The New Spacenet System
At
PRL
(Main Campus, Mt. Abu and Udaipur)

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Abstract: SPACENET is a Close User Group (CUG) network of ISRO/DOS Units. Initially, SPACENET was established using Demand Assigned Multiple Access (DAMA). The system was widely used among the ISRO units for Telephony, Video Conferencing and Data Applications. With the advancement in communication technology, ISRO decieded to moderniz the SPACENET with solution based on Internet Protocol (IP). The new SPACENET was commissioned in all ISRO units in the month of August 2008. This technical note explains the new SPACENET system setup at PRL, Mt. Abu and Udaipur campuses.

Introduction

SPACENET is a satellite-based Close User Group (CUG) network of ISRO/DOS units. Various units of ISRO are located at places across India and carry out specific tasks related to the Indian Space Programme. Most of the projects of ISRO like building satellites and launch vehicles, utilizes data received from various satellites and are interdisciplinary in nature. These are executed with a team approach and in an interactive mode, such that the work is being distributed among all ISRO centers/units. With the advent of modern communication facilities it is now possible to interconnect various ISRO centers through satellite based communication links to provide voice, email and computer to computer networking facilities. SPACENET provides Video Conferencing (VC) facility which enables any two of the ISRO centers to conduct a meeting without a need for the participants to travel between the two centers. At times, in case of a special event at any of the center, the video conferencing facility can be configured in a broadcasting mode, so that video and audio signals can be received at all other centers in real time.

Presently, SPACENET services are obtained via INSAT 3B satellite. SPACENET is configured through multiple access network topologies. Selection of the network topology, data rates from various applications, antenna diameters and power amplifier sizing at various remote stations were done in such a way that the power and bandwidth of the Satellite transponders are utilized in balanced way. Fig.1 provides SPACENET Setup.

Initially, SPACENET was established using Demand Assigned Multiple Access (DAMA) network supplied by M/S. TIW systems. The system was widely used among the ISRO units for Telephony, Fax, Video Conferencing, and Data Applications. The network hub currently is located at ISRO Telemetry, Tracking, and Command Network (ISTRAC), Bengaluru. These systems are in operation since 1998. The network is primarily designed for the voice and various data transmission requirements of all the ISRO centers located in India. This network also supports various Telemedicine Projects, Remote control of the IR telescope (situated in Hanle, Himalayan Mountains) from Bengaluru and to cater to any disaster management needed during a natural calamity. It also provides connectivity at high data rate for establishing inter-center computer networking.

With the advancement in communication technology, ISRO decided to modernize the SPACENET to provide better facilities for various applications. In December 2007, M/s Electronics Corporation of India Limited (ECIL), Hyderabad, was chosen for implementation of the new SPACENET systems in various ISRO units. The new hub is located at ISRO Telemetry, Tracking, and Command Network (ISTRAC), Bengaluru, and uses iDirect technology. The iDirect technology supports Star, Mesh and Point-to-Point connectivity with the same Indoor Data Units (IDUs) provided earlier and using the same satellite resources. It also supports Ku (10-12 GHz), C and Extended C band (4-8 GHz) for satellite communication with the hub on the selected network topology and bandwidth on demand (BoD). The iDirect 5300 modem is completely IP based solution with 8 port switch built into the modem. Ethernet port is used for connecting Video Conferencing System, Cisco Router, local area network.

The new SPACENET system was commissioned in all ISRO units (45 units or remote stations in the first phase) in the month of August 2008. The network is operating with a geostationary satellite INSAT 3B located at $83°$ E longitude in the equatorial plane.

SPACENET setup AT PRL

In August 2008, the SPACENET set up at PRL, Ahmedabad was upgraded and new SPACENET stations were installed, one each, at IR Observatory, Gurushikhar, Mt. Abu, and Udaipur Solar Observatory, Udaipur. The SPACENET set-up at PRL consists of a 3.8 m parabolic dish antenna (an outdoor unit) located in PRL lawns opposite the parking lot, the SPACENET Room on the Ground Floor of the Stores and Purchase building accommodating the iDirect satellite router, and Cisco 2611 Router for voice (Telephony) communications and a Video Conference Room located on the way from Ground Floor Lecture Hall to Main Building accommodating Video Conference System (SONY PCS-G70). Installation and Configuration of new equipment was carried out in coordination with ISTRAC, M/s ECIL. Fig. 2 depicts the new SPACENET setup at PRL.

