new trains and increase of passenger traffic the workload in the booking and reservations offices increased tremendously . Introduction of passenger reservation system on Indian Railways in 1985 was an important effort . It has brought about a revolutionary change in the reservation system.

Networking solution to Indian Railways Passenger Reservation System has been one of the applications which has truly brought the benefits of Information Technology to the masses. Indian Railways computerised Passenger Reservation System (PRS) currently operates from five regional centres located at Delhi, Bombay, Calcutta, Madras and Secunderabad. All of the five sites have been internetworked over a 64 kbps and 2 Mbps lines using routers, on leased communication line connections from Department of Telecom (DOT).

Considering the scope of the operation. Indian Railways is the world's second-largest railway , the challenge is to provide a reservation system that can support such a huge scale of operations - regardless of whether it's

measured by kilometers, passenger numbers, routing complexity, or simply the sheer scale of India.

OBJECTIVE

With the tremendous growth of PRS terminals all over the country , the extra load of various interface software such as Internet enquiries and Unreserved ticketing which constitutes major component of the overall ticketing in Indian Railways the overall load on the backend PRS system had increased manifold.The objective of the above research work is to study and analyse the interface issues relating to PRS / UTS (unreserved ticketing system) . UTS contributes a large amount of earning for Indian Railways.

The following hypothesis are proposed to be tested in the above study :

Whether unreserved ticketing system is the solution to curb ticketless travellers .

METHODOLOGY

For the purpose of study collection of data was done from passenger reservation office and CRIS . Also the views of senior officers dealing with the subject were considered .

The study is organised under following heads –

Chapter- I gives brief over view of Indian Railways and history of PRS.

Also it describes the importance of Computerized Reservation.

Chapter-II describes how the networking of Passenger Reservation System has been done.

Chapter-III describes about the software of PRS i.e. CONCERT. How the CONCERT software is better than earlier software i.e. IMPRESS.

Chapter-IV gives the brief over view how UTS and how Railways and public has benefitted because of UTS since year 2002

Chapter-V gives details of software used in UTS system.

Chapter-VI describes the innovations done in PRS and UTS , road map of PRS and UTS , Special features of UTS some of issues / interface problems of UTS / PRS softwares and some recommendations .

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CHAPTER-I IMPORTANCE OF COMPUTERIZED RESERVATION.

PASSENGER RESRVATION

- **INDIAN RAILWAYS**

Indian Railways (IR), the country's largest public sector undertaking and the world's largest Railway Network, carries 11 million passengers in over 8500 trains daily. About half of the total passenger traffic on IR comprises of long and medium distance inter-city traffic. It is estimated that on an average over 5,75,000 berths and seats on these trains are reserved everyday.

Indian Railways is the second largest railway under single management (only China is larger). To give some indication of its size, it has 7,000 stations, 62,000Km of track, around 30,000 passenger coaches and 261,000 freight wagons. Annually it carries some 400M tons of freight -- and 11Million passengers per day (about four Billion people a year).

Of this 11 Million passengers/day, around 5-8% represent 'reserved accommodation' -- with almost 5,00,000 such accommodations being

offered each day on 3000 trains. Journeys can start from any part of India and go to any other part, with travel times being as long as 48 hours and distances being several thousand kilometers at the extreme. The challenge is to provide a reservation system which can support such a huge scale of operations, irrespective of whether this is measured by route/kilometers, numbers of passengers, complexity of routing or simply the sheer scale of India.

Also computerisation for passengers includes other projects like providing reserved accommodation over the Internet, Unreserved ticketing and its implementation, National Train Enquiry system, Data Ware-Housing .

IMPORTANCE OF COMPUTERISATION OF PASSENGER RESERVATION

Until 1985, the Herculean task of railway reservation was handled manually by the railway staff. With the introduction of new trains having reserved accommodation facility, and phenomenal increase of passenger traffic, the workload in the booking and reservation offices increased tremendously. It was no longer possible to cope with the situation manually. Introduction of the Passenger Reservation System

on Indian Railways in 1985 was a pioneering effort and a milestone in the history of Indian Railways. It has about a revolutionary change in the reservation system.. The project was completed on the entire Indian Railways in April 1999 enables tickets being issued from anywhere in any existing train, class, route and date on about 2000 terminals across the country

So far, more than 96 percent of the total reservation has been computerized and the mission of providing reservation facilities at the doorsteps of passengers has been almost fulfilled. Computerized reservation facilities have been extended even to the remote non-railway heads of the capital cities of the states such as Port Blair in Andaman, Itanagar in Arunachal Pradesh, Srinagfar in Kashmir, Gangtok in Sikkim, Agartala in Tripura, Kohima in Nagaland, Aizwal in Mizoram, Shillong in Meghalaya, Imphal in Manipur and Kavaratti isloand of Lakshadweep. More than 1000 locations have so far been opened.

This has been possible with the assistance and co-operation of the State Governments which have provided accommodation and other infrastructural facilities to open the reservation offices.

OPERATION OF PRS

The technical operation of all the computerized reservation offices on Indian Railways is controlled by Passenger Reservation System (PRS) at Calcutta, New Delhi, Mumbai, Chennai and Secunderabad operated and maintained by CRIS.

PRS NETWORKING

Networking solution to Indian Railways Passenger Reservation System has been one of the applications which has truly brought the benefits of Information Technology to the masses. Indian Railways computerised Passenger Reservation System (PRS) currently operates from five regional centres located at Delhi, Bombay, Calcutta, Madras and Secunderabad. All of the five sites have been internetworked over a 64 kbps and 2 Mbps lines using routers, on leased communication line connections from Department of Telecom (DOT).

Considering the scope of the operation. Indian Railways is the world's second-largest railway, with 6,853 stations, 63,028 kilometers of track, 37,840 passenger coaches and 222,147 freight cars. Annually it carries some 4.83 billion passengers and 492 million tons of freight.

Passenger Reservation System

PRS NODE	Trains	Terminals	Locations	Peak No. of Passenger per day (in lakhs)
1. Delhi	1103	1370	344	2.75
2. Mumbai	686	999	233	3.14
3. Kolkata	630	1042	375	1.81
4. Chennai	372	637	188	1.65
5. Sec'bad	293	493	107	0.81
TOTAL	3084	4541	1247	10.16

Of the 11 million passengers who climb aboard one of 8,520 trains each day, about 550,000 have reserved accommodations. Their journeys can start in any part of India and end in any other part, with travel times as long as 48 hours and distances up to several thousand kilometers.

The challenge is to provide a reservation system that can support such a huge scale of operations regardless of whether it's measured by kilometers, passenger numbers, routing complexity, or simply the sheer scale of India.

PRS started in 1985 as a pilot project in New Delhi. The avowed objective was to provide reserved accommodation on any train from any counter preparation of train charts and accountal of the money collected. When initial pilot project was implemented at Delhi, the software (referred to as version I) had a number of limitations. These were mainly removed in next version i.e. version II implemented in in 1987.

With the addition of new locations and many redefinitions needed the new version III evolved in 1990.Even the version III of the earlier software called Impress fell far short of the growing expectations of the travelling public and the need was felt to have a software which

has the capabilities of providing the Networking of the five independent PRS nodes namely Secundrabad, Delhi, Calcutta, Mumbai and Chennai.

Now anywhere to anywhere reserved ticketing became a possibility on any PRS booking terminal. In order to facilitate the availability, PNR status and other journey planning information to the common public various interfaces like the Interactive Voice Response System (IVRS) on the telephone, Touch Screens at selective locations, RAPID, DISPLAY, Passenger Operated Enquiry Terminals (POET) and Daily Press Availability Reports through newspapers have been provided.

PASSENGER TICKETING APPLICATIONS

- **Reserved Category has to cater for -**
- 1 million passengers per day.
- Operate from 8 AM to 10 PM for booking across counters.
- Operate from 4 AM to 11.30 PM for Internet booking.
- Issue journey tickets.
- **Unreserved Category has to cater for -**
- 11 million passengers per day.

- Operate round the clock.
- Issue MST, QST, Platform tickets, Misc. tickets besides journey ticket.

ADMINSTRATION HEAD

Each PRS is headed by a Senior Administrative grade Officer of the Indian Railway, Traffic Service, namely Chief Commercial Manager (Passenger Marketing) who is assisted by one or two Dy. Chief Commercial Managter to maintain the database and operation of the system. Senior Commercial Manager and Assistant Commercial Manager (Reservation) have also been posted in PRS to look after day-to-day work pertaining to reservation matters.

The erstwhile designation of CCM (Computerized Reservation) has been changed to CCM (PM) to make his functioning more market oriented. The CCM(PM) has been assigned the following duties and responsibilities.

- Maintenance of existing computerized reservation offices and opening of new reservation offices.
- Computerized issue of unreserved tickets at important stations.
- Distribution of quota of berths/seats in new trains to the originating and road side stations.

- Clearance of wait-listed passengers by attaching extra coaches and running special trains when required.
- Introduction of new trains based on occupation of the existing trains and demand for reserved accommodation.
- Interaction with the passengers for customer satisfaction.
- Keeping watch over offering of passenger traffic sand taking action to attract more traffic to9 improve earnings.
- Reservation –related refund of fare to passengers.
- Dealing with the Railway Travelling Agents.
- Refund of fare.

The working hours of all the reservation offices are uniform i.e. 8 hours to 20 hours in main reservation offices and from 8 hours to 14 hours in satellite reservation offices. The shifts are from 8 hours to 14 in satellite reservation offices. T The shifts are from 8 hours to 14 hours and 14 hours to 20 hours. On some Railways, tiffin/lunch break is allowed by staggering the working of the counters, so that some counters always remain open and reservation work is not interrupted. On national holidays and Sundays the satellite reservation offices are

fully closed, while the main reservation offices function in the first shift only on such occasion.

IMPORTANCE OF COMPUTERIZED RESERVATION:

The major benefits of computerized reservation are as follows-

Availability of booking at doorstep: Large scale expansion of PRS terminals in major cities and towns across the lengvth and breadth of the country has brought the Railway booking much closer to the place of living and made it convenient and easy. Now. All people, irrespective of the place of their residence, equally get the facility of reservation.

Universal counter: The PRS has made it possible to book tickets in any train any class and on any date in any counter. Also the facilities such as cancellation, boarding point change, preponement/postponement of journeys, etc. are available on all counters unlike erstwhile manual booking system.

Transparency: The information on fares, availability position of seats and berths etc. is accessible from any counter. Due to universal nature of the counters, the possibility of cheating by providing wrong information by the booking operator is generally ruled out. Moreover,

the information is available through other self-dialling means where manual interface is missing. Computerization has, therefore, brought about transparency in the reservation system. There is nothing to hide from passengers unlike manual reservation. As a result, chances of corruption and complaints have substantially reduced. Now. Passengers themselves can see their status of reservation at the booking counter. They can also check easily the position from time to time either through manual enquiry or Interactive Voice Response System (IVRS).

The transparency has brought about change in perception and increased confidence in the system by reducing the possibility of frauds.

Single window service: With the net working of all PRS completed on 18.4.99, reservation of now possible for any train of Indian Railways from any booking counter located under any of the PRSs. The PRS network has become truly national. It is the second major milestone in the PRS history. Passengers are greatly benefited from this facility. They may plan round trip journeys and get the reservation done in advance from any booking counter.

Reduced queuing time: After introduction of the PRS the productivity of operators has gone up considerably in railway bookings. As a result the queuing time has also come down. Nation-wide, this saves millions of man-hours daily. The Railways have also been benefited due to higher efficiency and productivity.

Bilingual ticketing: Bilibngual ticket printing has made wasy to readyh ticket information for the masses who know only one language- their mother tongue. The public at large is generally satisfied with this customer-friendly service.

Avoiding Frauds: Since the data basis located in the PRS the possibility of frauds has been almost ruled out. Also due to universal nature of counters, an individual booking operator cannot cheat the passenger.

PRS has, therefore, opened immense possibilities of introduction of computers in other service sectors also for providing clean and transparent service.

The accountal of tickets issued, cancelled, modified , etc,. has also become easier, DTC-cum-summary can be prepared by the ECRS at the end of each shift very quickly and accurately.

CHAPTER- II NETWORKING OF PRS

System Network of Computerised Passenger Reservation

NETWORKING

PRS A countrywide online passenger reservation and ticketing system and the world's largest online reservation application, is a complex online distributed client server application developed in 'C' on AVMS using RTR (Reliable Transaction Router) as middleware.

The project of designing, developing a new PRS software as well as PRS interzonal backbone network included :-

- a complex, on-line, mission critical transaction processing application based on client-server technology.
- network the existing PRSs so as to evolve universal terminals allowing reservation operations on all the trains on the network.

Role of Networking includes

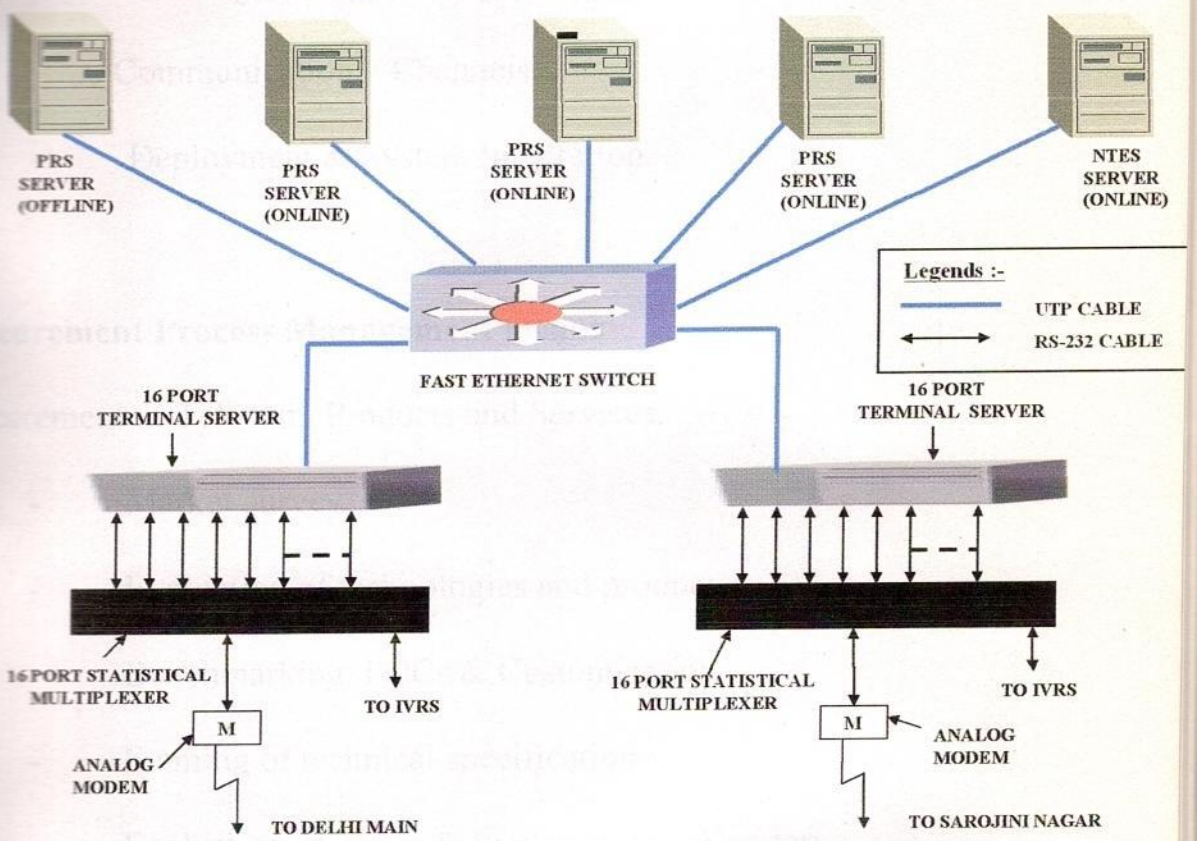
Planning, Design and Implementation of Communication Networks.

Procurement of Telecom products & Services.

Network Management

PRS SERVER AREA NETWORK

DELHI PRS



Network Design means

Planning, Design and Implementation of Communication Networks.

- Requirement Analysis.
- Network Topology, Addressing Scheme.
- Routing Strategy, Sizing of Equipment. and Communication Channels.
- Deployment & System Integration.

Procurement Process Management means

Procurement of Telecom. Products and Services.

- Market survey
- Evaluation of technologies and products
- Benchmarking, POCs & Customization
- Framing of technical specifications
- Evaluation of offers & Liaison with Vendors

Network Management means

Network Management entails

- Performance Analysis
- Capacity planning

- Optimization
- Liaison with Telecom. service providers
- Up-gradation and Maintenance

Need for networking of stansdalone PRSs

Indian Railways consists of several regional Railways each of which operates passenger trains. The reservation pattern on the various trains reveals that 80% of the reservation transaction volume is meant for trains operated by the local Railway, while the remaining are for the trains operated by the other Railways. It is for this reason that Indian Railways computerised the Passenger Reservation operations of the various regional Railways separately, thereby leading to the existence of five different computerised PRSs at Delhi, Bombay, Calcutta, Madras and Secunderabad. To cater to the reservation requirement on trains belonging to all Railways other than the local, a few terminals connected to the remote PRSs were kept.

However, this approach does not fully serve the requirements of the customers. This background clearly indicated the need for a

distributed database approach by which the databases of all the 5 different PRSs are integrated into a single system.

Solution to inter-networking of PRSs

There were two solutions:-

a. *To create a networking layer around the existing applications at the five PRS sites so that the applications at various PRS sites would enter into a peer-to-peer conversation in a synchronous mode and perform a distributed commit for transactions pertaining to different PRS.*

This involved writing of in-house Transaction Processing (TP) software system to resolve the distributed two phase commit related issues.

The pros of this solution were that it would take advantage of using the existing fully operational software and also there would be no major on-line data migration related issues involved in going over to the new system.

The cons were that that the in-house TP software it would be a closed system solution and would be required to be modified/ maintained each time the hardware / operating system were to be upgraded. Also

the organisation's thrust was to concentrate on the application development/ enhancements and not system software development. Another issue was the life cycle of the product. The existing software had grown obsolete for two reasons. One was that it had been coded in FORTRAN which was no longer popular language in the IT community and secondly, the application architecture also had grown obsolete. With the emergence of open transaction processing systems (Middleware) taking care of distributed commits on heterogeneous platforms, majority of contemporary OLTP applications being launched were based on client-server paradigm. This also allowed hardware and software scaleability, and application development in a modular fashion.

