e-Gov@Gujarat - An e-Governance Bulletin from GUJARAT INFORMATICS LTD.

Vol. 1 I No. 2
January 2003

Special Issue on GSWAN

- Introduction
- GSWAN & Gujarat State
- GSWAN Network Arch. & Topology
- Technology & Dataflow in GSWAN
- Achievements

Information Courtesy

- **Shri R K Dave**
  OSD (IT)
  Dept. of Science & Technology
- **Ranjit Menon**

Editorial Team

- **Neeta Shah**
- **Satish Iyengar**
- **Sumit Ghosh**
- **Amrish Panchal**

GSWAN (Gujarat State Wide Area Network):
Implementing Converged IP based networks

The landscape of Indian Governance is fast changing. State Governments in India are leveraging Information Technology for driving efficiency into their processes and providing better services to citizens, a fact that is a given in most other countries. The State of Gujarat was amongst the first State's to identify and leverage Information Technology for better Governance. The Government of Gujarat embarked on a mission to setup an IP based State Wide Area Network to realise its mission of providing better Governance to its citizens, even before states claiming to be leader in IT utilization, including Andhra Pradesh.

The Need

The State of Gujarat is divided into 25 Districts with 225 Talukas, with marked administrative boundaries. Number of Talukas under a District varies from 8 to 12. The need was to setup Gujarat State Wide Area Network (GSWAN) that would connect the State Secretariat to all 25 District Headquarters and 225 Talukas across the State. IP based solution was selected for this work by GoG.

The GSWAN will . . .

- Establish reliable horizontal and vertical communication within the State administration driving government productivity and enabling electronic transactions;
- Achieve e-governance commitment and bring governance closer to public;
- Strengthen Disaster Management capacity;

Introduction

GUJARAT STATE WIDE AREA NETWORK (GSWAN)

Gujarat State's E-Governance vehicle with a State-of-the-Art Converged Network

People want a Government, which meets their needs at affordable cost, improve the quality of lives, which is available when they need it, and which delivers results to them. Physical separation between citizens and Government must not pose any limitation to the effective Governance. people.

Information Technology is a key enabler to the process of **smart e-governance,** offering **access** and **delivery** of services to the expectations of people.

Horizontal and **Vertical integration** within the organization is essential for effective and efficient information exchange. This is to be followed by authorizing public access to administration at various points in this Horizontal and Vertical information corridor. Standardizing, and transforming all citizens' centric, Government's applications into electronic form for interactive public use is the last step in e-governances process.

'Government of Gujarat, with an emphasis on the "open standard ***access (both inter intra and extra organization) converged network,*** *has succeeded in creating required infrastructure, unparalleled any where in the country.'*

Today GSWAN achieves distinction in the category of state owned ICT infrastructure for (a) Voice, Video and Data – all services on IP, (b) 25 Districts and all 225 Talukas connected and functional, (c) About 560 offices in the network, high speed data and video conference (d) One of the robust campus area network at Secretariat connected with GSWAN enabling Taluka level access for all officers at secretariat and vice versa, (d) Satellite interconnect with GSWAN Hub has made all services of the network omni present in the state/country through portable VSAT terminal which was put into services in June

GSWAN & Gujarat State

Gujarat State Wide Area Network (GSWAN), a unique state-of-the-art, e-governance project commissioned by the Gujarat state

GSWAN & GUJARAT STATE:

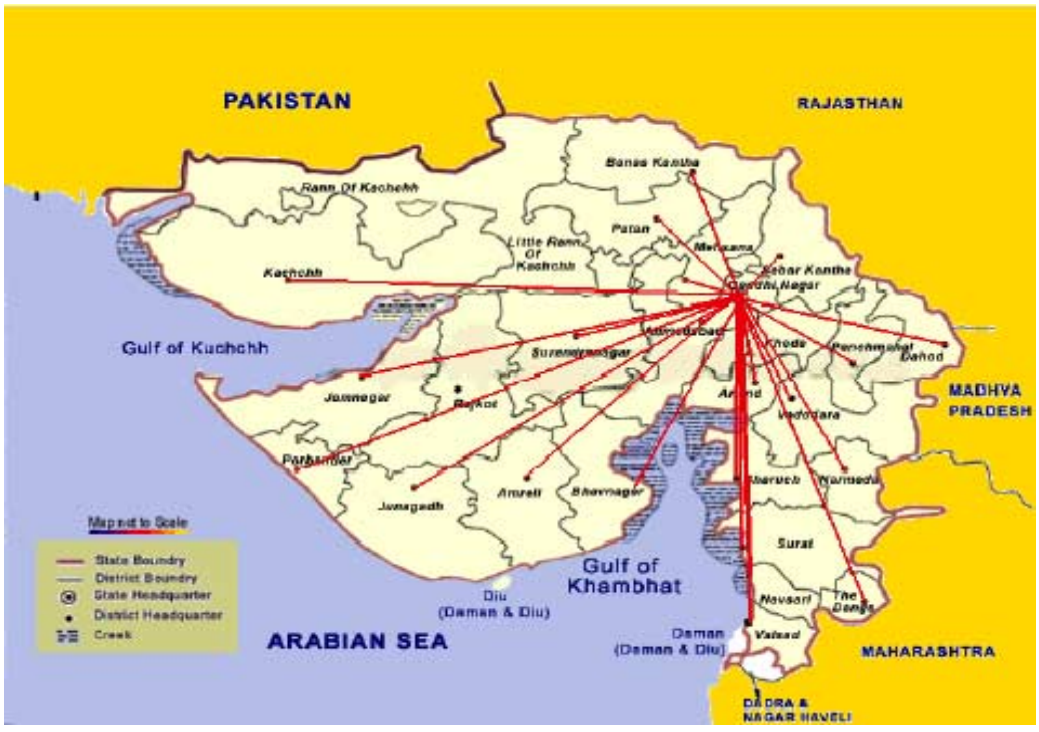
The State of Gujarat, with an area of 196000 sq. Kms, occupies the northern extremity of the western seaboard from between 20.6 and 24.42 degrees north latitude and 68.10 and 74.28 degrees east longitude, with 1600 km long Arabian sea-coastline.

State of Gujarat is divided into 25 Districts with 225 Talukas, with marked administrative boundaries. Number of Talukas under a District varies from 8 -12. Gandhinagar is the capital city from where the state is administered through various departments, and other offices. Each department is headed by Secretary to the Government. For political guidance to every department there are Ministers, Ministers of state and Deputy Ministers which constitute the cabinet. The cabinet, in turn is responsible to the legislative assembly, for all its action to ensure well administered, progressive and benevolent state machinery for well being of its population.

GoG had decided to create state-of-the-art, Gujarat State Wide Area Network (GSWAN) to –

- Establish a reliable horizontal and vertical communication corridor for within the state administration to make government more productive and compatible for electronic transactions
- achieve e-governance commitment and bring governance closer to public;
- strengthen disaster management capacity;

Project report was prepared for state wide area network after undertaking a detailed feasibility study. Inclusion of various offices and their location, traffic load and its characteristics, security, LAN/WAN protocols, topology, bandwidth requirements and utilization, allocation of bandwidth ETC.., were some of the components considered while designing the project document. Various climatic zones, coastal areas and identified disaster prone areas were also taken into consideration while finalizing the project specifications.