SPACENET Services at PRL

Various services provided by SPACENET are described below:

Voice (Telephony)

The Cisco 2811 router with Voice over Internet Protocol is configured for telephony operations. The telephone calls with other ISRO units are made by dialing the prefix 85, ISRO
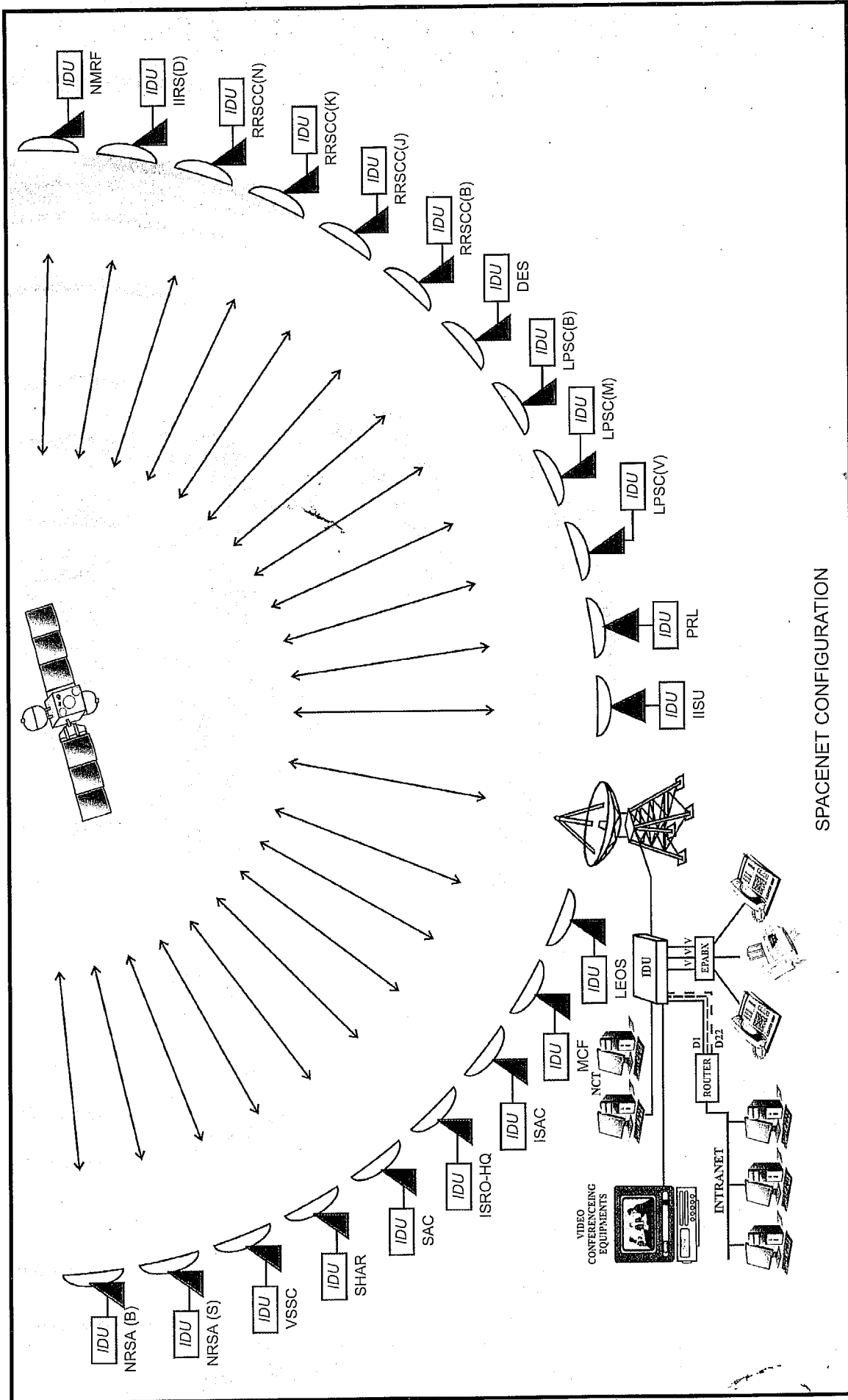
SPACENET CONFIGURATION

Fig.1: SPACENET Setup.