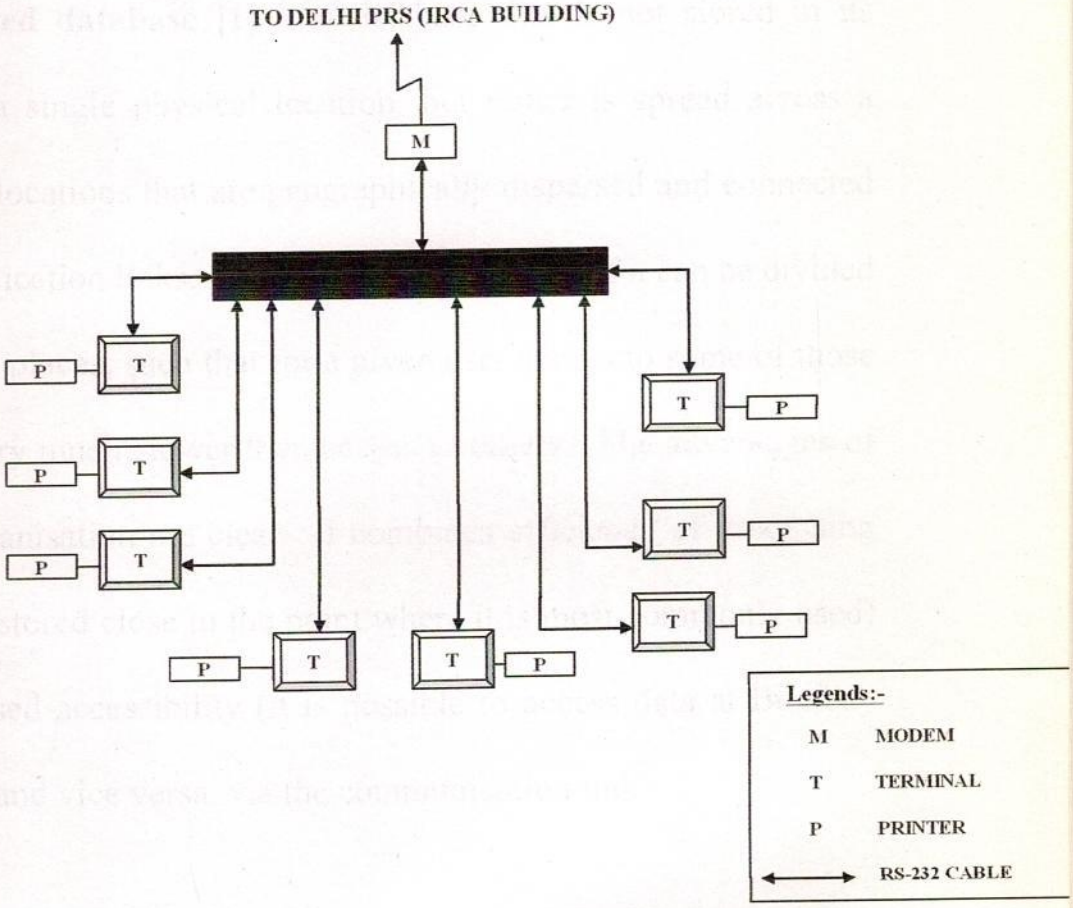
b. *To go in for development of a new software around an existing open transaction processing middleware using the client-server paradigm and replace the esisting software at all the sites and enable networking in a phased manner.*

This would to a large extent keep the man-machine interface more or less same as the existing system so that the operations staff can switch to the new system without training.

The pros were that the advantage of the latest technology would be imbibed during the development of the software. Secondly, it would be woven around a latest state of the art client-server based application architecture which would be scaleable, allow downsizing, open, flexible, maintainable, secure and take in to consideration futuristic requirements and technological changes. It would also get coded in the popular languages thereby graduating from a less popular FORTRAN code. This approach would also take care of the on going changing requirements of the customers. It would also address the shortcomings of the existing system in terms of its design limitations, enhancements and bugs/ anamolies.

The cons of this approach was that it would mean knocking down already existing stable reservation software running at the five regional centres - disruption of services, fine tuning to the local site requirements, migration from older system to the new by data migration of the on-line data. (This would amount to overnight migration of static and dynamic records from old system to the new

PRS TERMINAL DISTRIBUTION NETWORK



with a high degree of accuracy.). It would also amount to training of the customer staff especially if new features (forms) were introduced.

Configuration of PRS as a distributed database

A **distributed database [1]** is a database that is not stored in its entirety at a single physical location, but rather is spread across a network of locations that are geographically dispersed and connected via communication links. A database is distributed if it can be divided into distinct places, such that for a given user access to some of those pieces is very much slower than access to others. The advantages of such an organisation are clear. It combines efficiency of processing (the data is stored close to the point where it is most commonly used) with increased accessibility (it is possible to access data at Bombay from Delhi and vice versa, via the communication link).

A major objective of distributed databases is to provide what is usually called location transparency. Location transparency means that users and user programs should not need to know (i.e. at which site) any particular item of data is located.

The advantage of such transparency are obvious :

It simplifies the logic of application programs, and it allows data to be moved from one site to another as usage patterns change without necessitating any reprogramming.

Distributed PRS offers the following advantages to the Indian Railways.

(i) Local Autonomy

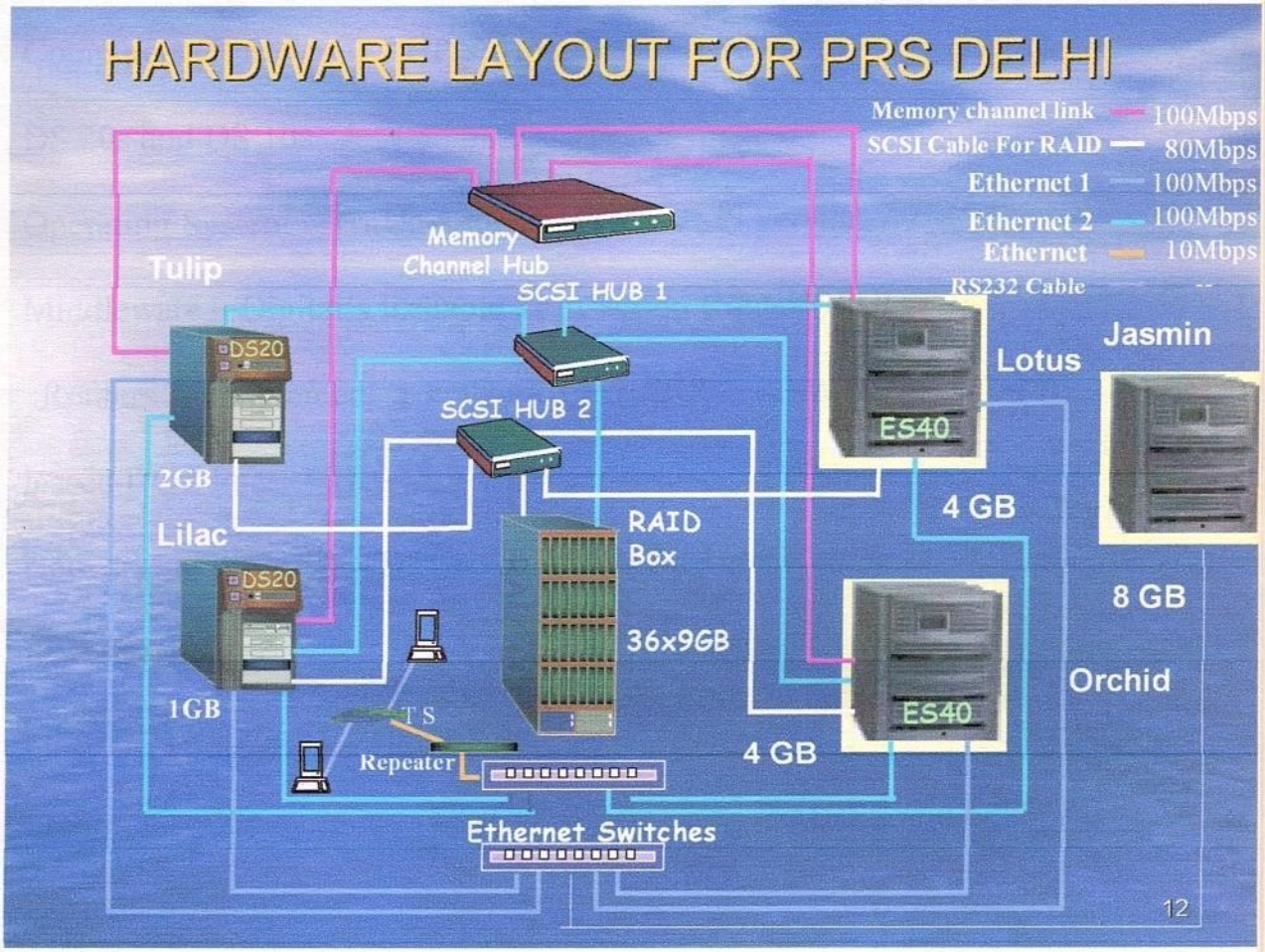
(ii) Capacity and incremental growth

(iii) Reliability and Availability

(iv) Efficiency and flexibility

Distributed transaction Processing approach

Distributed TP approach in its simplest form, so called Client/Server model has been adopted, to develop and implement one of the largest Passenger Reservation Systems, in contrast to centralised TP approach as generally it has been seen in the past that even the largest centralised system can run out of capacity. On the other hand, distributed TP systems allow existing centralised PRS to grow more easily and meet specialised PRS performance requirements.


HARDWARE LAYOUT FOR PRS DELHI
Memory channel link 100Mbps
SCSI Cable For RAID 80Mbps
Ethernet 1 100Mbps
Ethernet 2 100Mbps
Ethernet 10Mbps
RS232 Cable
Memory Channel Hub
Tulip
SCSI HUB 1
SCSI HUB 2
DS20
2GB
Lilac
DS20
1GB
RAID Box
36x9GB
T S
Repeater
4 GB
Lotus
ES40
4 GB
Jasmin
8 GB
Orchid
ES40
Ethernet Switches
12

Salient Features of PRS

Infrastructure used to implement the reservation and ticketing system:-

Computers (Hardware) – HP's AlphaServer hardware

DS 20s and DS 10s

Operating System – TruUnix 64 and Open VMS version 7.2

Middleware – Digital's Reliable Transaction Router (RTR)

Routers to implement a network of 5 PRS Centres over 2 MB leased DOT lines

Networking protocol – DECNET and TCP/IP DecNet phase V/ TCP-IP networking software .

Firewall – Raptor EC version 4.1

Communication systems – CISCO routers using 2 MBPS and 64kbps DOT lines

Over 4000 Terminals connected to the 5 centres over DOT and leased lines

Network topology – partially connected mesh topology.

Networking protocol - DECNET

Front End – VAX Forms, C and FORTRAN as development tools

NETWORK INFRASTRUCTURES

Information Technology based Applications have become more demanding in-terms of speed, reliability, scalability etc. These applications are being developed to build efficient systems and processes and thus save lot of time and effort with-in an organization. The needs and requirements in all spheres of life have forced IT-Organization to re-orient, re-build and re-plan the application architectures.

Network infrastructure is very critical component is supporting the nature of new applications. Infrastructures needs to be intelligent in-terms of understanding the behavior of the applications and dynamically adapt according to the expectations of the same. For e.g. one single network today carries Data, Voice, Fax and Video and the expectations of all these applications are different from the "Network Infrastructure".

Voice is delay sensitive but requires moderate bandwidth, Video is delay sensitive and it bandwidth hungry, Data is of various types like File transfer, Remote Login, Web, Messaging etc and all of them

require different treatment. Network architectures and components thus have to be Application aware, Redundant, Scalable, Reliable, Modular and Manageable.

Building Networks is not a one time job because they need to be augmented, modified, and managed. It has been a challenge for most of the organizations to deploy technologies which can report Network Congestion Points, Traffic Behavior, Down Times etc. so that right action can be taken at right time. Management of networks thus is key to extracting maximum out of the network. The challenges today in overall "Network Management" are because of Multi-Vendor equipment, Intelligence of the equipment to report any malfunctioning, Deployment of equipments is remote areas etc. It is critical to build network keeping in mind the management aspect.

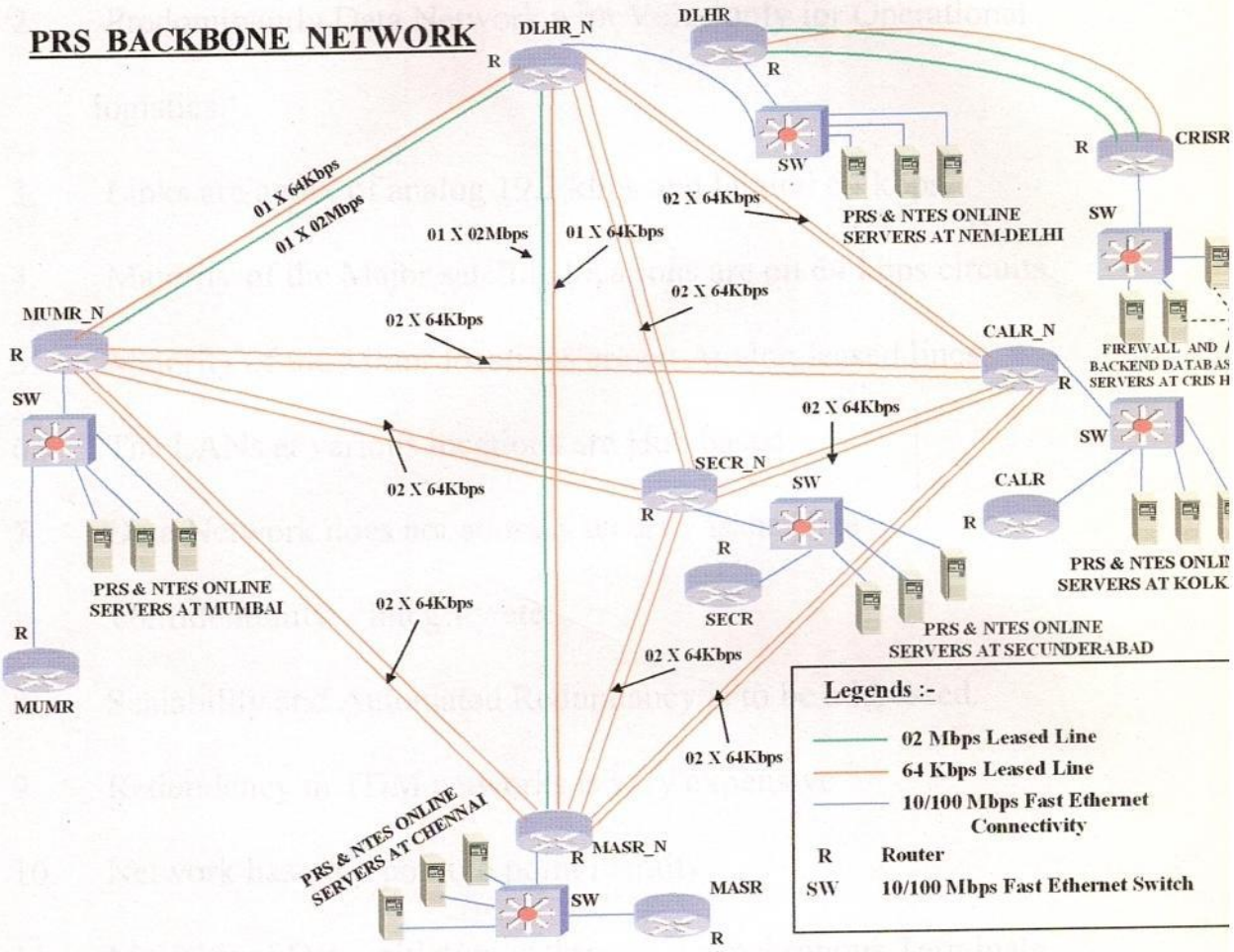
Components of A Network

1. **Network Nodes: Multiplexers, Routers, Switches, PBXs etc. Decides the intelligence of the Net work**

2. **Media : Copper, Fiber, Radio Links etc. Decides the speed, reliability and reachability of the Network**

3. **Network Accessories : Convertors, Modems, LAN Extendors etc.**

4. **End Equipments : PCs, Terminals, Servers, Printers etc.**


PRS BACKBONE NETWORK
DLHR_N
DLHR
R
SW
CRISR
PRS & NTES ONLINE SERVERS AT NEM-DELHI
01 X 64Kbps
01 X 02Mbps
02 X 64Kbps
MUMR_N
CALR_N
FIREWALL AND
BACKEND DATABAS
SERVERS AT CRIS H
SECR_N
CALR
PRS & NTES ONLINE SERVERS AT MUMBAI
SECR
PRS & NTES ONLIN
SERVERS AT KOLK
PRS & NTES ONLINE SERVERS AT SECUNDERABAD
MUMR
PRS & NTES ONLINE SERVERS AT CHENNAI
MASR_N
MASR
Legends :-
02 Mbps Leased Line
64 Kbps Leased Line
10/100 Mbps Fast Ethernet Connectivity
R Router
SW 10/100 Mbps Fast Ethernet Switch

PRESENT PRC NETWORK

1. Presently Time Division Multiplexing Based Network.
2. Predominantly Data Network with Voice only for Operational logistics.
3. Links are a mix of analog 19.2 kbps and Digital 64 kbps.
4. Majority of the Major satellite locations are on 64 kbps circuits.
5. Majority of the Minor locations are on Analog leased lines.
6. The LANs at various locations are Hub based.
7. Data Network does not address security issues like confidentiality, integrity etc.
8. Scalability and Automated Redundancy is to be addressed.
9. Redundancy in TDM networks is very expensive.
10. Network has only point to point identity.
11. Majority of Data initiation is through Asynchronous Terminals.
12. Data requirements are increasing very fast.
13. PRS networks of various zones already connected on routing backbone with redundancy.

CHAPTER-III PRS SYSTEM'S ARCHITECTURE.

CONCERT (Country-wide Net work of Computerized Enhanced Reservation & Ticketing), inter comnnets the regional computing systems into a National PRS grid .

Evolution of PRS

Before 1985: Manual System

1985:Pilot Project online at Delhi

1988:IMPRESS Phase I implemented

1991:IMPRESS Phase II implemented

1994:CONCERT phase I implemented

1997:CONCERT phase II implemented

1999:All India Network commissioned

2000:E-CONCERT implemented

Full cost for CONCERT development and Implementation

CONCERT development and implementation has been one of the topmost projects at national level. Following is an estimate of the cost of CONCERT development and implementation spent till date:-

1. Application development and implementation cost 7 crore

2. Maintenance cost/ year ... 2.6 crore

Architecture

" As *the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution*"

ATTRIBUTES OF ARCHITECTURES OF APPLICATIONS OF IR

Scalability

Horizontal scalability is achieved by Data Partitioning

Vertical scalability is achieved by using Middleware

Reliability

RAID Levels 0 and 1give reliability of data at disk level

Stand by servers give reliability against servers failures

Highly Performant

Static Information required for validation is loaded in the cache of client machines.

Information required for faster access of records is loaded in the cache of server machine.

Response Time is 1 second for local transactions.

Response Time is 3 seconds for remote transactions.