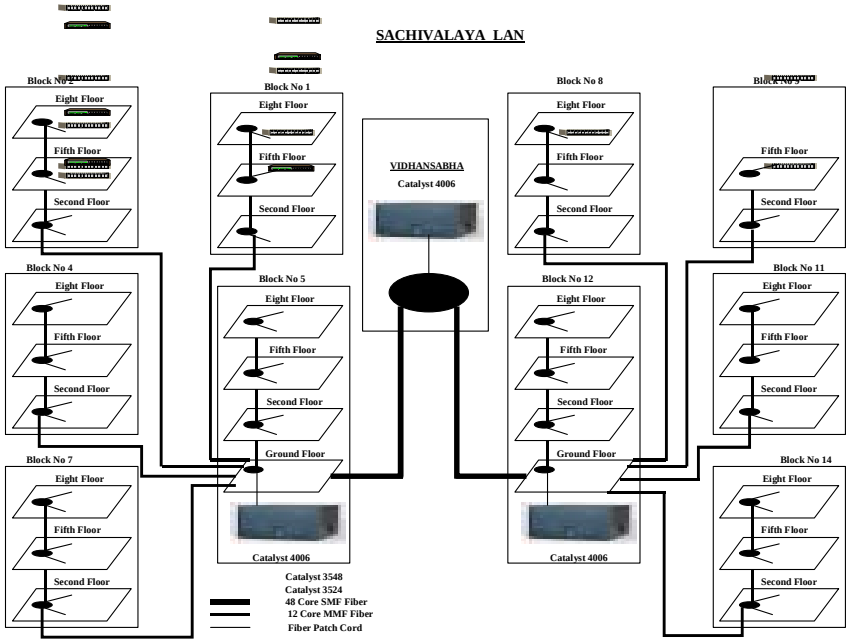


STATE OF GUJARAT – CAPITAL AT GANDHINAGAR

Connectivity (bandwidth) needs were defined on the basis of traffic estimated between various network nodes. The project specifications included – bandwidth requirements, dialup connections, VSAT links (to impart mobility feature to WAN and to cover inaccessible location when required). Number of subscribers and the growth pattern were analyzed for arriving at various resources requirements on time scale. Assessment of Internet bandwidth, email service, web hosting resources, DBM resources etc. was done keeping e-governance objectives into consideration. Web sites have been found very effective media for mass communication, specifically information dissemination to whole world at a any point of time. This was considered that each department shall have their web site for dissemination of information to the public and vice -versa.

Bids were invited for qualifications and RFP (Request for proposal) were circulated to all qualified agencies. Work was awarded on 1st march 2001 to the vendor for creation of GSWAN on BOOT (Built Operate Own and Transfer) basis. The BOOT period was fixed up for 8 years, after which project assets shall be transferred to Gujarat Government by the BOOT service provider at a nominal charge of Rs 1.

GSWAN was commissioned and accepted by Government of Gujarat on 26.12.2001. Gujarat Government has created a history in the area of state owned wide area networks in the country by having commissioned a total IP based , converged wide area network interconnecting even last and smallest administrative units in administrative hierarchy, i.e. Taluka , into the network.



GSWAN Network Architecture and Topology

The network topology as conceived and designed for GSWAN was based on a hub-and-spoke design philosophy, with three tiers.

First tier

Secretariat Center (SC) at state capital ,Gandhinagar, where from the highest office of Government functions in the state. Various departments and hundreds of subordinate offices located at the state capital are connected to SC horizontally through SCAN (Secretariat Campus Area Network). All districts and Taluka offices are vertically connected with SC (the hub of wide area network).

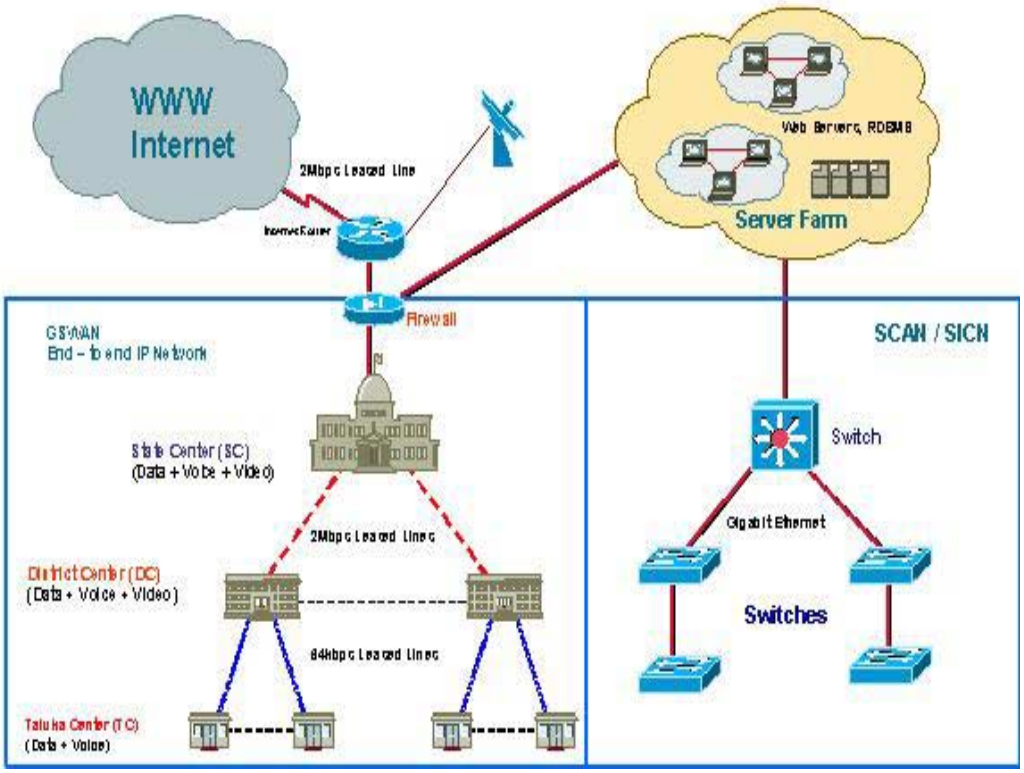
Second Tier

constitutes District Centers, or "**DC"**s, located at district collector's office, and multiple district level offices connected with DC horizontally.