Center Code (Table-1) and extension number. The method of making a call to other centre is

Dialing SPACENET number
85-   SPACENET accessing prefix
XXX-   code number of any ISRO centre
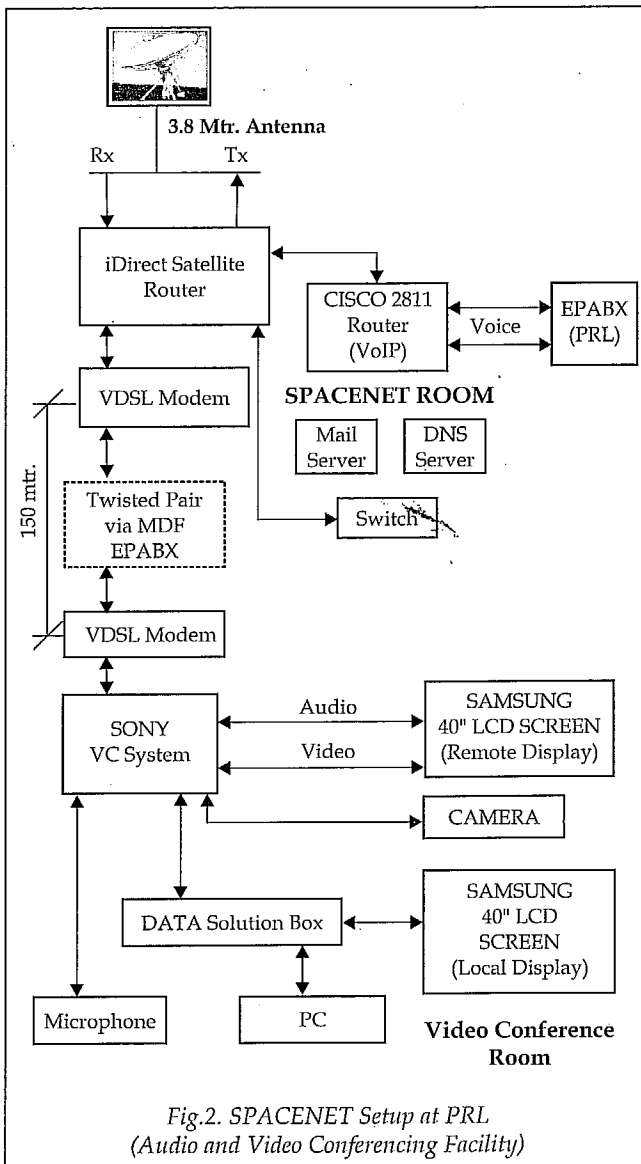XXXX-   ISRO centre's Extension number

Fig.2. SPACENET Setup at PRL
(Audio and Video Conferencing Facility)

The various centers codes are as follows:

Tabel - 1

Sr. No.	ISRO Centre	Code No.
1.	ISRO-HQ Bangalore	710
2.	ISAC	711
3.	ISTRAC	712
4.	MCF Hassan	713
5.	LPSC Bangalore	714
6.	LEOS	715
7.	VSSC	720
8.	IISU	721
9.	LPSC (V)	722
10.	LPSC (M)	723
11.	SHAR	730
12.	NNMRF	731
13.	NRSA(Balanagar)	740
14.	NRSA (Shadnagar)	741
15.	ADRIN	742
16.	SAC	750
17.	PRL	751
18.	PRSSC (B)	761
19.	PRSSC (N)	762
20.	PRSSC (K)	763
21.	RRSSC	764
22.	IIRS(Dehradun)	765
23.	DES Delhi	770
24.	USO(PRL)	752
25.	MT.ABU (PRL)	753

Video Conference Service

A Video Conference comprises a set of interactive telecommunication technologies that allow two or more geographically distributed locations to interact via simultaneous two-way video and audio transmissions. Besides the audio and visual transmission of meeting activities, video conference can be used to share computer displayed information, document and the whiteboard.