Flexibility

Flexible enough to support Web Interfaces around it

Maintainability

Offers support for single copy of the application for better maintenance, administration and release management Security

Supports two tier security: One at Terminal Level and another at User Level

ARCHITECTURE OF PRS

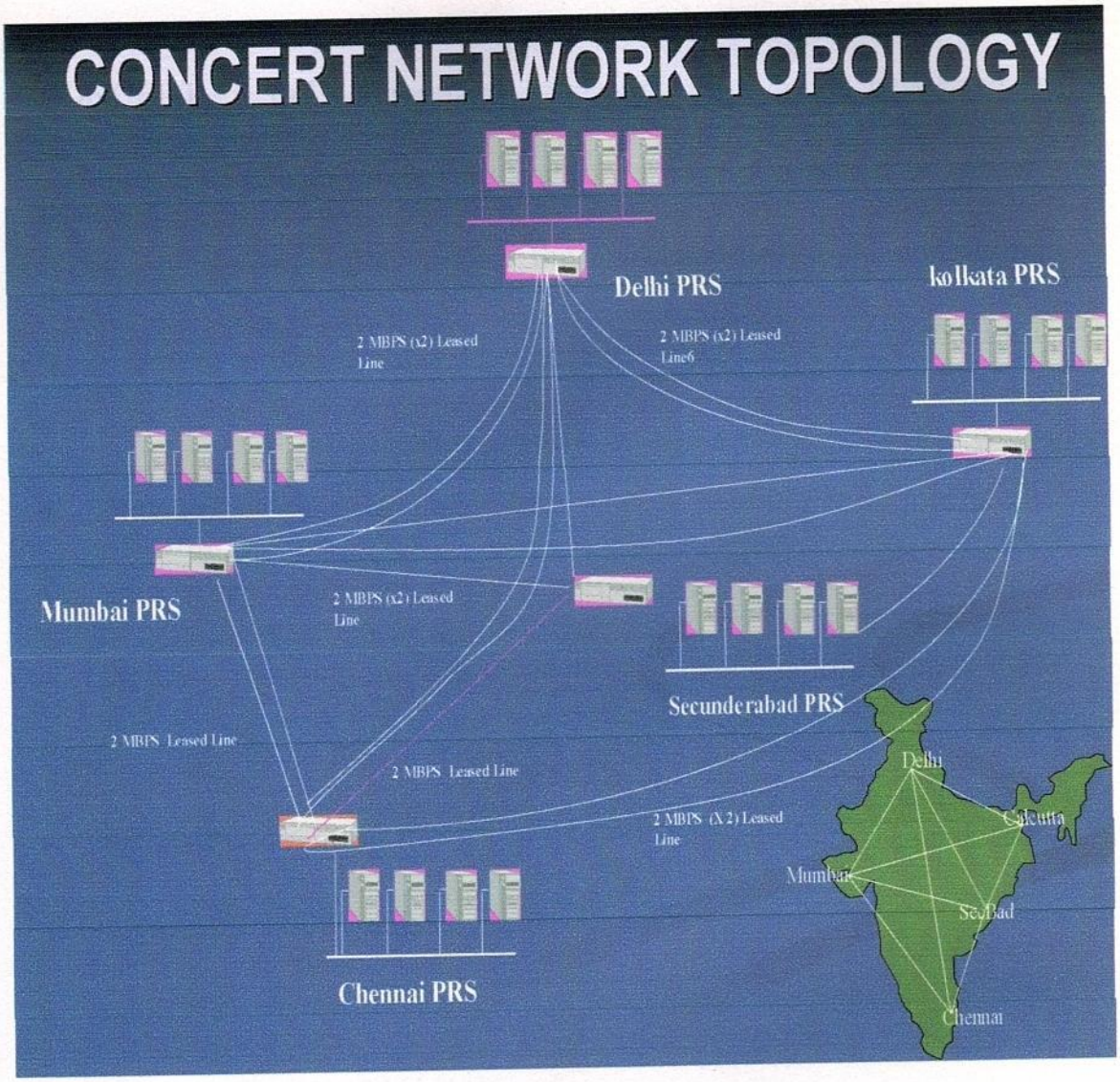
3-Tier Architecture

Client is a dumb terminal written in high level language C

Middleware is a Reliable Transaction Router version 4.1 based on the principles of Message Passing.

Backend server process is written in C language using flat files and in-house developed database.

Distributed Data Model


CONCERT NETWORK TOPOLOGY
Delhi PRS
kolkata PRS
2 MBPS (x2) Leased Line
2 MBPS (x2) Leased Line6
Mumbai PRS
2 MBPS (x2) Leased Line
Secunderabad PRS
2 MBPS Leased Line
2 MBPS Leased Line
2 MBPS (X 2) Leased Line
Chennai PRS
Delhi
Mumbai
Chennai

Bus architecture capable of being extended in both horizontal and vertical direction

FEATURES OF CONCERT SOFTWARE:

CONCERT, a fully automated passenger reservation system is a complex on-line distributed transaction application based on client-server architecture interconnects the standalone regional computing systems into a National PRS grid. The salient features of CONCERT software are:-

- Allows passenger from anywhere to do a booking for a journey in any train in any class from anywhere to anywhere.
- Handles reservations, modifications, cancellation/refunds, 31 supervisory on-line functions and 21 on-line enquiries.
- Performs reservation for over 9,95,000 seats and berths (peak rush as high as 10,17,000) daily.
- Available on over 2600 trains nation-wide for various classes
- Bookings for over 8400 destinations
- 4619 reservation terminals
- Across about 1232 locations.

CONCERT software offers a range of operating options which include:-

- 40 types of quotas
- 8 types of trains,
- 11 types of classes,
- 199 types of discounts (concessions),
- More than 102 types of bogies etc.
- Prints bilingual journey tickets and passenger manifests both in English and in Hindi.
- One Million Lines of Code in C-Language
- 18 Server machines distributed across the country at 5 regional Data Centres
- Reservation, cancellation and modifications for any train from anywhere upto 60 days in advance and 360 days in advance for Foreign Tourist .
- Provides a response time of less than two seconds for the reservation transaction irrespective from where it originates from and offers services for 7 days a week 365 days a year with 99% uptime.
- Caters to newer requirements namely,
- Tatkal bookings,

- Bookings over telephone (Tele-booking)
- Bookings by Travel agents (RTSA bookings).
- It has a complex algorithm for seat allocation based on the preference of the passengers in addition to dynamic waitlist management. In addition, the allocation logic has been programmed for optimal utilisation of the seat/ berth resources on trains.
- complex rules, validations and fare computation techniques inter woven in the application .
- High grade Finance/Management Information Systems to generate reports ranging from end of the shift, daily, periodical, to monthly reports
- Database administration package to cater to dynamic operational requirements with respect to changes in train profile , timetables and fares.
- A comprehensive user interface with hierarchical panel and pop up menu screens has been provided with extensive help on most of the user input fields and self prompting cursor movements.
- Efficient security measures have been built in to the system so that the functionality access by the users is controlled. This has been

achieved by implementation of hierarchical levels of user and terminal profiles.

- CONCERT prepares reservation charts so that all the passengers are mapped onto their respective seats and seats are allotted to the waitlisted passengers. It also allows for last minute changes in the composition of the train by adding /deleting /modifying a coach before the chart gets finally prepared.

Interfacing with the external world

Interactive Voice Response systems to enable telephonic enquiry access to the CONCERT database

Teletext/TV displays of the availability positions of major trains.

Touchscreen interface for on-line display of enquiry at important locations

Passenger Traffic Handled. .

Dynamic Information available on the website.

- PNR status
- Trains between a pair of stations
- Accommodation availability
- Train Schedule
- Station-code.

All the above enquiries are also available through SMS on mobile phones.

Static information dissemination.

- Reservation/Refund Rules
- General information
- Tourist information
- Special trains

The static information is also available in Hindi.

National Train Enquiry System www. Trainenquiry.com for current train status.

Dynamic Information

- Spot your train
- Find your train
- Arrivals
- Departures
- Passing by trains

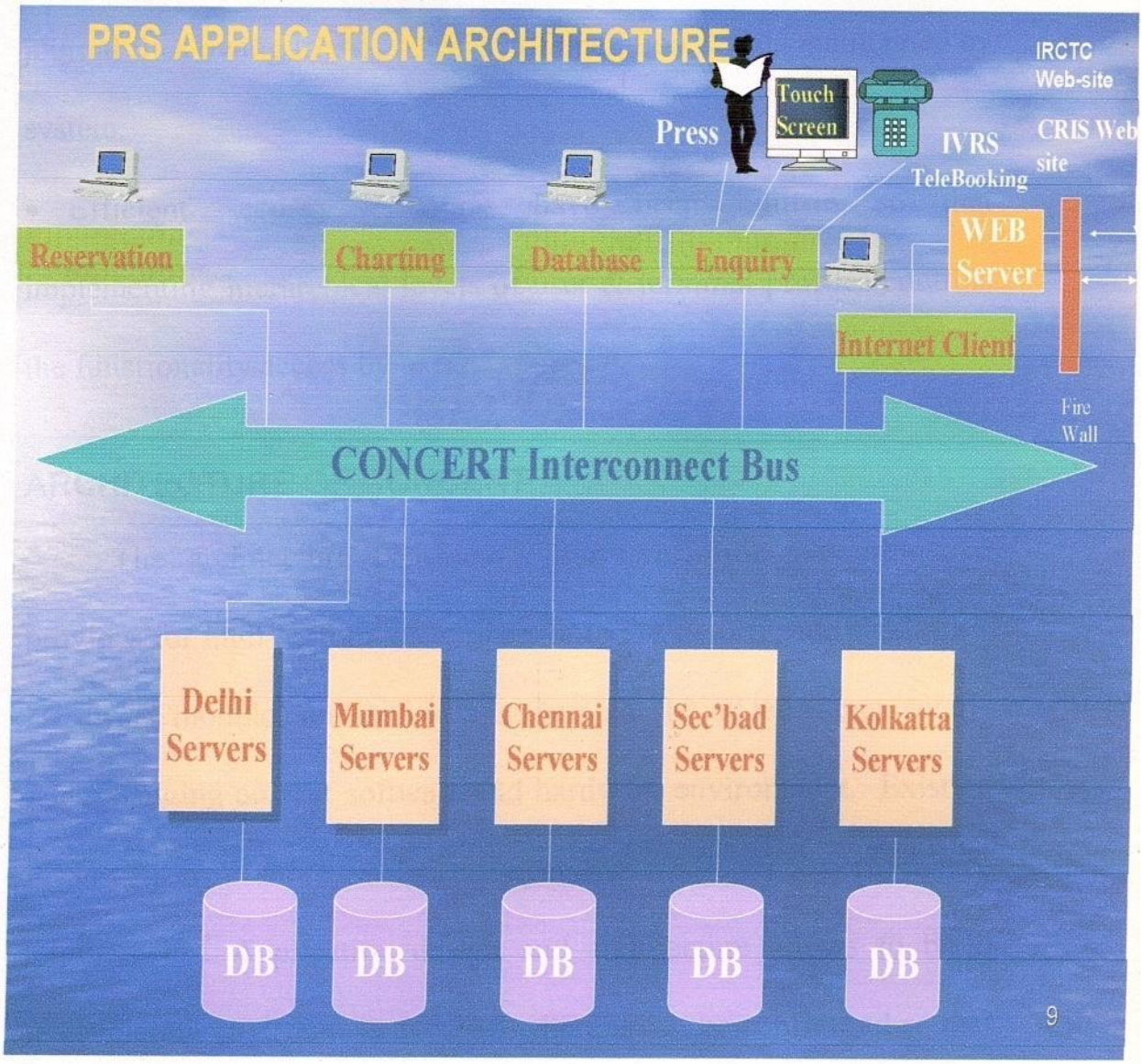
Static information

- Train time table
- Prestigious trains
- Railways amenities

- Railway rules
- Tourist information

PARAMETERS OF CONCERT

- It comprises over 5000 procedures and 1,000,000 lines of computer codes. It has taken some 100 years of developmental/ implementation effort.
- Single copy of the software running on all PRS sites.
- It is highly modular in design resulting in easy maintainability.
- It is a parameter driven software.
- There is a unique PNR (Passenger Name Record) independent of Train, Date, Route & Class (TDRC).
- The application's business logic is coded as client and server. It has the facility to offload much of the validation work to front end machines, in the process releasing the back end machines for only fast data processing.
- It has a transaction process (TP) monitor facility.
- It takes care of the various types of failures at the transaction level, disk access level and terminal or overall system level by means of dual porting, volume shadowing, signal time outs, online


PRS APPLICATION ARCHITECTURE
IRCTC Web-site
Press
Touch Screen
IVRS TeleBooking
CRIS Web site
Reservation
Charting
Database
Enquiry
WEB Server
Internet Client
Fire Wall
CONCERT Interconnect Bus
Delhi Servers
Mumbai Servers
Chennai Servers
Sec'bad Servers
Kolkatta Servers
DB
DB
DB
DB
DB
9

reconfiguration of failed terminals, recovery from last back up & log journal files owing to the criticality of operation & data maintained by system.

- Efficient security measures have been built-in so that implementing hierarchical levels of user & terminal profiles controls the functionality access by users.

ARCHITECTURE OF CONCERT

The architecture provides a framework for networking. It provides for high performance, scaleability, reliability, and flexibility. Hardware modules and software servers can be added incrementally with changing current software and hardware environment. Existing PRSs can grow more easily and meet specialised PRS performance requirements. Application design and architecture allows to build fault-tolerant environment for PRS where it can be configured so that the application continues to work even on certain hardware failures. The architecture is open, needless to say, it supports a well defined interfacing with external systems. It is adaptable i.e., it allows for configurability of software to adapt to different sites and changing environment. It supports for remote system maintenance features. The client server architecture has been implemented using **Reliable**

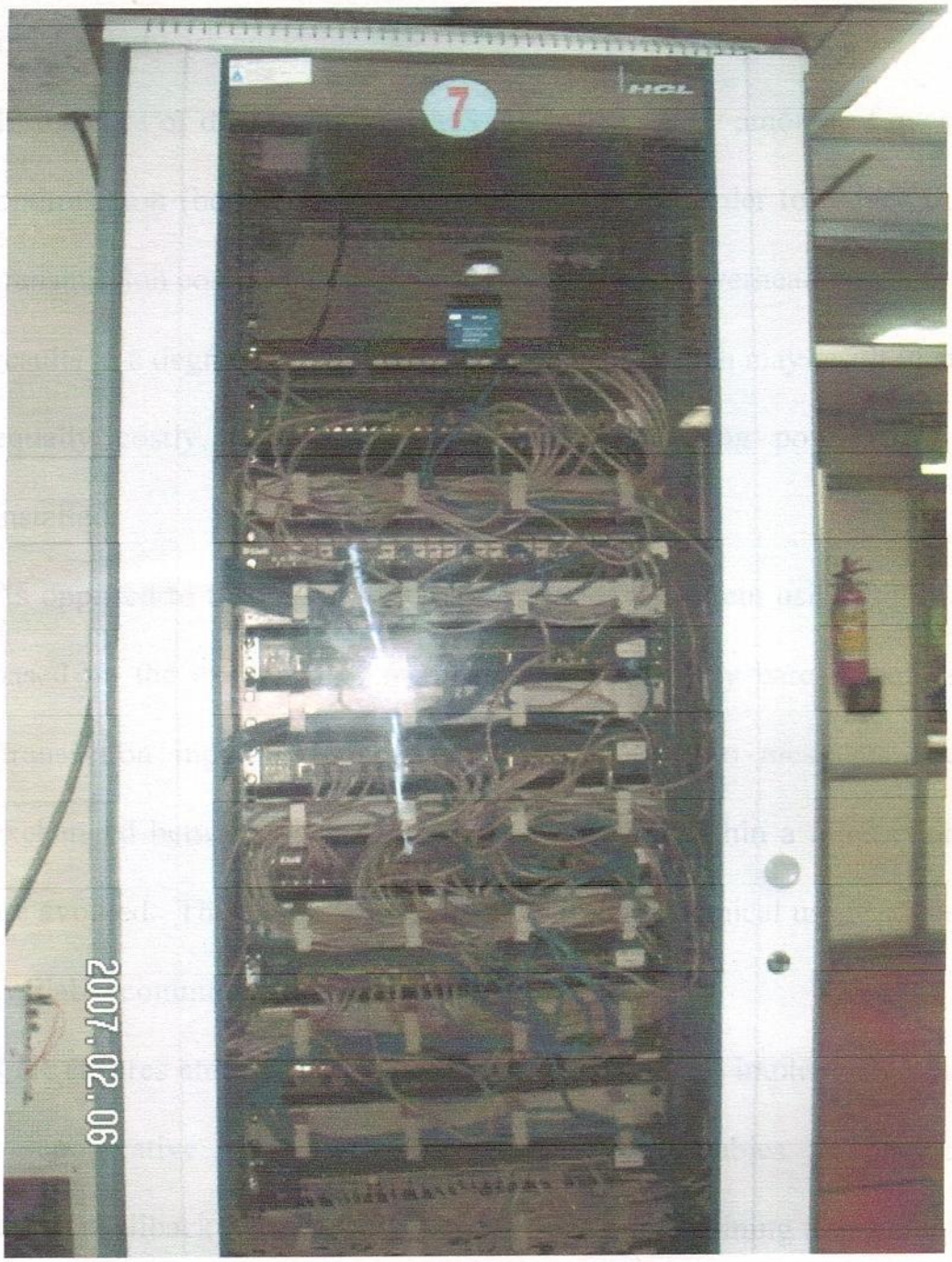
Transaction Router (RTR) [2,3] as the middleware. RTR provides an environment for developing highend distributed application. It ensures the 'ACID' (Atomicity, Consistency, Isolation and Durability) properties of a distributed transaction.

IMPLEMENTATION OF CLIENT-SERVER ARCHITECTURE THROUGH RTR

The Client/Server model implemented through Reliable Transaction Router (RTR) involves running forms processing on a front-end-processor, and the database and applications managers on a back-end processor. As the user interface is handled by the front-ends which invariably are local, the overhead on the communication lines is reduced.

The purpose of RTR is to provide a transparent transaction routing function, using partitioned data model. In fulfilling this role, RTR acts as the interface between user-written transaction Requesters (Clients) and Servers by "breaking" the network end-to-end coupling thus removing the network considerations from the application programmers. Hiding the network operations from the TP application writers not only allows the Programmer to view the application as a

ROUTER RACK



relatively simple remote procedure call, but offers several advantages in large network environments.

In the case of distributed RDBMS network a heavy amount of query optimisation (both Local and Global) is done in order to reduce the transmission cost over communication lines. This overhead inevitably results in a degradation in transaction response which may result in an equally costly, if not more, additional processing power to be installed.

As opposed to this scenario, the distributed TP system using RTR is based on the exchange of messages, in which only bare essentials (transaction input and output) are composed into messages and exchanged between sites, interactive exchanges within a transaction are avoided. This approach results in a more economical usage of the available communication bandwidth.

RTR ensures atomically of transactions (all or none) implemented by a cooperative termination protocol. It enables automatic failover/failback of Servers on a backend while remaining transparent to the requesters executing on a remote Front End. RTR includes System Management Utilities For On-line Monitoring, help facilities and system control. These include statistics of queues,

requesters/servers and system manager control of RTR application distributed over a large network.

RTR is not tied to any particular DBMS or any particular forms package. This allows for the retaining of the existing PRS forms interface making the user interface similar (thereby minimising any significant training efforts for users of the system). Also, a file system specially tuned to the requirements of the application is being used.

FUNCTIONALITIES OFFERED BY CONCERT SOFTWARE

CONCERT software offers a range of operating options which include 40 types of quotas , 10 types of trains, 9 types of classes, 125 types of discounts, 100 types of bogies etc.

In addition it prints bilingual journey tickets and passenger manifests both in English and in Hindi. It is designed to provide a response time of less than two seconds for the reservation transaction irrespective from where it originates from and offers services for 7 days a week 365 days a year with 99% uptime.