Third Tier

constitutes Talukas Centers, or **"TC's,** located at Taluka Mamlatdar's office, and couple of Taluka level offices horizontally connected with TC.

Secretariat Center (SC) at capital is marked as tier -1. This is the network hub. Secretariat Campus Area Network (SCAN) integrates with GSWAN at SC (shown in figure below). SCAN has about 7000 Ethernet I/Os at capital city, Gandhinagar and all these I/Os are interconnected with GSWAN for information exchange. 300 Telephone connection given to various offices at Secretariat. Table given below summarizes service (data, voice and video) to be commissioned in the beginning and after three years of commencement of the project.



GUJARAT STATE WIDE AREA NETWORK ARCHITECTURE

Voice/ Data/ Video service provisions for present and after 3 years

Tier-2 is the District Center (DC) and there are 25 such DCs in the network connected on 2 Mbps (E1) leased lines with SC. Project design kept provision for connecting 20 number of other district level offices, which was subsequently enhanced to 33 due to demand received. All other offices located within 600 meter radius from their respective DCs are connected with OFC (MM) and copper cable and are capable of serving voice, video and data to the users. The offices beyond 600 meters of distance from the DC node of GSWAN are connected on 64 Kb leased lines capable of serving voice and data services to these locations.

Tier-3 represents Talukas Center (TC). Out of 225 Talukas in the state, 210 Talukas are connected with the GSWAN network on 64 Kb leased lines, and rest of 15 Talukas are connected directly Ethernet backbone because of the proximity of later with DC location. All Talukas are having internet/intranet and voice services operational from the date of commissioning. Taluka node design has provision for interfacing Taluka LAN .

In each of the stations, there is a state-of-the-art Cisco router, which terminates the Leased Line. These routers route IP packets intelligently throughout the network, and provide the Quality of Service (or QoS) features necessary to enable convergence of voice, video and data on a single network infrastructure.

At the first and second tier, Channelised interfaces are used to aggregate the links from the lower tier. The Cisco 7513 router at the SC uses Channalised E3 interfaces to aggregate the E1 links form the DCs, while the Cisco 3662s at the DCs use a channelized E1 interface to aggregate the 64kbps links from the TCs.

GSWAN management:

GSWAN, implemented on BOOT basis, is maintained by the vendor under the scope of the terms and conditions specified in the concession agreement. Stringent service availability, both qualitative and quantitative, criterions are spelt in this agreement and a third party is appointment for performance monitoring and measurement. Payments to vendor are regulated on the basis of service availability. Network Growth Pattern has been anticipated and incorporated in the agreement on time scale. 24*7 monitoring of network traffic pattern, outages and errors is done using automated tools and reports are generated for network managers, policy makers and finance section.

TECHNOLOGY AND DATA FLOW IN GSWAN

GSWAN is a total IP network. Data, Voice and video travels as IP packets in the network, with a total convergence. An attempt is made to explain the data flow, taking place in the network for Data, voice, and video services.

Data Flow from PC to PC in GSWAN:

- Application on computer encapsulates the data in Layer 7-Layer 5 headers
- Network driver on PC then includes Layer 4 and Layer 3 information, packetization, and encapsulation in IP. This includes source and destination IP address, TCP port, etc.
- NIC encapsulates IP data within Layer 2 MAC header, and sends it out over the LAN.
- If the destination IP address is not on the LAN, the frame reaches the router. Router strips off layer 2 MAC header, and looks at the destination IP address.
- Router does a lookup in the routing table, finds appropriate interface to send the packet out of. If this is a WAN interface, then a Layer 2 PPP header is appended to the packet, and it is queued on the interface. At this time, appropriate QoS/Queuing mechanisms are applied to the packet, based on the configuration done on the router, and the information available in the IP header.
- Once the packet reaches the remote router, the remote router strips off the Layer 2 PPP header and looks at the destination IP address will typically be on the local LAN.
- Then, the router encapsulates the IP packet into a MAC header and puts it on to the LAN interface. The packet now has the destination MAC address of the PC that the data is destined to.
- The destination PC receives the data, strips off the L2-L7 information, processes it and presents the data to the application after gathering all IP packets in that flow.