A SONY Video Conferencing system is installed and configured in replacement of Polycom/Picture Tel system used earlier. The Video Conferencing system has the ability to transmit power point presentation slides or any other documents from a PC along with a live video and audio. The new system has a local recording facility and supports a multi party video conference through a CODIAN MCU installed at ISTRAC. A Samsung 40″ LCD monitor is also provided to all remote stations.

The VC facility in PRL is approximately 150 meter away from the SPACENET room. This implied the need to connect the VC and SPACENET rooms over Ethernet as the new VC facility uses Internet Protocol (IP) for transmitting video and audio data packets. Due to the topography of these two locations in PRL, it was not possible to lay a new Ethernet cable between the VC Room with SPACENET room as the cable length exceeded the maximum stipulated distance of 100 meter for a LAN segment. After few experiments, we decided to convert an existing spare telephone line pair between the two rooms to Ethernet cable by installing a pair of Ethernet modems (VDSL modems) at the two ends of the telephone pair. The VC camera has host of peripherals attached to it through interconnecting cables. The LCD monitor shows the remote video in full screen and the local video in a small window Picutre-in-Picutre (PIP) mode on the screen. With a remote control, the VC camera can be zoomed, tilted or moved in focus. The remote control can also control the movement of the far end camera when permitted by the remote site. The VC system has an Internet Protocol (IP) interface on which video conference is conducted with other ISRO units. The IP addresses of PRL Main Campus VC system

is:
PRL Main Campus, Ahmedabad : 10.201.1.28

Large Screen Projection of Live Telecasts

Important events in ISRO family like broadcast of GSLV/PSLV launches, ISRO Chairman's address. over SPACENET are projected live in K.R.Ramanathan Auditorium. The video and audio output signals from the LCD monitor are parallely routed to the K.R.Ramanathan Auditorium in PRL where the video signal is fed to the multimedia projector and the audio signal is connected to the sound system of the auditorium. A Direct to Home (DTH) system has also been installed. The Digital Satellite Receiver of DTH is connected to a 40" Samsung LCD monitor. Occasionally, ISRO programs/launches are broadcast on this DTH system and can be projected on the screen in the K.R.Ramnathan auditorium via the same cables.

Data (Intranet)

Intranet is an important service provided by SPACENET. It can deliver information to each individual desktop. It is an exclusive for ISRO units. Intranet uses standard well-defined network technology and TCP/IP protocols. Any SPACENET unit can interact with any other unit via E-mail, FTP and Web. IP scheme adopted for all the units is shown below:

Table - 2

Sr No.	ISRO Centre	IP Address
1.	ISTRACT	10.2.1.1
2.	ISRO-HQ	10.11.1.1
3.	ISAC	10.21.1.1
4.	MCF	10.31.1.1
5.	VSSC	10.41.1.1
6.	SHAR	10.51.1.1
7.	SAC	10.61.1.1
8.	NRSAB	10.71.1.1
9.	NRSAS	10.81.1.1
10.	IISU	10.91.1.1
11.	LPSCV	10.101.1.1
12.	LPSCM	10.111.1.1
13.	LPSCB	10.121.1.1
14.	LEOS	10.131.1.1
15.	BRSD	10.141.1.1
16.	RRSSCB	10.151.1.1
17.	RRSSCN	10.161.1.1
18.	RRSSCK	10.171.1.1
19.	RRSSCJ	10.181.1.1
20.	RRSSCD	10.191.1.1
21.	PRL	10.201.1.1
22.	NMRF	10.211.1.1
23.	NRSAH	10.221.1.1
24.	DES	10.231.1.1
25.	ISTRLUC	10.3.1.1