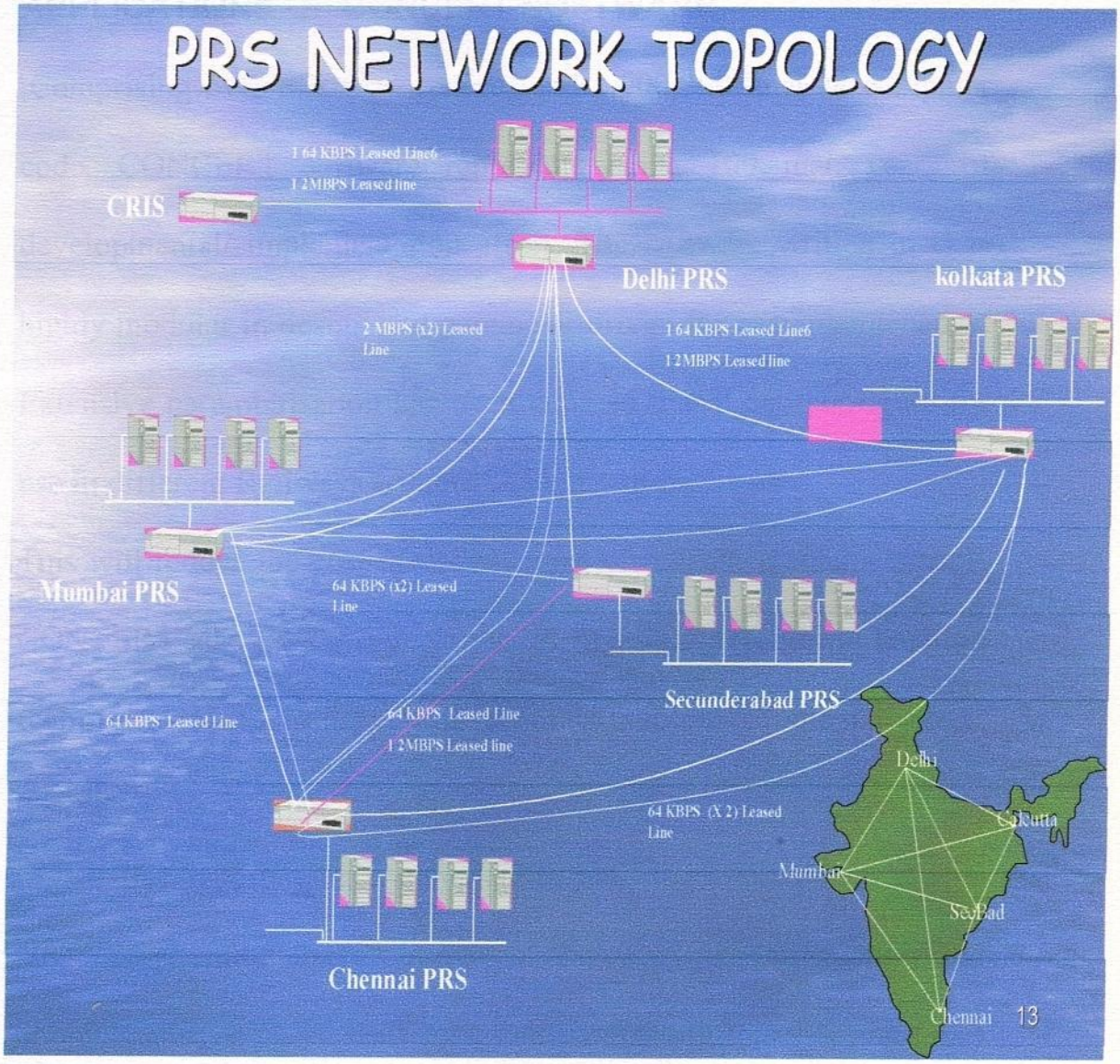
The software handles reservations, modifications, cancellation

refunds , 26 supervisory on-line functions and 15 on-line enquiries. It has a complex algorithm for seat allocation based on the preference of the passengers in addition to dynamic waitlist management.

The software has complex rules, validations, fare computation techniques inter -woven and a high grade Finance \ Management Information Systems to generate reports ranging from end of the shift ,daily , periodical, to monthly reports and Database administration package to cater to dynamic operational requirements with respect to changes in train profile , timetables and fares. A comprehensive user interface with hierarchical panel and pop up menu screens has been provided with extensive help on most of the user input fields and self prompting cursor movements.

Extensive validations on the user inputs has been implemented to ensure database integrity. Enhanced design for giving unique PNR which is independent of Train-Data-Router-Class (TDRC) has been implemented.

Improved design for recovery to ease preventive software maintenance thereby reducing the system downtime has been incorporated. Efficient security measures have been built in to the system so that the functionality access by the users is controlled. This


PRS NETWORK TOPOLOGY
1 64 KBPS Leased Line6
1 2MBPS Leased line
CRIS
Delhi PRS
kolkata PRS
2 MBPS (x2) Leased Line
1 64 KBPS Leased Line6
1 2MBPS Leased line
Mumbai PRS
64 KBPS (x2) Leased Line
Secunderabad PRS
64 KBPS Leased Line
64 KBPS Leased Line
1 2MBPS Leased line
64 KBPS (X 2) Leased Line
Delhi
Mumbai
SecBad
Chennai
Chennai PRS

has been achieved by implementation of hierarchical levels of user and terminal profiles.

APPLICATIONS OF CONCERT SOFTWARE

Comprising over 5,000 procedures and 1,000,000 lines of computer code, CONCERT software represents some 100 man years of developmental/ implementation effort. The software written in C is highly modular in design and parameter driven for easy maintenance. Extensive paramterisation has been done so that it can configure for use in different Railways without changing the software.

This will reduce the cost of the software maintenance/enhancements.

CONCERT also uses a state of the art **dynamic extendible hashing technique [5]** for quicker and accurate access of the passenger records.

CONCERT incorporates a complete in-built logic to cater to a wide range of potential users based on choice of accommodation and optimum utilisation of seats for groups travelling together and takes into account 40 kinds of quotas for example, defence personnel, foreign tourists, pass holders, road-side quotas etc.

CONCERT prepares reservation charts (Passenger Manifests) so that all the passengers are mapped onto their respective seats and seats are allotted to the waitlisted passengers. It also allows for last minute changes in the composition of the train by adding /deleting /modifying a coach before the chart gets finally prepared.

The system also takes care of various types of failures at the transaction level, disk access level, and terminal or overall system level by means of dual porting, volume shadowing, signal time-outs, on-line re-configuration of failed terminals, recovery from last backup and log journal files owing to the criticality of operations and data maintained by the system.

The system is interfaced with the outside world through reservation terminals (across the counters), through slow data channels carrying messages across the Indian railway's internal communication system , Interactive Voice Response systems to enable telephonic enquiry access to the CONCERT database and teletext displays of the availability positions of major trains.

CONCERT – IN SHORT

Like all other cybernetic software systems, CONCERT is an evolving software. Owing to its flexibility and scaleability, it allows for modifying effectively maintaining the production environments while they are up and running without disrupting critical operations. With the reliance of Railways on CONCERT increasing everyday, disaster backup configurations, backups of databases etc. are being planned to increase the dependability of the whole system.

With the commissioning of the entire national network, CONCERT would make available basic services to the customers. Also over the times CONCERT would also bring about sophistication in these services in an effort to continually keep in pace with the changing requirements of the customers and serve the needs of the customers to their satisfaction.

CHAPTER-IV BENEFITS OF UTS AND ITS NETWORKING

Unreserved Ticketing System (UTS)

Indian Railway is the most popular mode of transportation in India. But it is continuously under threat by the newly introduced cheap domestic airlines and public buses. The Indian Government has earmarked handsome amount to construct Express Highways golden quadrilateral National Highway connecting four major metropolitan cities.

BACKGROUND ...

Indian Railways, the world's second largest Railway carries around 15 million passengers every day, out of which some 14 million passengers travel in the un-reserved category.

Unreserved ticketing constitutes major component of the overall ticketing in Indian Railways. On Northern Railway, of the total of 1.2 million passengers are booked per day , 93 percent forms un reserved segment

It contributes a large amount of earning for Indian Railways.

EVOLUTION OF UNRESERVED TICKETING

Earlier system for booking of unreserved Passengers?

Unreserved passengers are cleared by commuter trains,unreserved passenger trains and GS coaches attached to Mail/express trains.For these passengers,unreserved tickets as well as MST/QST were issued .

printed card tickets

self printing ticketing machines

unreserved ticketing system (uts)

Manual – Printed Card Tickets/EFTs/BPTs.

PROBLEMS EXPERIENCED IN PRINTED CARD TICKETS

- huge cost involved in printing presses
- accountal is very complicated
- dispensation through ticket tubes and direction wise windows are required to be opened
- during fare change,lot of pre-printed card tickets become obsolete
- re-use by manual correction not desirable
- High costs involved in printing, stacking and packing.
- Tedious disposal of obsolete and damaged tickets

- Manual corrections during Fare RevisionManual procedure for
- preparing Accounting Details

MAJOR DEFICIENCIES IN MANUAL SYSTEM

Printed Card Tickets is prone to forged and fake ticket sale, besides recycle of tickets. This includes, defacing of tickets in regards to date, value & class of travel

Time lag in demand- Time overrun in indenting and supply.

supply of card tickets leads to non-availability of tickets for required destinations and thereby giving a scope for re-circulation and sale of fake ticket.

To over come the short comings in the use of pre-printed card tickets- system of dispensing tickets through SPTM **s was developed**

SPTM is a ticket-printing machine in a standalone mode and operates on a PC-based Station Server.

It issues unreserved tickets, one hour before the departure of the train at a small station and round the clock on the same day of journeys at larger stations

LIMITATIONS OF SELF PRINTING TICKET MACHINES

Standalone Machines - each machine being in stand alone can be manipulated by the operator .

Cancellations were restricted to the issuing counters -

Facility of Advance Tickets not available

no cancellation across the counters

no central accounting of tickets sold through sptms.

Database Updations were time consuming -

fare changes or surcharge etc. are difficult to implement as eproms are required to be burnt in individual machines-leads to the problem of version control besides cost and time involved .

Highly Fraud-prone System

Data of each machine is transferred to PC after the closure of 8-hour shift

The SPTM printers are vulnerable to manipulation and fraud some of the frauds committed on sptms

In **Western Railway**,fraud was committed in connivance of maintenace engineer of vendor by blocking data transfer of fraudulent tickets to the PC of SPTM .

At **Jalandhar city Railway** station a fraud of around 6 crores invoving generationof high value sptm tickets on stationary accounted for low value by manipulating the printer was detected

What is the need for new UTS?

Following shortcomings were experienced in the present system of the issuance of unreserved tickets: -

(i) Tickets are sold only from journey commencing station and one hour before the departure of the train.

(ii) Strenuous waiting and long queue make passengers feel miserable in purchasing the tickets.

(iii) Opting forced gratis travel by the passengers due to non-availability of tickets easily.

Printed Card Tickets/EFTs/BPTs are prone to fraud and re-use of tickets for the repeated journeys on the date as printed on the ticket.

Mismatch in demand and supply of PCTs/EFTs/BPTs also generate re-circularation of tickets.

Fraud activities prevalent in SPTM generated tickets.

Authenticity of Earnings and Accountal are manual / periodical and cumbersome.

In order to overcome the imitations and shortcomings of SPTM Unreserved ticketing system (uts) was conceptualised on the lines of PRS

UTS -- SHORT SUMMARY

To improve customer satisfaction, revenue generation, accounting and reporting capabilities and reduce fraud, Indian Railways, the world's second largest railway carrying 11 million passengers daily, created the Unreserved Ticketing System.

This system has improved the traveling experience for customers while providing Indian Railways with significant operational efficiencies and management capabilities.

UTS is the complete solution to provide computerized unreserved tickets to railway passengers from dedicated counter terminals, hand-held terminals, smart card, automatic vending machines etc.

ROUTER RACK

OBJECTIVES OF UTS

The vast majority of passengers do not purchase their tickets in advance, the unreserved tickets had to be purchased at the station from which the passengers were departing and have been available for purchase only one hour prior to departure, unreserved passengers have had little choice but to wait in long lines in congested stations to buy their tickets. In addition to the significant customer dissatisfaction this has created, the ticketing system has been the source of a number of operational problems for Indian Railways including system downtime, lost revenue, fraud, cumbersome reporting and accounting, and high maintenance costs.

Determined to remedy these problems, and anticipating growth in passenger traffic in the range of 60 percent, Indian Railways' Centre for Railway Information Systems (CRIS) undertook the creation of a new '24 X 7' system for issuing unreserved tickets.

The objectives were to:

Enable passengers to purchase unreserved tickets at any booking station for travel to any Indian Railways destination

Allow the purchase of unreserved tickets up to 30 days (a configurable parameter) in advance of a travel date

Eliminate manual ticketing and reporting

Reduce station congestion

Prevent fraud

Increase revenue generation

Improve the reliability and availability of the ticket issuing system while reducing the total cost of ownership

Ensure station servers always have the most current fare and route information

Provide management with more timely transaction information

Ensure data and application security

Allow system upgrades to be implemented more simply and cost-effectively from a central location

To achieve these objectives and create an infrastructure that would support increasing passenger traffic, seamless system upgrades

and the incorporation of new technologies as they emerge, CRIS chose to develop the new Unreserved Ticketing System as a three-tier application built entirely on open standards.

Tier One: Indian Railways' central server

Tier Two: Zone Headquarters and Station Servers

Tier Three: Dumb terminals and thin-client machines at the ticket generation points

A diagrammatic representation of the architecture is attached

CRIS is looking for a highly efficient and lightweight smart client platform that can execute all it's terminal based applications in a distributed computing environment, where the smart clients are going to be spread across India will be synchronizing the data with the Central Data Centre.

The UTS (Unreserved Ticketing System) application which keep track of the issued un-reserved tickets, is the main application to run on this platform. This system issues tickets based on *preconfigured fares, which is synchronized from the central database* to the local embedded database. The system is capable of working in stand alone mode for a minimum interval of two days, in case of a

link failure. It can do this because when it loses the server link it will store/cache the transaction data to the local storage, which is a flash memory card . It continues to do this until the server link is back online. When that happens, the Smart Client sends the stored data, in the order in which it was received, to the server where it will be posted to the database like any other transaction.

The underlying OS has to provide support for this activity as well as keep in mind features as security, stability and maintainability. The OS can also run scheduled synchronizations on a hourly/ daily/ weekly/ monthly basis, if required.

Passengers have the option to buy tickets :

Passengers can get tickets in advance up to 3 days (a configurable parameter), from any station to any station.

From non-journey station / non-railhead.

It provides exceptionally hassles free and little time consuming services.

SALIENT FEATURES OF UTS

Enables the passenger to get a ticket from any of the cluster UTS location to any destination station on Indian Railway served by them

Added advantage of issuing tickets for journey on a future date up to 3 days in advance.

Renewable of MST/QST permitted 10 days in advance.

Unreserved Ticketing System over Northern Railway

was announced by Hon'ble MR for Delhi area in budget speech of year 2002-2003

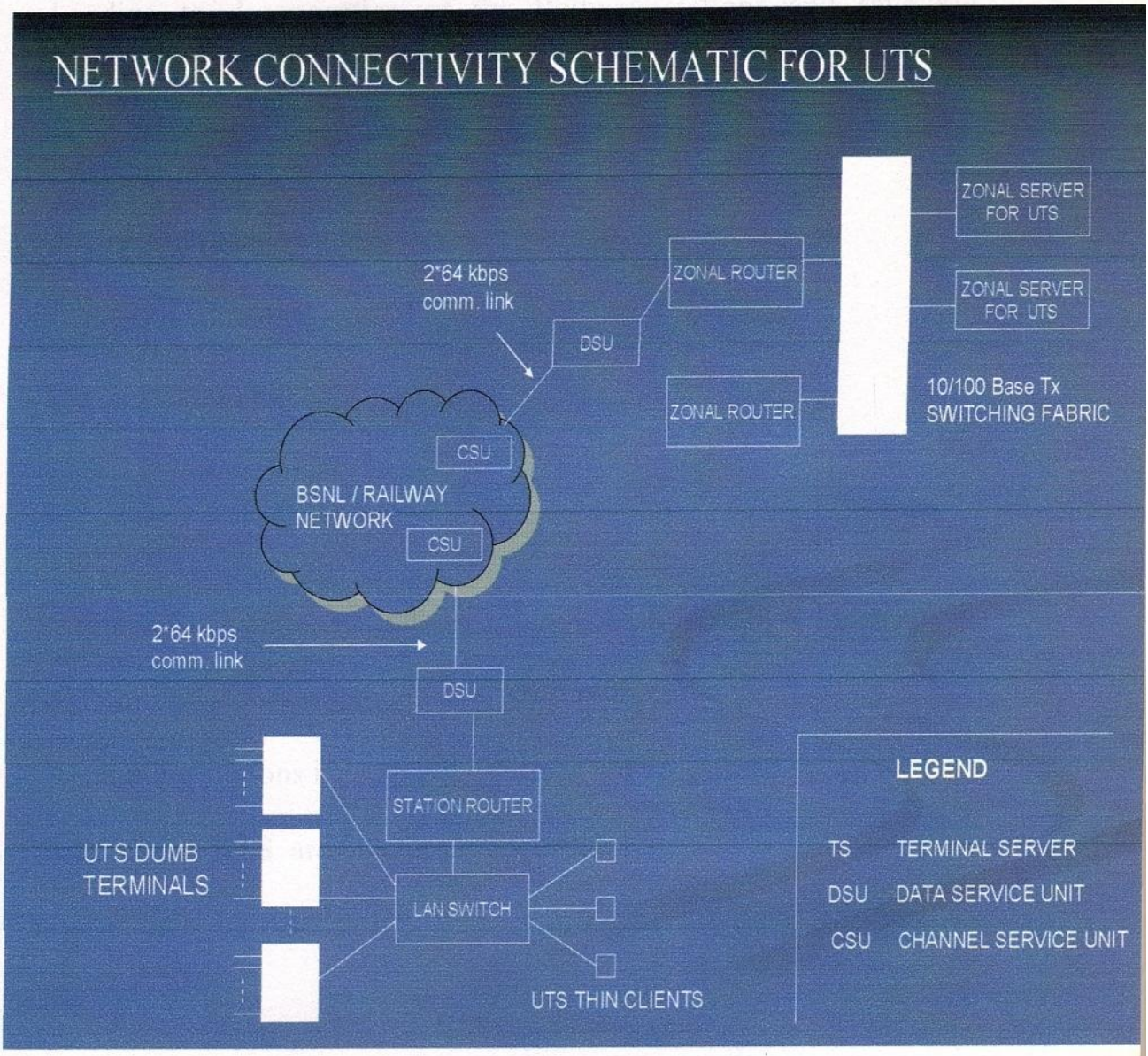
UTS was introduced with the inauguration of 10 stations/ locations on 15.08.2002 in Delhi area.

On Northern Railway 87 locations with 322 counters have been commissioned.

On an average 2.5 to 3.0 lakhs tickets, approximate 8.0 lakhs passengers are being handled per day.

On an average Rs 2.5 to 3.0 crores revenue is earned per day.

Enables the passenger to get a ticket from any of the cluster UTS location to any destination station on Indian Railway served by them.


NETWORK CONNECTIVITY SCHEMATIC FOR UTS
ZONAL SERVER FOR UTS
ZONAL SERVER FOR UTS
2*64 kbps comm. link
ZONAL ROUTER
DSU
ZONAL ROUTER
10/100 Base Tx SWITCHING FABRIC
CSU
BSNL / RAILWAY NETWORK
CSU
2*64 kbps comm. link
DSU
STATION ROUTER
UTS DUMB TERMINALS
LAN SWITCH
UTS THIN CLIENTS
LEGEND
TS TERMINAL SERVER
DSU DATA SERVICE UNIT
CSU CHANNEL SERVICE UNIT

Added advantage of issuing tickets for journey on a future date up to 3 days in advance.

Renewable of MST/QST permitted 10 days in advance.

Leading to decongestion of the Railway stations and save the passengers from last minute hassles and waiting in queue.