Voice calls flow from GSWAN phone to GSWAN phone:

- User picks up GS-WAN phone, dials access code for trunk line (“0” or “9”).
- The PBX understands that this call is destined to another location, and therefore passes on the call to the router over the TDM link (E1). Here, all digits are passed on to the router, one 64-kbps timeslot on the E1 is allocated to that call.
- The router receives the call on its voice interface. It understands the TDM signaling (E1 CAS), and converts it into H.323 standard for IP calls. It

does a lookup and converts the destination phone number into the IP address of the remote router to which the destination user is connected.

- The remote router receives the H.323 call from the source router. It places that call on to the TDM link to the destination PBX. It also converts the H.323 signaling back to E1-CAS, which the PBX can understand. A 64-kbps slot on the E1 is allotted for this call.

- The remote phone starts ringing. Once the phone is answered, an RTP (real-time protocol) stream is set up between the two routers for transport of VoIP packets.

- At the source router, the digitized voice call travels from the PBX to the router. The router pocketsize and compresses the voice from 64kbps to 8kbps (G.729a standard) using on-board DSP resources.

- IP routing ensures that the VoIP packets traverse the WAN to the remote router.

- IP and RTP headers are added to the compressed and packetized voice. The destination IP address in the IP header is of the remote router. This brings up the bandwidth per call to approximately 12kbps.

- The router identifies the voice traffic as high priority and puts it before the data traffic on the interface. If there are some large packets in the queue, they are broken up up into smaller packets, and voice packets are then queued in between these. This ensures that voice does not face undue latency because of large data packets. This technique is known as Link Fragmentation and Interleaving.

- Once the voice packets reach the remote router, the reverse process is done – strip IP and RTP headers, decompress the voice, and put it on the designated 64kbps E1 link to the PBX.

- The PBX then switches the voice to the destination phone using TDM switching technology.

Video Call Flow:

- User at Polycom end station dials the H.323 prefix (phone number of remote device). This may be for another end station in a point-to-point scenario, or may be an MCU.

- Polycom talks to the Gatekeeper in the network, and gets the IP address corresponding to that specific prefix. Once found, a call setup message is initiated over H.323 to the remote device.

- Once call setup is complete, a call is established. The Polycom digitizes and packetises voice and video from the camera and microphone and puts it onto the LAN port.

- While doing this, it classifies that the router can identify it and give it the requisite treatment for QoS.

- Once the IP Packets are on the LAN, they are then routed to the destination device using normal IP routing, just like VoIP or data traffic.

Achievements

GSWAN is a state owned, IP based, converged wide area network connecting administration upto Taluka. The network was commissioned in Dec 2001 and working satisfactorily. Integration of VSAT station at the hub of the network enabled GSWAN services omni present any where in the state /country. This is first, multi services (voice, video, and data), wide area network owned by any state on IP technology. Network availability and quality of services are monitored and managed using powerful SLA monitoring engines. Long term objectives, technology obsolescence considerations, level of service (LoS) requirements in Government networks, were the key components of the project design. Use of IP technology has imparted immense flexibility to the expansion plan of Government.

- Gujarat becomes the first state to have a total IP based network for integrating whole administration for converged services ;
- Gujarat becomes the first state to have a stringent SLA and it's enforcement mechanism put into place;
- Gujarat becomes the first state to have this converged WAN working for last one year with network availability of the order of 99.99 %;
- Gujarat becomes the first state to have interfaced satellite terminal interfaced with WAN for making the services omni present;
- Gujarat becomes first state to have 530 district level government offices with direct fiber connectivity for data, voice and video;
- Gujarat become first state to have a plug-n-play converged WAN.

Web Corner

Income-Tax
www.incometaxgujarat.com

Sardar Sarovar Nigam
www.sardarsarovardam.com

GIDB
www.gidb.org

Please look out for this section for URLs of Government websites

For electronic subscription to the bulletin, please email us with your email address at:
coe-gil@gujarat.gov.in

or visit us at:
www.gujaratinformatics.com

Contact Address:
Gujarat Informatics Ltd.
Block No. 1, 8th Floor,
Udyog Bhavan,
Gandhinagar – 382017
Phone: 079 – 3256022
Fax: 079 – 3238925