26.	ISTRTVM	10.4.1.1
27.	ISTRSHAR	10.5.1.1
28.	ISTRPBL	10.6.1.1
29.	ISRAD	10.7.1.1
30.	BYLALU	10.8.1.1
31.	ISITE	10.25.1.1
32.	MCFB	10.35.1.1
33.	ITRG	10.45.1.1
34.	MKIII	10.46.1.1
35.	IIST	10.245.1.1
36.	CHENNAIGH	10.55.1.1
37.	REPLACE	10.95.1.1
38.	USO (PRL)	10.205.1.1
39.	MT.ABU (PRL)	10.206.1.1
40.	NESAC	10.28.1.1
41.	ALUVA	10.47.1.1
42.	ILCM	10.142.1.1
43.	SCL	10.143.1.1
44.	MVIT	10.105.1.1

For providing the SPACENET INTRANET services like email, web, ftp, the individual centers need to install, configure and maintain these services. At PRL, a Mail Server, a DNS Server, and a Secure File Transfer server are installed and configured. They are used to send and receive e-mails, data from various DOS centers.

PRL SPACENET Mail Server

PRL SPACENET mail server is installed and configured with reliable and secure Mail Transfer Agent-Postfix. To provide better and secure E-mail access, Mail Server is configured with Clamav (Open Source Antivirus), Squirrel mail (Web based email access) and Apache (with self-signed digital certificate) [Appendix-I]. The digital self-signed certificate provides end-to-end secure encrypted web communication. We have also provided web-based facility to change the password [Appendix-II]. Once the user successfully logged in to check email, the system shows the user's last login detail (IP address, Date, time) [Appendix-III]. PRL SPACENET Email facility can be accessed with the URL link given below:

https://mail.prl.dos.gov.in

Secure File Transfer

Secure file transfer is allowed using scp along with proper authentication and permission.

DNS Server

The entire Intranet setup relies on Domain Name System (DNS) configuration. With DNS in place, it is easier for the user to provide a URL rather than giving the IP address of the server. ISTRAC, Bengaluru, maintains the Primary and Secondary DNS servers at central locations. ISTRAC is the root DNS server for dos.gov.in domain. At other centers of

DOS/ISRO, a secondary DNS server will be maintained. To resolve the domain prl.dos.gov.in a DNS server is installed and configured at PRL.

SPACENET LINK Utilization

We have installed and configured Simple Network Management Protocol (SNMP) and Multi Router Traffic Graper (MRTG) as reporting tool for providing PRL SPACENET Link bandwidth utilization. The tool provides daily, weekly, monthly and yearly bandwidth utilization of PRL SPACENET link [Appendix-IV]. We have written a program which maintains a log of daily status report into archival area. So, we can have each day link status. We have provided authentication base access of reporting tool. Along with link utilization, we have also written program which provides us information about PRL SPACENET network uptime/downtime status every 15minutes interval. Presently, it is text based output. We are writing code for graphical display of network status.

SPACENET setup at other PRL Campuses
(IR Observatory, Mt. Abu and USO, Udaipur)

An identical set up exists at IR Observatory, Gurushikhar, Mt Abu, and Udaipur Solar Observatory, Udaipur. The dish antennas at these two stations, however, are of smaller (1.8 m diameter as against 3.8 m diameter at PRL). The video conference room at Gurushikhar Observatory is located in the Library Room on the first floor and that at Udaipur Observatory is in the USO auditorium on Ground Floor. The stations at Mt. Abu and Udaipur are also part of the same SPACENET. Both the units have similar Telephony and Video Conferencing and intranet facilities as of the main campus.

(a) The IP address of VC System at PRL USO Campus, Udaipur: 10.205.1.28
(b) The IP address of VC System at PRL Mt.Abu Campus is :10.206.1.28

SPACENET call is possible by dialup to Udaipur, 85-752. This connects to Computer Center, Udaipur

SPACENET call to Mt. Abu is 85-753. It connects to the Library room at Mt. Abu observatory.

SPACENET services at Thaltej Campus, Ahmedabad is under the process.