3-Tier Architecture

Tier-1: Zonal server

Tier-2: Station Server

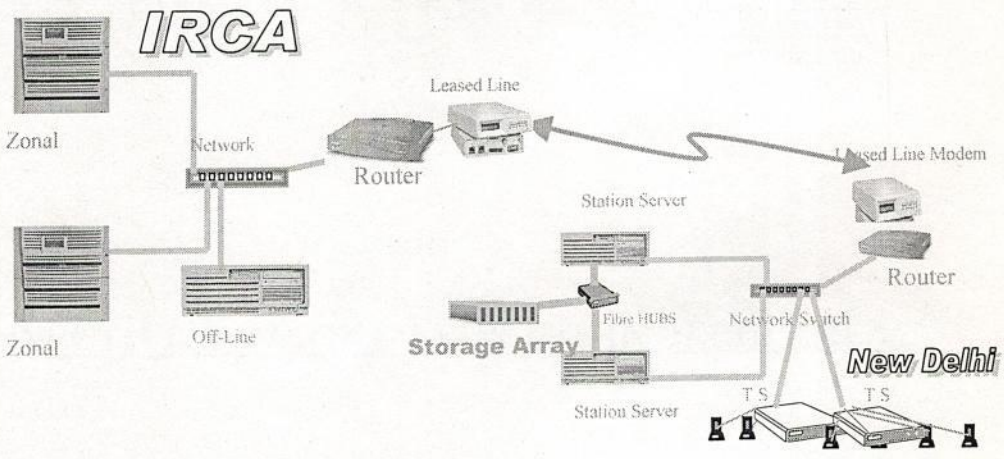
Tier-3: Dumb terminal

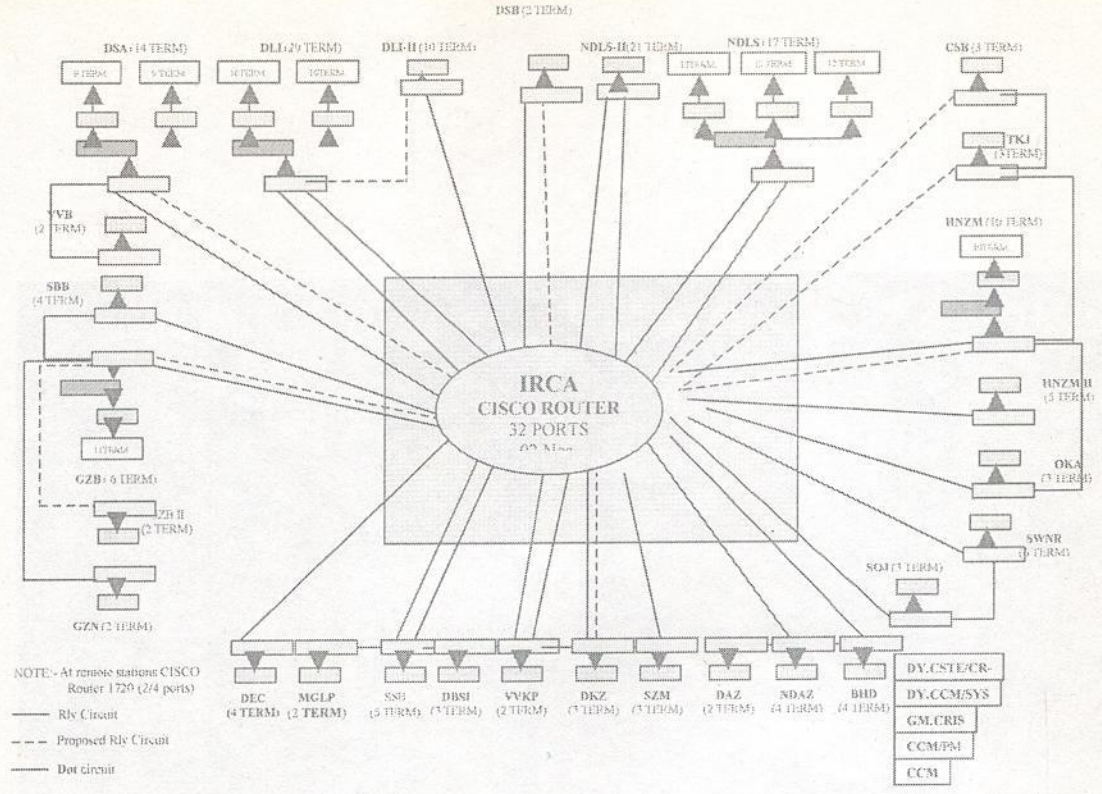
Terminals at 4 major stations i.e. NDLS, DLI, HNZM & GZB linked with the zonal server through stations servers .

Remaining stations have direct interface with the zonal server.

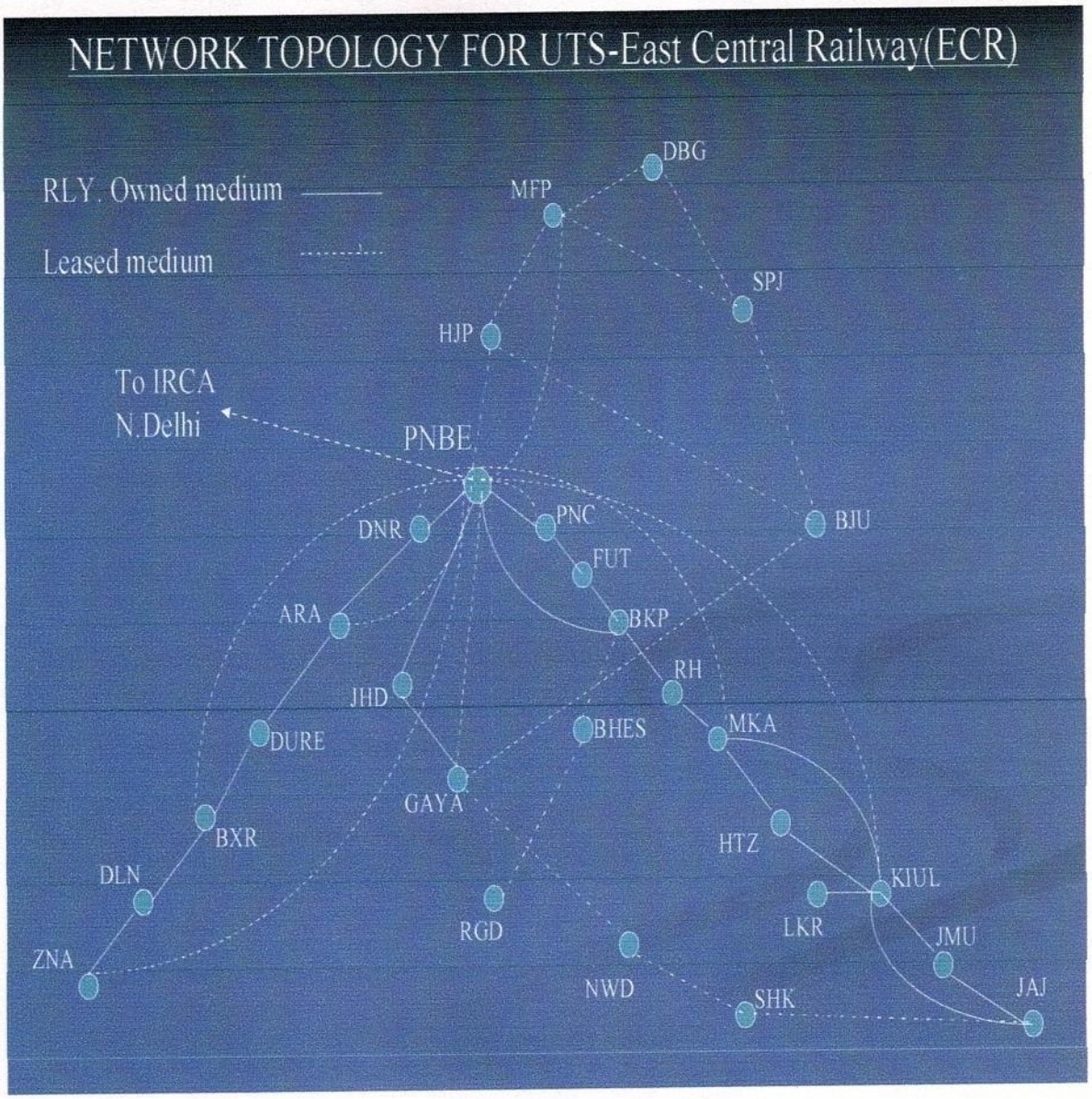
Delhi zones UTS architecture is enclosed

UTS ARCHITECTURE





CONNECTIVITY DIAGRAM FOR UTS IN DELHI AREA


NETWORK TOPOLOGY FOR UTS-East Central Railway(ECR)
RLY. Owned medium
Leased medium
To IRCA
N.Delhi
DBG
MFP
SPJ
HJP
PNBE
DNR
PNC
BJU
FUT
ARA
BKP
RH
JHD
BHES
MKA
DURE
GAYA
BXR
HTZ
DLN
KIUL
RGD
LKR
JMU
ZNA
NWD
SHK
JAJ

How will passengers be benefited by UTS ?

Passengers have the option to buy tickets:

(i) Passengers can get tickets in advance upto 30 days, from any station to any station.

(ii) From non-journey station / non-railhead.

(iii) It provides exceptionally hassles and little time consuming services.

How will the Railway be benefited by UTS ?

(i) To have cost effective management system.

(ii) Keep pace with the technological environmental changes.

(iii) To encourage the people to purchase the tickets in advance.

(iv) To decongest the station.

(iv) To eliminate the chances of providing sale of forged and fake tickets.

(vi) To prevent recycling of tickets / leakage of Railway revenue.

(vii) To have fraud free printed tickets at a time only one,

provisioned in modified Wipro & TVSE printers.

(viii) To have foolproof inventory management of ticket rolls/ other

stationery.

(ix) To have centralized online accountal sale proceeds.

(x) To eliminate the manual working by generating online MIS report.

(xi) To have rational analysis of pattern of traffic to enable

(xii) Railways for the augmentation/de-augmentation.

(xiii) UTS No. ____ PNR No._____ of the MST/QST Holder will be the key for automatically getting the Passenger Information. This will save time.

(xii) Last but not the least, Railway will have revenue 30 days (now 3 days) in advance.

IMPACT ON BUSINESS ENVIRONMENT

More secure

Central accounting, auditing.

Reduced fraud mechanism

Industry standard software/hardware

Central management of the entire application

Software release

Fare modification

Database modifications

Central monitoring

Easier maintenance

Single point for external world connectivity

Reduced cost

Single point authentication and management

Single source of repository for analysis

CHAPTER-V UTS SYSTEM'S ARCHITECTURE

UNRESERVED TICKETING SYSTEM

UTS is the Computerized System for the issuance of unreserved tickets for Indian Railway. Unreserved ticketing constitutes major component of the overall ticketing in Indian Railways. It contributes a large amount of earning for Indian Railways.

Indian Railways, the world's second largest Railway carries around 15 million passengers every day, on approximately 8500 trains touching 7000 stations, out of which some 14 million passengers travel in the un-reserved category.

UTS is the complete solution to provide computerized unreserved tickets to railway passengers from dedicated counter terminals.

Salient Architectural Features of Computerised System for issue of Railway Tickets to Unreserved Passengers

RDBMS based software running on unix server at zonal level with dumb terminals with limited intelligence at ticketing window

Zonal server for on- line centralized accounting

Enhanced security by use of user and terminal validation

Centralized management of route tables and fare tables –no need to change EPROMs at each machine.Reduction in maintenance cost and enhanced security of data base

Proper accountal of each ticket issued

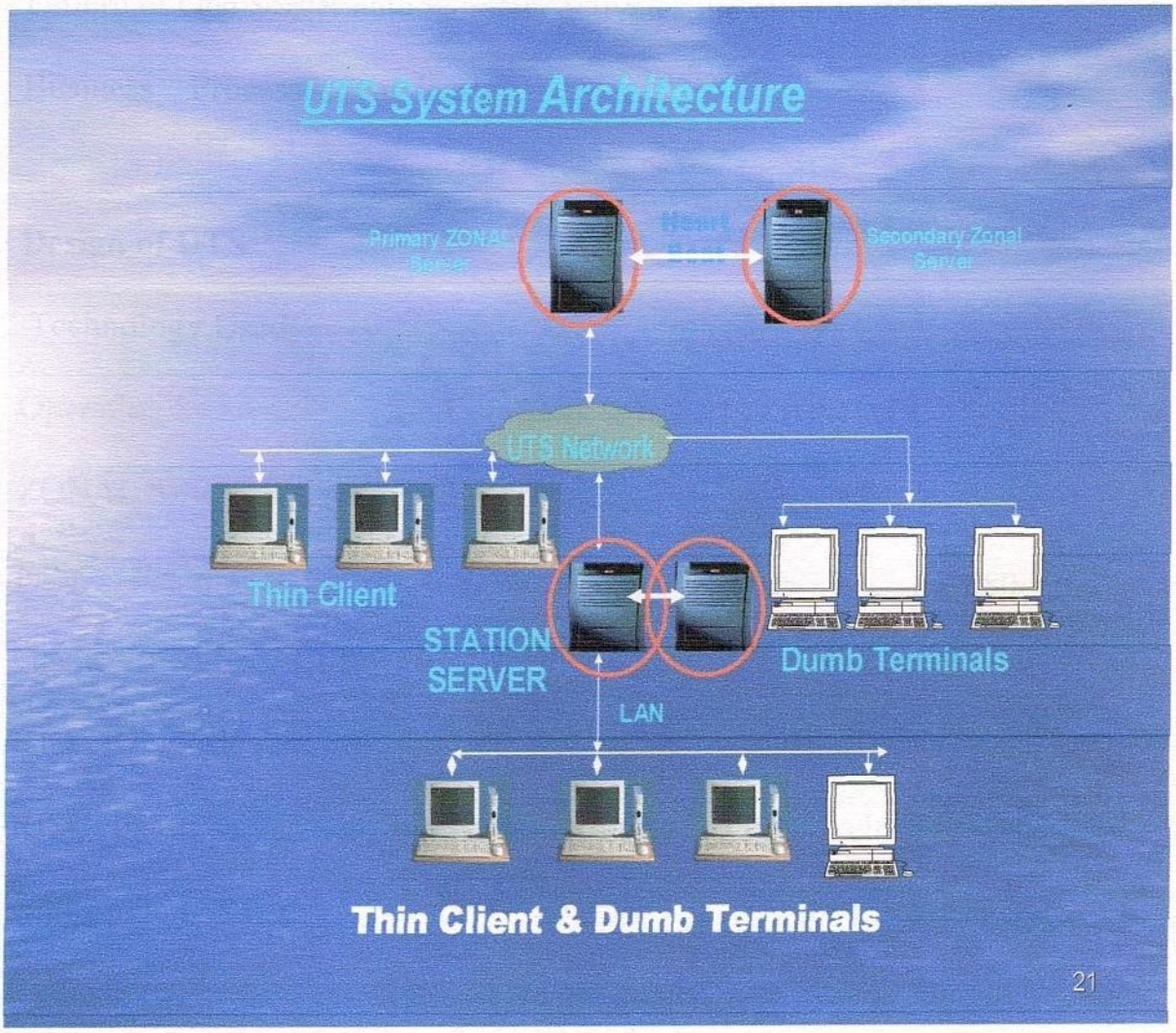
Because of centralized accounting,broad demand and OD flows of unreserved passenger traffic segment help in demand forecasting for various unreserved segments

Usage of modified ticket printers with UTS eliminates the kinds of frauds committed in SPTMs because of printer

Printers have panel less working and also platen knobs have been removed to eliminate physical manipulation of movement of ticket rolls

Ticket rolls have been covered in a box with keys with the supervisor for divided security of rolls

Ticket stationary thickness increased from 90 GSM to 130 GSM – carbon copy of ticket can not be generated es ticketing even in the event of link failure as full logic is on it.


UTS System Architecture
Primary ZONAL Server
Secondary Zonal Server
UTS Network
Thin Client
STATION SERVER
Dumb Terminals
LAN
Thin Client & Dumb Terminals
21

Architecture Summary

No Single Point of Failure

Deployed over a Cluster of Two Servers with Shared Storage Box

Failure of One Server automatically activates the other to take over

Business Processes seamlessly.

Design of UTS

Technology Used –

Operating System : UNIX SUN SOLARIS / IBM AIX

ZONAL SERVER

RISC based unix server with storage and backup- 2 x sun 880-r cluster 2 CPU machines

STATION SERVER

RISC based server with storage and backup – 2 x sun 280-R cluster with single CPU

RDBMS : Sybase (HA Enabled)

•Front-end : C++

What Sybase products have been used in this project?

1. Sybase's ASE (Adaptive Server Enterprise)

2. Sybase's ASA (Adaptive Server Anywhere)
3. Sybase's Replication Server
4. High Availability Sub System
5. Adaptive Server IQ

IMPORTANT FEATURES OF UTS

Computerised Unreserved tickets for current / advance Daily Journeys, Monthly / Quarterly passes from a predefined cluster of location to any station over entire IR using a highly user friendly interface.

Feature to issue other general types of tickets like platform tickets, Money Reciepts and Identity cards

Across the counter cancellation of tickets issued from anywhere.

Provision of fare enquiry and enquiry on UTS number.

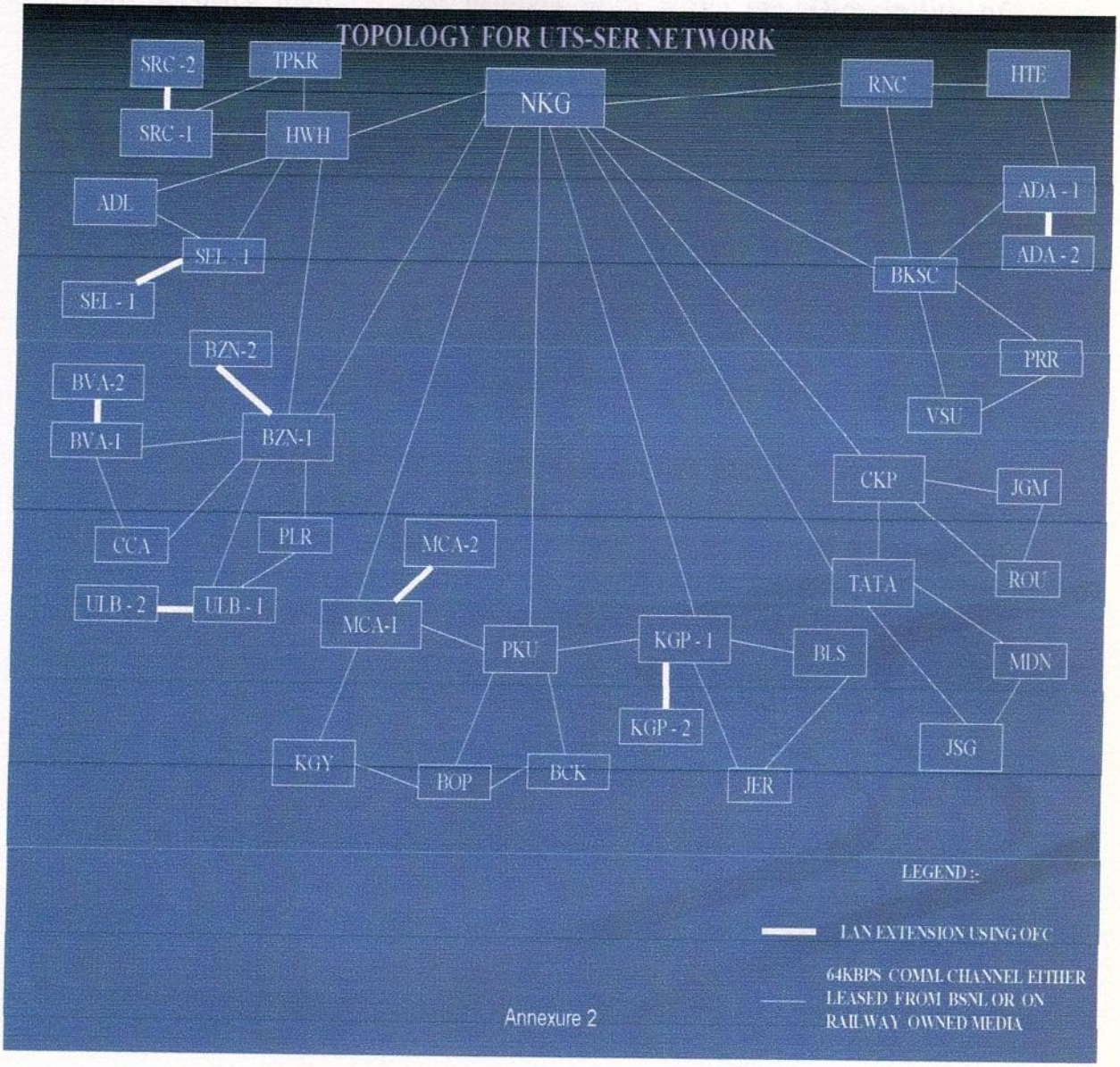
Minimized the possibilities of manipulations and malpractice.