Applications of SPACENET

With the start of the SPACENET services in PRL, we are in touch with all the ISRO centers in a round the clock mode. PRL is regularly conducting Video Conferences with ISRO Head Quarters for meetings avoid the need for travel. In addition,

1. PSLV/GSLV launches as seen live.
2. Data from SOX payload is downloaded from Master Control Facility (MCF), Hasan regularly on SPACENET.

3. During the development of HEX payload on Chandrayaan-1 mission SPACENET proved to be useful in monitoring monthly status reports on the mission activities from other collaborating groups.
4. During the implementation of 6th Pay Commission recommendations, all DOS Circulars issued from time to time could be accessed at PRL using SPACENET services.
5. The telephone calls made through SPACENET to a few ISRO centers cut the expenditure on STD calls made on BSNL telephones.
6. The PRL Purchase Committee uses facility of Video Conferencing for discussing with indenters from USO, Udaipur.
7. The PDF and Academic Committee meetings have also started with a live participation from USO members.

Thus, the use of SPACENET at PRL has brought down the distances from its field stations and other ISRO centers.

Acknowledgement

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References

Sengupta N., SPACENET Program Execution Team, 1998, Skylink and SPACENET Communication Network of ISRO, Technical Report, ISTRAC/TR/10/98

S.Ramani, New SPACENET System Configuration, by Email 25th Jan 2008

Glossary

DAMA - Demand Assigned Multiple Access
DNS - Domain Name System
DTH - Direct-to-Home
FTP - File Transfer Protocol
IDU - Indoor Data Units
LCD Liquid Crystal Display
MTA - Mail Transfer Agent
TCP/IP- Transmission Control Protocol/Internet Protocol
VoIP - Voice over IP
VDSL - Very high bit-rate Digital Line Subscriber

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Appendix-1

PRL SPACENET Webmail Facility with Digital Certificate

Appendix-II

Sign Out

PRL-SPACENET

Compose Addresses Folders Options Search Help

Change Password

Please read the following instructions before editing your password:

- You may use letters, numbers, and other special characters on your keyboard
- Passwords are case-sensitive, so an 'A' is not the same as an 'a'.
- Your new password must be at least 8 characters long.

Your user name: **jigar**

Current password:

New password:

Confirm new password:

Change Password

SPACENET Webmail Facility allow user to change password

Appendix-III

https://mail.prl.dos.gov.in/src/webmail.php

Certificate Error

File　Edit　View　Favorites　Tools　Help

PRL

Home ▾　Print ▾　Page ▾　Tools ▾

Sign Out

PRL-SPACENET

Folders
Last Refresh:
Tue, 9:44 am
(Check mail)

INBOX
INBOX.Drafts
INBOX.Sent
INBOX.Trash
Drafts
istrac
prl-spacenet
Sent
Trash

Current Folder: **INBOX**
Compose　Addresses　Folders　Options　Search　Help

Welcome, your last connection was from 10.201.1.11 (ns1.prl.dos.gov.in) on Tue, May 19, 2009 9:39.

Toggle All

Move Selected To:
INBOX ⌄　Move　Forward

Viewing Messages: 1 to 14 (14 total)

Transform Selected Messages:
Read　Unread　Delete

	From ☐	Date ☐	Subject ☐
☐	jigar@mail.prl.dos.gov.in	Aug 7, 2008	test
☐	rajeshta@prl.dos.gov.in	Jun 23, 2007	Information
☐	subhedar@prl.dos.gov.in	Jul 27, 2006	VSSC Machine on Spacenet
☐	root	Jul 13, 2006	LogWatch for web.prl.dos.gov.in
☐	Mail Delivery System	Jul 12, 2006	Undelivered Mail Returned to Sender
☐	leo@prl.res.in	Jul 12, 2006	(no subject)
☐	Jigar Raval	May 31, 2006	test new gif file
☐	Jayaraman V	Mar 24, 2006	Re: Online VC request form
☐	Jayaraman V	Mar 7, 2006	RE: Slow download speed
☐	Postmaster@istrac.dos.gov.in	Mar 6, 2006	Returned mail
☐	Jigar Raval	Jan 2, 2006	test
☐	Mail Delivery System	Jan 2, 2006	Undelivered Mail Returned to Sender
☐	root	Nov 23, 2005	test mail
☐	rajeshta@prl.dos.gov.in	Oct 10, 2005	test

PRL - Windows Intern....

Internet　100%

SPACENET Webmail shows user's last login detail

Appendix-IV

Traffic Analysis for 10.201.1.11 -- PRL SPACENET LINK

System: prlmisc.prl.res.in in Linux , PRL GW
Maintainer: Jigar Raval <jigar@prl.res.in>
Description: eth3
ifType: ethernetCsmacd (6)
ifName:
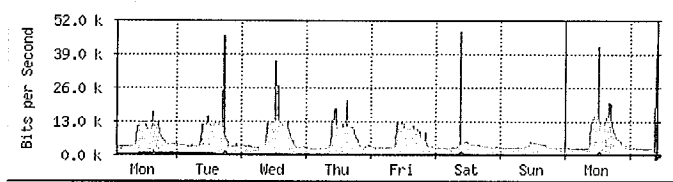Max Speed: 100.0 Mbits s
Ip: 10.201.1.11 (ns1.prl.dos.gov.in)

The statistics were last updated **Tuesday, 19 May 2009 at 10:43,**
at which time 'prlmisc.prl.res.in' had been up for 2 days, 6:40:50.
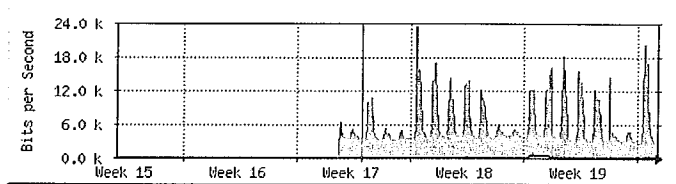
`Daily` Graph (5 Minute Average)
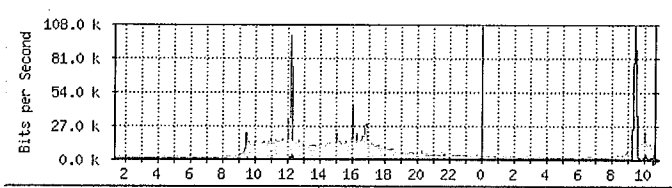
Max In:109.4 kb s (0.1%c) Average In:7344.0 b s (0.0%c) Current In:15.2 kb s (0.0%c)
Max Out:107.5 kb s (0.1%c) Average Out:664.0 b s (0.0%c) Current Out:1128.0 b s (0.0%c)

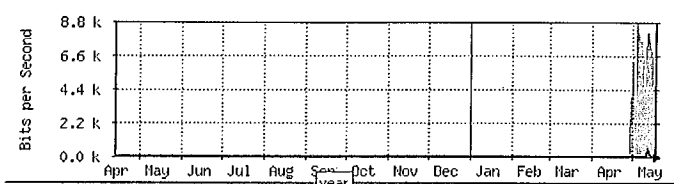## `Weekly` Graph (30 Minute Average)

Max In:48.2 kb s (0.0%c) Average In:6576.0 b s (0.0%c) Current In:15.5 kb s (0.0%c)
Max Out:37.5 kb s (0.0%c) Average Out:224.0 b s (0.0%c) Current Out:1072.0 b s (0.0%c)

`Monthly` Graph (2 Hour Average)

Max In:25.7 kb s (0.0%c) Average In:6168.0 b s (0.0%c) Current In:2936.0 b s (0.0%c)
Max Out:744.0 b s (0.0%c) Average Out:64.0 b s (0.0%c) Current Out:16.0 b s (0.0%c)

`Yearly` Graph (1 Day Average)

Max In:8776.0 b s (0.0%c) Average In:5928.0 b s (0.0%c) Current In:5640.0 b s (0.0%c)
Max Out:556.0 b s (0.0%c) Average Out:64.0 b s (0.0%c) Current Out:16.0 b s (0.0%c)

SPACENET Link Usage Statistics