Ease of Data Management

Providing secure access mechanism.

Centralized

Accounting


TOPOLOGY FOR UTS-SER NETWORK
SRC -2
TPKR
NKG
RNC
HTE
SRC -1
HWH
ADA - 1
ADL
ADA - 2
SEL - 1
BKSC
SEL - 1
BZN-2
PRR
BVA-2
VSU
BVA-1
BZN-1
CKP
JGM
CCA
PLR
MCA-2
TATA
ROU
ULB - 2
ULB - 1
MCA-1
PKU
KGP - 1
BLS
MDN
KGP - 2
JSG
KGY
BOP
BCK
JER
LEGEND :-
LAN EXTENSION USING OFC
64KBPS COMM. CHANNEL EITHER LEASED FROM BSNL OR ON RAILWAY OWNED MEDIA

Annexure 2

Database and system administration.

SOFTWARE RELEASES / UPGRADES

Enhanced auditing features (at the client as well as server side).

More security features like printers with locks etc. (Possibility of venturing into bi-directional communication)

More Informative Ticket with built in Fake ticket identification features

The application logic and database software were developed using C++, Sybase Adaptive Server Enterprise 12.5 (ASE 12.5), Sybase Replication Server and a High Availability Sub System of Sybase, all of which reside on the Zone and Station UNIX-based servers. They provide the information and functionality needed by end-users working from dumb terminals in order to sell and print the unreserved tickets. The dumb terminals are connected to the Zone and Station servers via 64 KB phone lines over routers that have been configured for maximum security.

The thin clients, such as handheld and automatic ticket vending machines, are Linux-based diskless PCs, using 144 MB Flash ROM to

accommodate the operating system and iAnywhere Solutions' Adaptive Server Anywhere mobile database. These clients are networked to Zone and Station servers via a TCP/IP connection.

The thin client contains the full business logic for ticketing, foot print version of the Red Hat Linux operating system, iAnywhere Solutions Adaptive Server Anywhere trimming done (by R&D team of CRIS) and space to store details of tickets sold, all embedded inside the 144 MB Flash ROM. The thin client issues the ticket using the business logic stored in it without interacting with zone or station server. But it sends all the ticketing transactions periodically to the zone server for cancellation and accounting purposes.

On the other hand, the dumb terminals are fully dependent on zone and station servers for ticketing. If their link with zone and station servers goes down, tickets cannot be issued. The thin clients, however, can continue to issue tickets even if the link with zone and station servers goes down. This is the key difference between the thin clients and dumb terminals.

PRS NETWORKING ROOM

Thin Clients as a pilot project has been implemented in East Central Railway w.e.f Feb 2005 and is found to be working smoothly.

Beyond making it easier for passengers to purchase unreserved tickets, the new system's three-tier architecture delivers much needed functionality. Specifically:

The bi-directional synchronization capability of the system's Sybase database management systems enable fare and route information to be updated on one central server and pushed out to all points of sale. Likewise, information on ticket sales is automatically sent to the railway's central server.

Upgrades and new releases of the ticketing system software can be distributed to all points of sale from the central server, rather than having to be installed on each remote machine.

Both station servers and the central server can generate reports instantaneously.

The specially printed tickets produced by the new system feature index numbers, bar codes and a unique typeface that ensure they are valid and enable management to track ticket sales and usage more effectively.

System maintenance, including disk clean-up, defragmentation, and changes in configuration can be performed from a central location.

The system now has a failover and failback capability to ensure continued ticketing operations in the event of a hardware or network outage that interrupts the connection between the central server and the point of sale.

The new ticketing system was developed in a period of just nine months and was implemented in two phases beginning with a pilot and continuing through deployments in the Railway's Northern, East Central, Eastern and North Eastern service zones.

KEY FEATURES OF THE APPLICATION

Computerised unreserved ticket from a predefined cluster of location to any station over entire IR.

Computerised Tickets for Monthly Season Tickets / Quarterly Season Tickets, platform tickets and Identity cards.

Tickets can be issued upto 3 days (a configurable parameter) in advance

Across the counter cancellation of tickets .

Supports ticketing on multiple train types namely – Ordinary / Mail Express / Jan Shatabdi etc.

Supports ticketing for 102 Concessions

Ease in adding new terminals, users, locations, routes, and concession codes

Generation of Multiple Accounting Reports to meet requirements at all levels. There are about –

30 Daily Reports

26 Monthly Reports

26 Periodic Repots (generated on 1st, 11th and 21st of every month)

20 MIS Reports

Unreserved tickets can be issued from the application for Passenger Reservation System's trains to improve utilization.

IMPLEMENTATION DETAILS OF THE APPLICATION

Counters all across IR are to be served from Nine Server Locations. The matrix indicating the dependencies is as follows –

Server Location / Non-Server Location Matrix

S.No.	Server Location	Railways to be Served
1.	Northern Railway	Northern Railway, North Central Railway, North Western Railway
2.	Southern Railway	Southern Railway, South Western Railway
3.	Central Railway	Central Railway, West Central Railway
4.	Western Railway	Western Railway
5.	North Eastern Railway	North Eastern Railway
6.	Eastern Railway	Eastern Railway, Northeast Frontier Railway
7.	East Central Railway	East Central railway
8.	South Central Railway	South Central Railway
9.	South Eastern Railway	South Eastern Railway, South East Central Railway, East Coast Railway

Approximate Cost of implementation per zone is about Rs 1.5 Cr

Therefore, for 9 zones implementation cost is roughly about 13.5 Cr

Why New UTS

Unreserved Ticketing in its present state has many shortcomings spanning from huge installation and maintenance cost to no centralized management and monitoring. Introduction to new technologies and enhancements are either not available or very costly to implement.

To achieve the goal of modern ticketing system the solution adopted should not only solve the immediate and short-term needs but also be able to incorporate the future technologies easily and quickly.

BENEFITS OF NEW UTS

Cost effective

Near zero downtime

Quick implementation

Highly flexible to future enhancements

Both in terms of software

And technologies like smart card, wireless communication, web enabling, hand held terminal

More secure

Central accounting, auditing.

Reduced fraud mechanism

Enhanced cancellation

Enhanced integration

Industry standard software/hardware

Central management of the entire application

Software release

Fare modification

Database modifications

Central monitoring

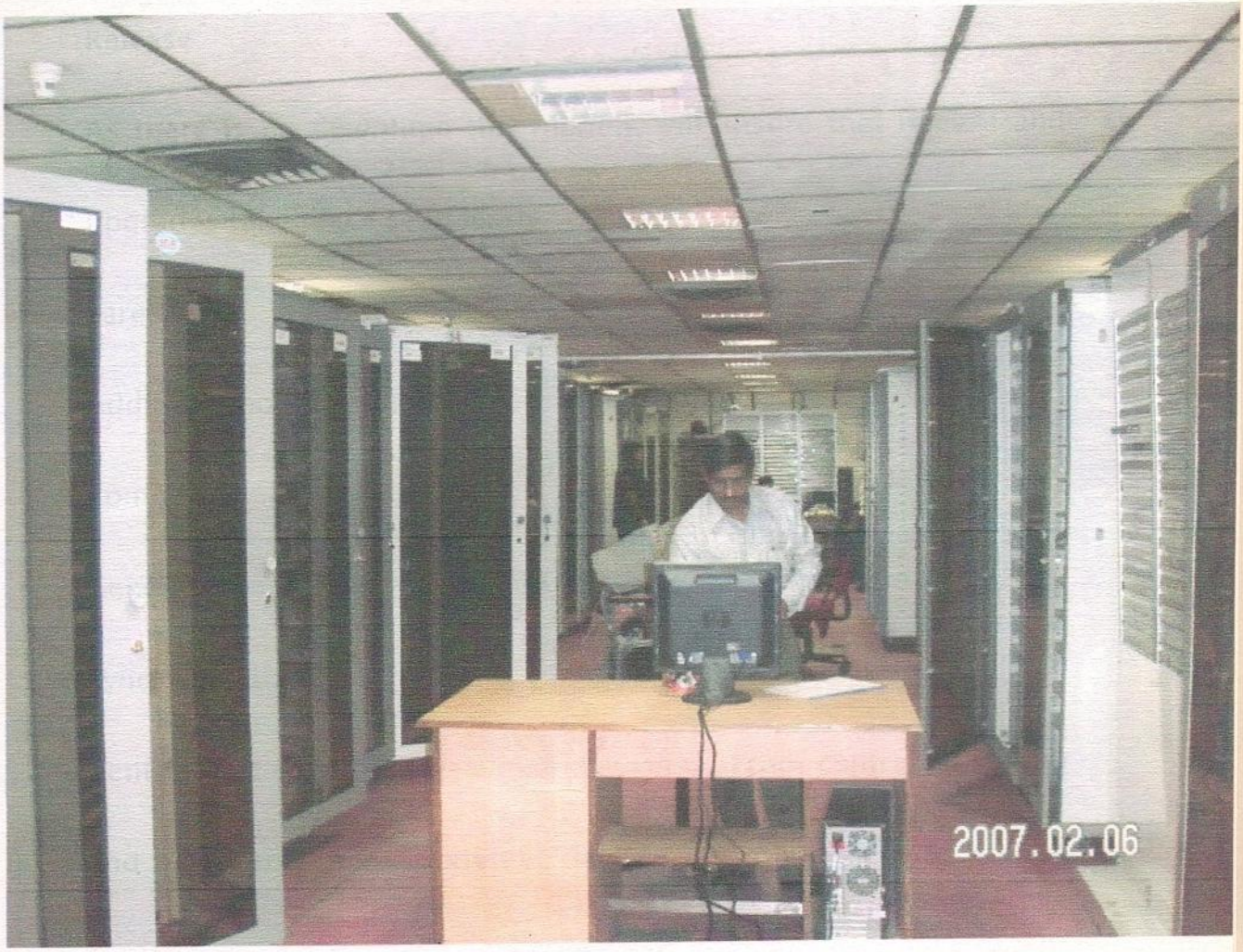
Easier maintenance

Single point for external world connectivity

Reduced cost

Single point authentication and management

SERVER ROOM



Key Features of new UTS

Release

As there is no downtime this module will ensure that release and upgrades take place seamlessly

Fare

Addition, modification, new fare release

Route

Generic logic to find routes from any where to any where

Synchronization

Central m/c to station m/c and vice versa. From central to station and vice versa. From external devices like hand-held to station servers.

Reports

Instantaneous

Printable and viewable

At station server

At central server

Printing

Index Numbers

Bar Code

Help

Context sensitive

Common architecture for different client types like hand held, DBA, counter, management, report

Monitoring

Warning, activity, failure, synchronization, networking

Testing

Test lab/ offline m/c, simulation of station environment, rigorous testing before release.

Healing

Disk cleanup, de-fragment, database cleanup, threshold enhancements]

Authentication

Of devices

Machines

Users

Fail over/failsafe

Hardware, software, database, network (LAN/WAN) fail over and fallback

IMPLEMENTATION PHASES

The entire implementation of the pilot project is divided into 5 phases

They are:-

Phase–I : The Zonal server application will be deployed at IRCA which will provide the functionalities of Ticketing of Unreserved , MSTQST and platform tickets and also the relevant accounting information. Initially The ticket can be issued for a journey starting station with in a defined cluster of stations and the journey ending station can be for which the routes are defined. The list of 21 station which are to be covered under phase-I is at annexure – "A"

The zonal servers will have the following additional features:

Periodic database and fare modification, addition of new user, location, station etc

Periodic information uploads from the station server to zonal server for MIS and accounting process.

Software upgrades/ release to station server machine from the zonal server.

Regular monitoring and management of station server and terminals from zonal server.

Drops will be provided to the divisional head quarters, traffic account office, EDP centre, printing press and statistical branch for both monitoring compilation and checking purpose.

The category 'Z' locations will be directly connected to this server

Phase-II : In this phase Station server application will be implemented at the five major stations. The list of 5 stations with number of terminals to be installed is at annexure – "B"

The features of the station server will be :-

This will contain the entire logic of all types of ticketing activity.

This will upload the transaction and management related information to the zonal server at regular predetermined interval (10 minutes)

The database, software and application logic can be updated from a remote location without physical intervention.

It will server large number of thin clients/ dumb terminals for ticket generation and printing purpose.

Phase – III : In this phase Centralised Accounting module will be implemented. The existing CARS machines will be connected to the new UTS system.

Phase – IV : In this phase the tickets to the passenger can be issued for a journey for any starting station with in a defined cluster of stations and the journey ending at any station for which the routes are defined.

Phase – V: In this phase external interfaces like ATM machines and smart card will be implemented. Touch screens will also be put up at the selected stations where passenger can buy the ticket based on debit card or smart card.

UTS BASED EMBEDDED TERMINAL

Based on Linux this is highly customized. Customization in Linux is much more than Windows XP Embedded architecture. Customization is required for enhanced security, very high compression for enhanced memory/storage usage, enhanced performance, enhanced resource utilization (CPU/memory/NIC,etc)

The architecture is similar to zonal architecture (UNIX/RDBMS), which makes management and control very easy. The solution is RDBMS based which makes the application highly efficient in managing data, synchronization of data between different hierarchy, deploying different data components (like logic, routes, fares, users, etc). The solution is based on following open standards :

a. Operating System : Linux,

b. Network Connectivity: TCP/IP

c. Data Management : RDBMS

Network management: SNMP

Different competitive applications/components are available in the market. This makes the product assembly very easy and efficient. Almost all the components used in the solution are available in the market and have already proved in the similar fields.

Synchronization between embedded and zonal servers can be done on web (using HTTP protocol). This makes the deployment and maintenance highly cost effective and wide spread because of availability of web/internet throughout India. The packets communicated can also be compressed for highly effective bandwidth utilization. The packets can be encrypted so as to travel in public/private network without any security breach. Because database-services are available on TCP-IP these can be remotely connected for management and monitoring.

Embedded RDBMS has in-built healing features.

UTS architecture that spans from zonal high-end servers to low-end station servers and embedded terminals provides single robust framework for fast implementation in the entire Indian Railways spanning into different zones and stations. The solution is highly customizable and flexible to span into any network (public/private)

and machines (RISC/intel/embedded). The technology used makes the solution availability on web(hugh spread, very cost effective network availability), ATM, smart-card, Indian Environmental condition.

More features can be added as per Linux usage (like open-source, hence highly customizable, cost effective, comparable support to windows, large no of utilities and features available like: central management, unicode, TCP-IP, SNMP, RDBMS etc) RDBMS usage (more efficient features, professional support and utilities, out of the box package. already proven. more embedded architecture like ultralite, mobile, PDA implementation..)

Open Standards (UTS embedded client now available from four different hardware vendors, almost all the features are based on open standard and hence are available from multiple vendors. this makes the product technically and economically competitive as well as the support). High flexibility (memory can be expanded in future, so can CPU power, smart-card hand-held devices, wireless features etc)

HARDWARE INFRASTRUCTURE OF A THIN CLIENT

1. Common hardware --- Thin Client

Diskless PC (144 MB RAM Pentium IV) Disk on Chip implementing the thin client

2.Operating system --- Linux (Red Hat) version 3.1 and above

3. RDBMS --- ASA (Adaptive Sybase Server anywhere)

4.Communication protocol --- TCP/IP

5.Communication systems --- Routers driving 64 kbps dot lines

THIN CLIENT SPECIFICATIONS:

Type a:

Bare minimum replacement of CUI to GUI interface. JVM enabled, tcpip connectivity, printer port. Performance enhancements like form downloading.

Details:

This terminal will act as a GUI client interface for application running on a server. The connectivity will be TCP-IP based. This terminal should be able to run java applets and applications invoked from server. The application hence running should be able to interact with enhanced features of terminal and its interfaces like printer etc.

Type b:

Replacement of station server. Embedded OS, RDBMS, application installation features. Remote management like application, data management.TCPIP interface. Flash ROM. ability to read/write Flash ROM from central management server.

Details:

This terminal will act as a complete server connected to remote site server using TCPIP/dialup. All the application and data will reside in this terminal. Hence this client should provide the installation of OS, RDBMS, application over it. It should also provide the remote management features like flash ROM upgrade, application modification, data downloading and uploading etc.

Enhancements:

Card based authentication.

Terminal authentication with the station (type a) and with central server (type b). This may be PKI based authentication.

Hot Key support.

Advantages of Using Thin Clients as desktops over PC :

Higher availability and productivity : MTBF of Thin Client is better than of PC i.e 4-8 times greater than a PC. This is largely due to no moving parts on Thin Client.

Better asset management: The above table depicts the huge savings.

Preservation and protection of Corporate data: Central Server being totally secure using thin client based computing, corporate data is safe.

No Frequent Upgrades: PC technology becomes obselete within 18-30 months. This demands frequent upgrades which can be totally avoided using thin client technology.

Better User experience: Ease in use , no complexity on start/logoff operation.

Higher level of data and application security: Thin Clients are completely secure. No user level data corruption.

They are virus and hack-proof: User access to operating and network systems is totally eliminated.

Rapid deployment of network/applications: Using Server based computing, deployment of large networks in less time is a reality. Also rollout/upgrades in applications is almost instantaneous.

Lower Power consumption : Thin Clients work at as low as 15W power as compared to 150W power consumed by PC. Thereby saving power consumption in normal mode or on UPS mode.

Ideal for Indian Power conditions : With a sturdy Power supply mode supporting 90V to 260V, thin clients can handle the fluctuations in power conditions and operates in any environments without cooling fan. The design is ideal for Indian environmental conditions thereby able to deploy in modern cities, towns and remote villages and rural areas.

UTS ...

Pilot project for 23 stations of Delhi Area was announced by Hon'ble MR in budget speech of 2002-2003.

Application went online on 15 August 2002

UTS has been implemented over **Nine** Server Locations hosting **Sixteen** Railway Zones

Covering approx. 680 locations and operating across approx. 2000 Counters

Per day Ticketing over UTS, on an average involves

Travel of approx. 5.1 million passengers

Sale of approx.2.5 million Tickets

Earnings of approx. Rs 143 million

Target for March 2007 –

To cover approx 1500 locations enabling ticketing over 4000 counters.

CHAPTER-VI THE INNOVATIONS / ROAD MAP , INTERFACE ISSUES AND RECOMMENDATIONS

INNOVATION DONE IN PRS

- Developed in-house data base engine using dynamic Hashing algorithm for fast retrieval.
- Data Base Engine supports
- Generation of PNR
- Insertion of PNR
- Modification of PNR
- Deletion of PNR
- View of PNR
- Storage space (disk) is divided into Pages each of size 4Kbytes
- The engine supports Integrity checks to ensure pages are linked properly
- Passengers data (known as PNRs) within page are stored in compressed format for saving external storage.
- Pages are used upto max 90% further insertions leads to overflow.
- Time to search PNR is o(1).

INNOVATIONS DONE IN UTS

- Along with thin clients the UTS application can run from Dumb terminals connected to Zonal Servers.

- Zonal Servers use High-Availability Subsystem so UTS is available during hard ware failures.
- Zonal Servers and station servers use Replication Server so Data is never lost.
- If Station Server is down the users can logon to Zonal Servers virtually a disaster tolerant solution is available
- Designed a special Railway Font for ticket printing so that ticket checker can distinguish between fraudulent and genuine ticket.
- An engine is printed before and after printing journey details on tickets so that journey and fare cannot be printed on unauthorized printer.
- Log is maintained each time printer is switched on and off to keep an eye on insertion of an unauthorized Ticket roll manipulation done in the ticket by the booking operator.
- Thin client (a ticketing machine with full business logic) is kept on each booking counter to act as a complete ticket issuing machine.
- Thin Client uses Disk-on-Chip (DOC) rather than hard disk
- The DOC can operate under high temperature and can withstand the vibrations experienced near Railway Platform where ticket counters are made

SPECIAL FEATURES OF UTS

➢Web Enabling of Monthly / Quarterly Passes

⋆Over Mumbai Area (Payment Mode – Credit Cards)

⋆Operational since mar 2000

⋆Front-end developed by IRCTC

⋆Ticket Verification over SMS

⋆Feature providing TTE's the facility to verify the authenticity of a Ticket over SMS

⋆POC completed

Non-Railway Point of Sale

◆So far Ticketing is done across counters placed in Railway Premises operated by Railway Personnel.

◆Shortly Ticketing will enabled over –

JTBSs – Jan Sadharan Ticket Booking Sewak
(Implemented over Dumb Terminals)

ATVMs – Automatic Ticket Vending Machines
(Implemented over Intelligent Terminals)

Phase 1 – Using Railway Smart Cards (Contact-less, RFID based)
Phase 2 – Using Credit Cards & Currency

ROAD MAP AHEAD

* PRS

  *E-ticketing

  *PDA for Train Ticket Examiners

  *Frequent Rail Travelers' Scheme

* UTS

  * Implementation of Thin Clients across all zones to ensure zero Downtimes Pilot project running successfully in East Central Railway
  * Hand Held Terminals (ticketing machines)
  * Data Warehouse
  * RFID Technology to update milage and check auntheticity of Ticket
  * Enhanced MIS Reports
  * Un-manned Machine for Issuance of Platform tickets (MST /QST)
  * Un-manned Machine for Issuance of MST /QST

Business Continuity in UTS

Intelligent Terminals (Customized Thin Clients)

⋆A solution based on Open Standards

⋆Capable of working independently and in disconnected mode for 'n' hours ⋆without any loss of data.

⋆Data is synchronized with the back-end using a Synchronization Server.

⋆Standby Environment – Provided at two levels

⋆On the Offline Servers

- ⋆ Used when both the Online Servers have failed and network across Server Locations is Un-Available.

- ⋆ Across the Server Locations
- ⋆ Used when there is a local failure affecting only the Servers (Online & Offline)

To bring down the total cost of ownership

- Business logic is stored on a Disk on Chip or Flash
- ROM instead of hard disk as it is cheaper
- Trimmed the size of Red Hat Linux Operating System,
- Adaptive Server Anywhere (ASA) and Unreserved Ticketing Application so that they take space less than 144MB which is the size of Flash ROM
- Thin client boots from DOC rather than hard disk so DOC is integrated on Mother Board of Processor as soon as it boots
- Thin Client is highly secure as Operating System and UTS application all booted as thin client is switched on so booking operator can never get command prompt on the monitor so he cannot manipulate data

- Thin client sends data to Zonal Server periodically almost instantaneously for universal cancellations and up-to the point in time accounting.

ISSUES AND INTERFACE PROBLEMS

Some of the common interface issues are detailed with some recommendation .These issues has been discussed with railway officers

1) Malfunctioning of the computer has been noticed in some cases when wrong accountal of earnings has been done, resulting, in either shortage or excess in booking. In case of shortage, complaints from the staff are received immediately and corrective action taken. The credibility of the system has, therefore, been occasionally questioned. Sometimes, system failures also occur, resulting in suspension of reservation work and causing great inconvenience to passengers. This can be avoided by proper maintenanance of the computer and other equipment.

2) PRS and UTS are two such networks which are getting augmented, modified and upgraded to cater to the upcoming needs and requirements. These two networks have been build at different times are thus use different architectures and technologies. It is very important and critical to converge

these two networks into one and manage from a single "Operating Centre" over a period of time.

3) Failures Needing Attention

*Communication Link Failures

*Cluster Failures

The above aspect may be looked by network engineers .

4) With the advent of CONCERT on all PRSs, the terminals connected to the network would give a global view of all the trains in the country. It would enable better tour planning facility for the passengers. It is also planned to go in for multilap reservations which would further help in itinerary planning. Secondly, it would ensure uniformity of Railway reservation operations through out the country. With its enhanced features like credit card booking, foreign tourists reservations, the operations have added to the convenience of the passengers. Enquiries at terminals are now supplemented by accommodation availability Displays which would display the information for all major trains in the country over Doordarshan, Teletext and other channels. Also, a person is able to access the reservation database directly for enquiring the current status of a ticket for any train

Breakup of UTS Failures in 2004-2005

Type of Failure	Frequency	Percentage
System hardware related	39	44.83
Sybase Related	6	6.90
Planned Maintenance activity	12	13.79
Purging Activity for old records	30	34.48
Total	**87**	

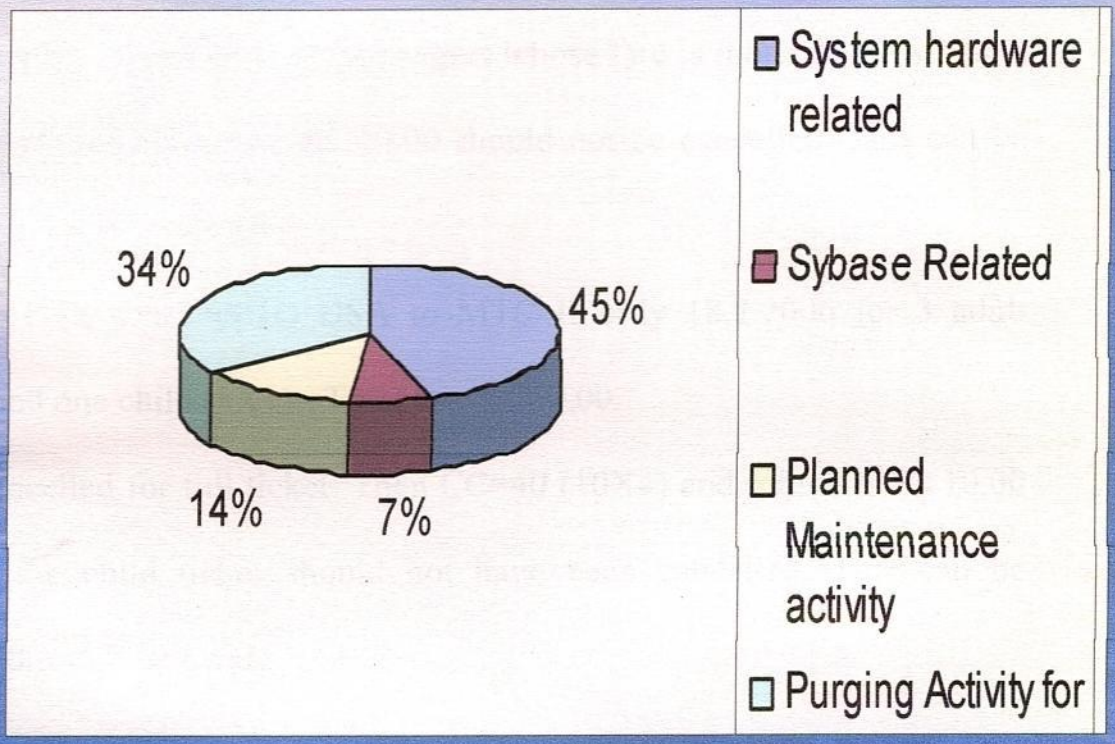
over a DTMF type telephone instrument and get a reply by the voice synthesis machine (IVRS). Access of the database (for enquiry purposes) over the internet has started .

There is already a demand for provision of PRS terminals to travel agents like in the Airlines reservations so it is planned to enhance the existing functionality of CONCERT to incorporate travel agent as a client. At present PRS has no linkages with any external reservation system network. In future, based on the requirements, linkages with other users like Airlines may also get established.

5) Requirement of Supervisory Intervention: If after completion of 500 tickets of the roll, an operator feeds a roll number which is neither (001 nor 501), the system should call for a supervisory intervention. This should be taken care into software .

6) Detailed Transaction Checklist: The tickets should be sorted on the time of issue and not on the ticket number . This can be rectified through software .

UTS failures due to non-availability of clusters



7) Display of routes: The system should not display the combined routes in case the choice of the train type is "C" i.e. combined train type. This can be rectified through software .

8) For generation of "Super Fast" tickets the system should accept both alpha numeric and numeric tickets. This can be rectified through software .

9) While performing the cancellation of multiple passenger tickets, system should permit cancellation of passengers whose fare is more than RS 10.00, child tickets if is less than Rs 10.00 should not be cancelled. This can be rectified through software .

Example UTS 05IJ74401D DSA to MTC II ordy 18.8.2006 for 3 adult (14X3) and one child (8X1)= Total fare Rs 50.00.

When cancelled for full ticket: Then CC=40 (10X4) and refund is Rs 10.00 whereas the child ticket should not have been cancelled. This can be rectified through software .

10) Duplicate Alpha code codes like (INDB, IND) (JIND, JHI), (HNZM, NZM) should be removed . This can be rectified through software .

11) Season ticket could not be renewed 10 days in advance . This can be

rectified through software .

12) Maximum restriction applicable to issue of tickets should also be applicable to issue of SF tickets .

13) Cancellation of advance/ reverse and military tickets do not exhibit the JCO of the original ticket. This can be rectified through software .

14) Error in calculation of ARTISV percentage of concession is 75 percentage for 2nd and SL class and 50 percentage for 1st class . This can be rectified through software .

15) Introduce cluster station concept

16) Enquiry module not working with ticket number . This can be rectified through software .

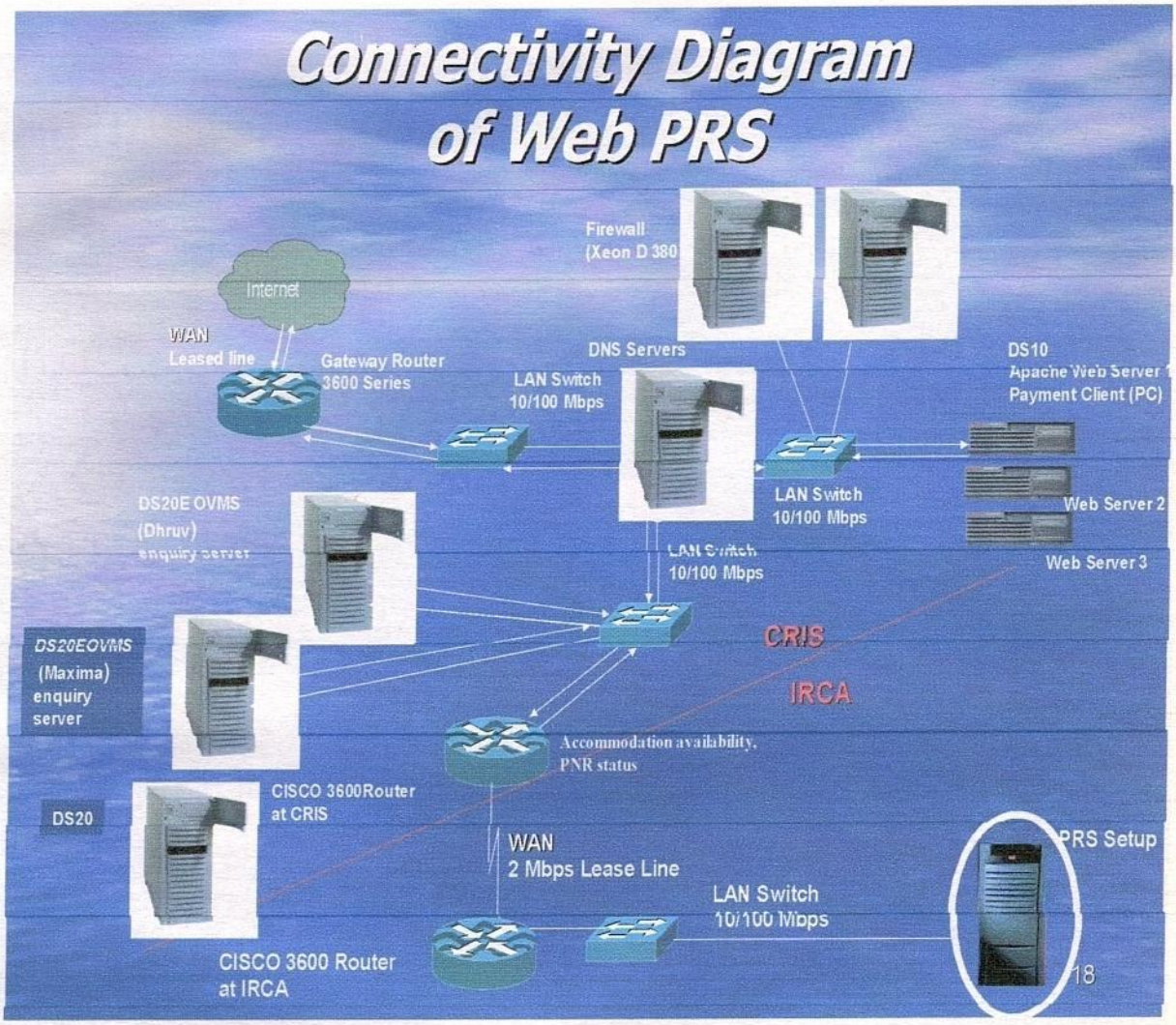
17) Accounting reports – Cancellation reports – introduction of time of cancellation and time of cancellation . This can be rectified through software .

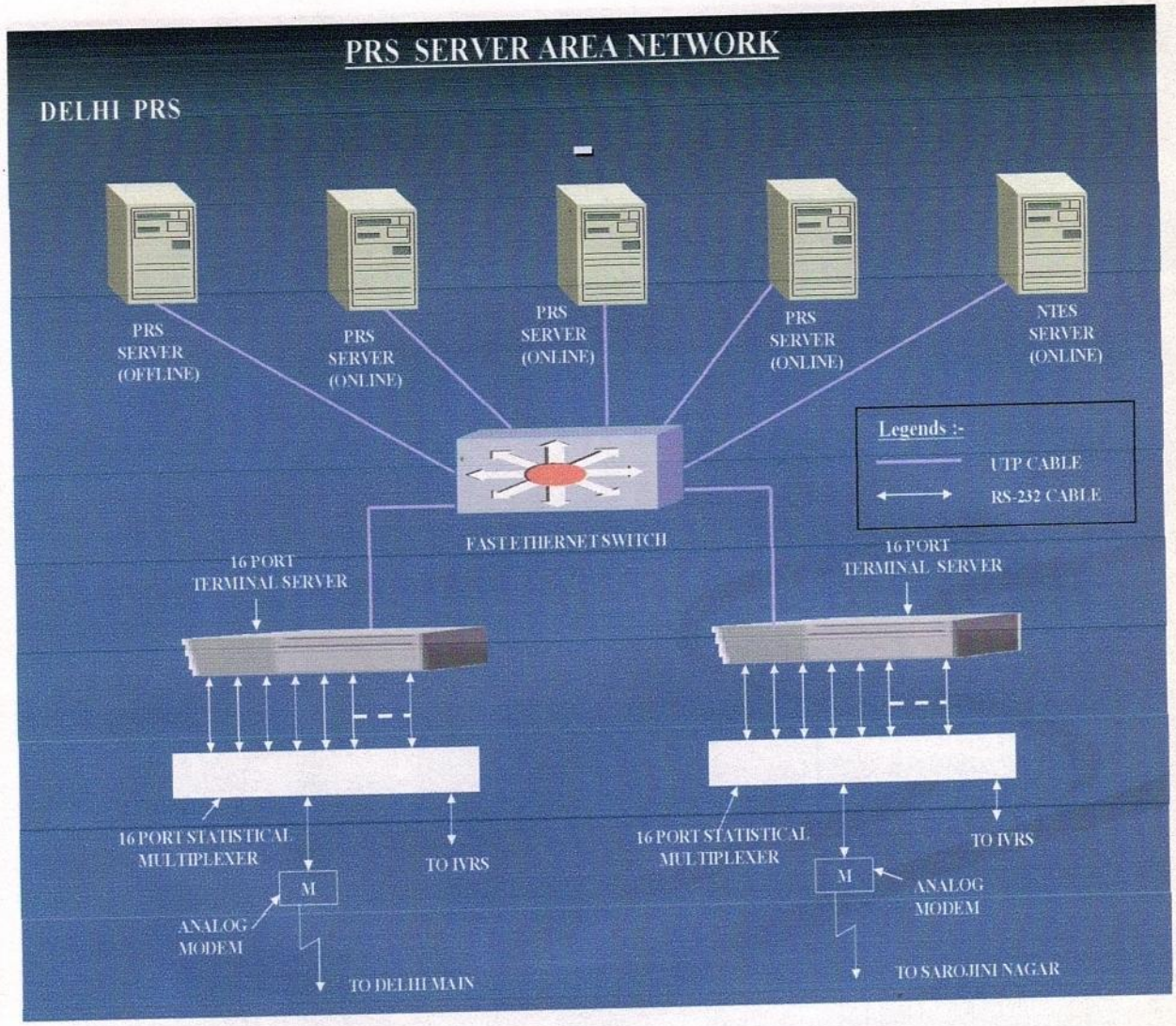
18) Introduction of number of tickets non-issued, cancelled and special cancelled in periodic and monthly reports . This can be rectified through software .

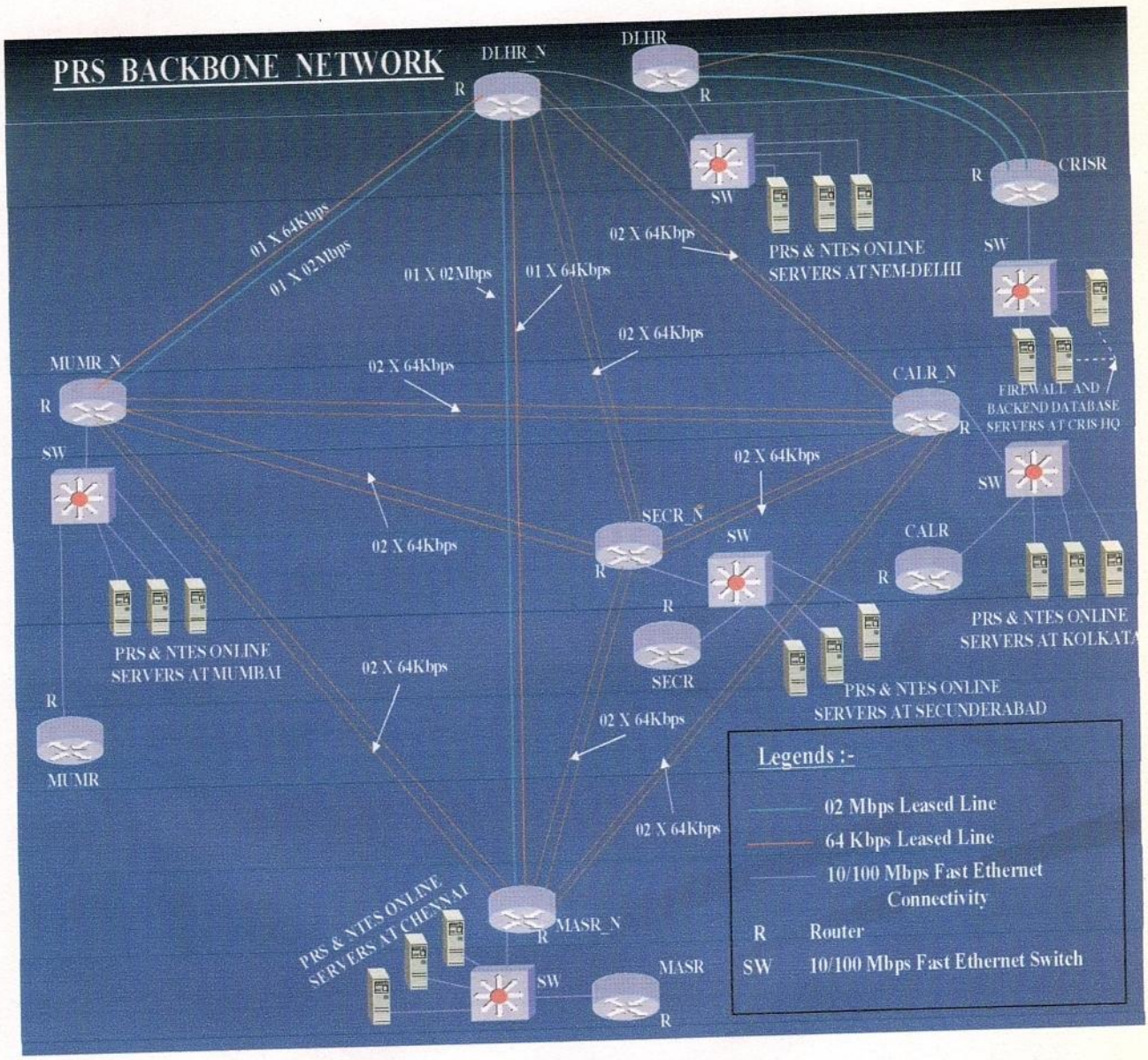
19) Non-generation of ticket at a station server for the first time after a shut down if the links are not available with the zonal server . This is quite common problem . This can be solved by using thin client concept .

ABBREVIATIONS

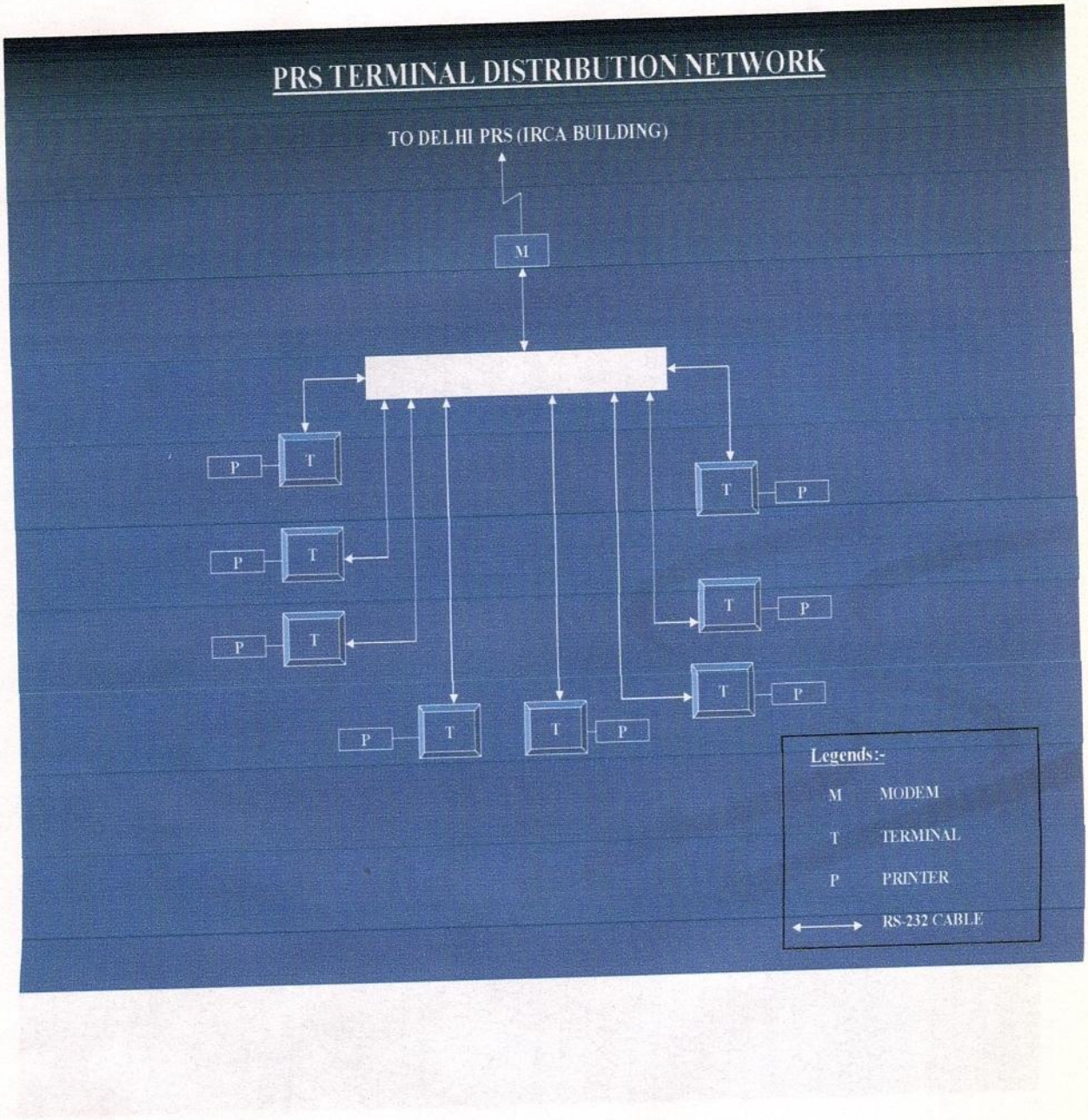
SPTM	Self printing ticketing machines
CRIS	Centre for Railway information system
RDBMS	Relational data based management system
PCT	Passenger counter ticket
UTS	Unreserved Ticketing system
PRS	Passenger Reservation system
MR	Minister of Railways
LAN	Local area Network
WAN	Wide area Network
OS	Operating System
IVRS	Interactive voice response system
RTR	Reliable Transaction Router
ECRS	Enquiry cum reservation supervisor
TP	Transaction Process
MST/QST	Monthly season ticket /Quarterly season ticket

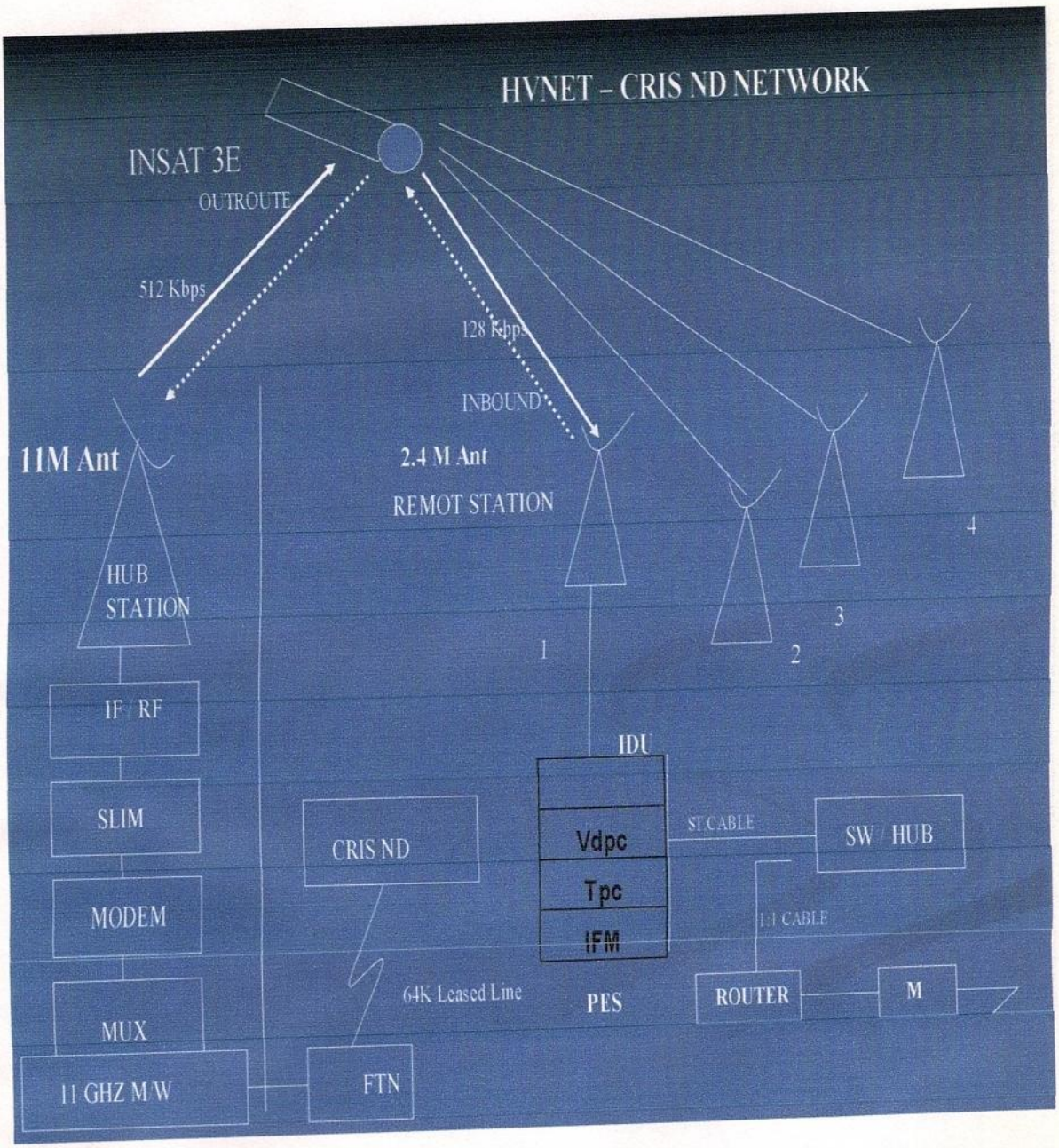

Connectivity Diagram of Web PRS
Firewall (Xeon D 380
Internet
WAN
Leased line
Gateway Router 3600 Series
DNS Servers
LAN Switch 10/100 Mbps
DS10
Apache Web Server
Payment Client (PC)
LAN Switch 10/100 Mbps
Web Server 2
Web Server 3
DS20E OVMS (Dhruv) enquiry server
LAN Switch 10/100 Mbps
DS20EOVMS (Maxima) enquiry server
CRIS
IRCA
Accommodation availability, PNR status
DS20
CISCO 3600Router at CRIS
WAN
2 Mbps Lease Line
LAN Switch 10/100 Mbps
PRS Setup
CISCO 3600 Router at IRCA

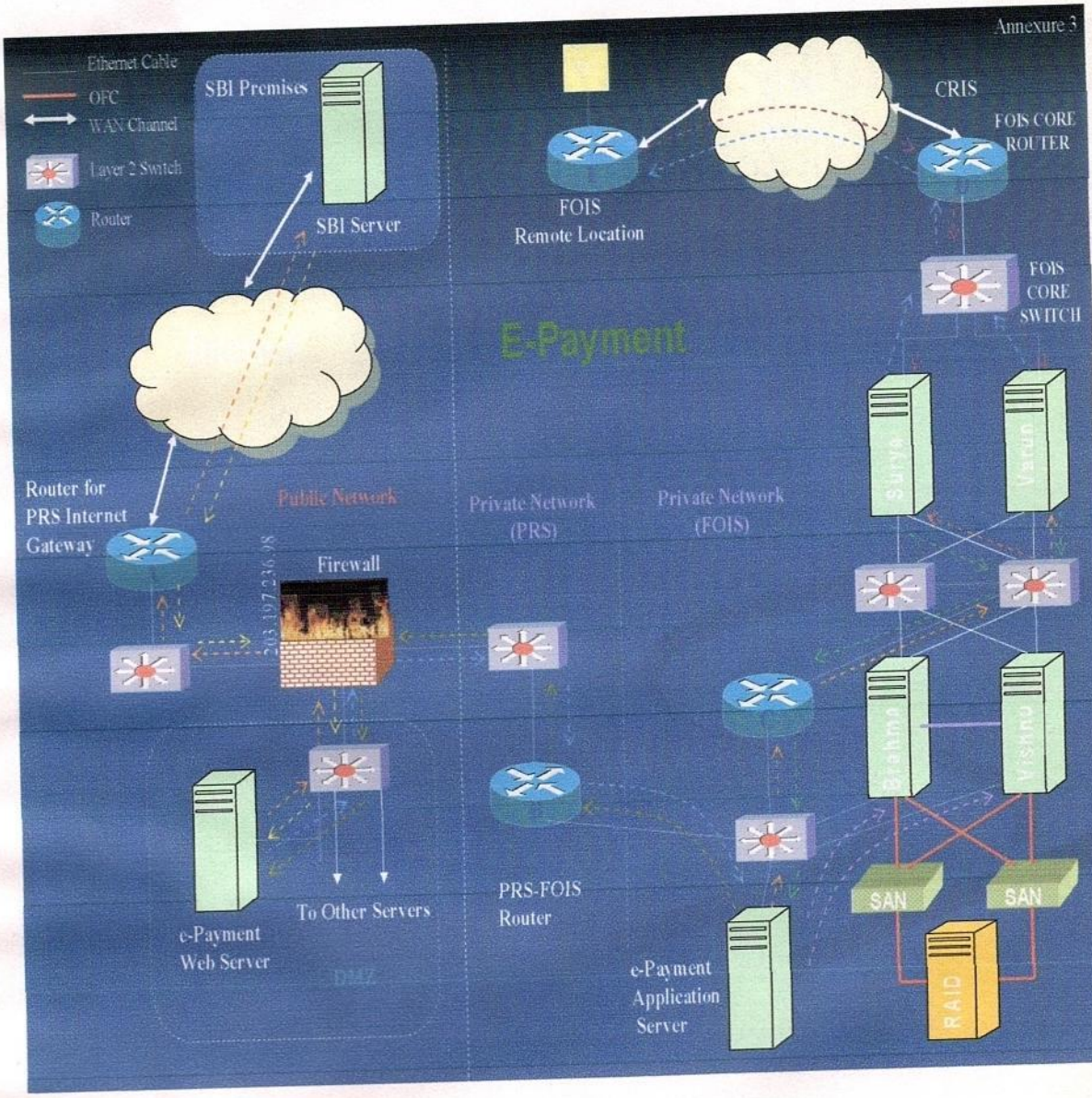

PRS SERVER AREA NETWORK
DELHI PRS
PRS SERVER (OFFLINE)
PRS SERVER (ONLINE)
PRS SERVER (ONLINE)
PRS SERVER (ONLINE)
NTES SERVER (ONLINE)
Legends :-
UTP CABLE
RS-232 CABLE
FAST ETHERNET SWITCH
16 PORT TERMINAL SERVER
16 PORT TERMINAL SERVER
16 PORT STATISTICAL MULTIPLEXER
TO IVRS
M
ANALOG MODEM
TO DELHI MAIN
16 PORT STATISTICAL MULTIPLEXER
TO IVRS
M
ANALOG MODEM
TO SAROJINI NAGAR


PRS BACKBONE NETWORK
DLHR_N
DLHR
R
R
SW
CRISR
R
01 X 64Kbps
01 X 02Mbps
01 X 02Mbps
01 X 64Kbps
02 X 64Kbps
PRS & NTES ONLINE
SERVERS AT NEM-DELHI
SW
MUMR_N
R
02 X 64Kbps
02 X 64Kbps
CALR_N
R
FIREWALL AND
BACKEND DATABASE
SERVERS AT CRIS HQ
SW
SW
02 X 64Kbps
SECR_N
SW
CALR
R
R
R
02 X 64Kbps
PRS & NTES ONLINE
SERVERS AT MUMBAI
SECR
PRS & NTES ONLINE
SERVERS AT KOLKATA
R
PRS & NTES ONLINE
SERVERS AT SECUNDERABAD
02 X 64Kbps
02 X 64Kbps
MUMR
02 X 64Kbps
PRS & NTES ONLINE
SERVERS AT CHENNAI
R
MASR_N
SW
MASR
R
Legends :-
02 Mbps Leased Line
64 Kbps Leased Line
10/100 Mbps Fast Ethernet
Connectivity
R Router
SW 10/100 Mbps Fast Ethernet Switch

PRS TERMINAL DISTRIBUTION NETWORK




HVNET – CRIS ND NETWORK
INSAT 3E
OUTROUTE
512 Kbps
128 Kbps
INBOUND
11M Ant
2.4 M Ant
REMOT STATION
HUB
STATION
1
2
3
4
IF / RF
SLIM
MODEM
MUX
11 GHZ M/W
FTN
CRIS ND
64K Leased Line
IDU
Vdpc
Tpc
IFM
PES
ST CABLE
SW / HUB
1:1 CABLE
ROUTER
M


Annexure 3
Ethernet Cable
OFC
WAN Channel
Layer 2 Switch
Router
SBI Premises
SBI Server
FOIS
Remote Location
CRIS
FOIS CORE
ROUTER
FOIS
CORE
SWITCH
E-Payment
Router for
PRS Internet
Gateway
Public Network
Private Network
(PRS)
Private Network
(FOIS)
Firewall
203.197.236.98
Surya
Varun
Brahma
Vishnu
SAN
SAN
RAID
PRS-FOIS
Router
To Other Servers
e-Payment
Web Server
DMZ
e-Payment
Application
Server

Load of UTS

Zone	Booking Locations	Terminals	Pssgr Booked (thousand)	Tickets Issued (thousand)
North	54	309	526.487	192.31
Central	18	55	45.371	18.626
Western	7	21	23.624	13.537
North Estern	7	29	52.846	31.508
East Central	26	82	70.553	37.601
Eastern	11	108	365.819	123.446
North Frontier	5	5	0.083	0.046
South East Central	4	4	3.994	1.616
South East	2	7	9.928	7.01
East Coast	2	2	1.071	0.406
Total	136	622	1099.776	426.106