

E4-E5 (CFA)

Rural BroadBand & Multiplay

Brief Overview

- **Broadband deployment is catered through Project 2.2 of NIB-II using ADSL technology.**
- **Tender done through two stage process.**
- **NIT floated by Karnataka Circle on 22/01/2004**
- **First Year PO placed on 03/08/2004 and second year PO placed on 03/11/2004**
- **50% add on order through the same tender also processed.**
- **Service on a countrywide basis spanning 198 cities. Cities classified as A1, A2, A3, A4, B1, B2 and Other cities.**
- **Network supports ADSL, ADSL2 and ADSL 2plus**

Internet Connections (Lakhs)



Segment	Year1	Year2	Total
DSL Customers (lakhs)	1.80	3.08	4.88

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Overview Of Broad Band

- BSNL is in the process of commissioning of a world class, multi-gigabit, multi-protocol, convergent IP infrastructure through National Internet Backbone–II (NIB-II),
- that will provide convergent services through the same backbone and broadband access network.
- The Broadband service will be available on DSL technology (on the same copper cable that is used for connecting telephone), on a countrywide basis.

Overview Of Broad Band

- In terms of infrastructure for broadband services NIB-II would put India at par with more advanced nations.
- The services that would be supported includes **always-on, Voice & Data**, simultaneous, **high bandwidth** broadband access to the Internet for residential and business customers.

Overview Of Broad Band

- **Content based services, Video multicasting, Video-on-demand** and **Interactive gaming, Audio and Video conferencing, IP Telephony, Distance learning, Messaging:** plain and feature rich, Multi-site MPLS VPNs with Quality of Service (QoS) guarantees.
- The subscriber will be able to access the above services through Subscriber Service Selection System (SSSS) portal.

Key Objectives

- To provide high speed Internet connectivity (upto 8 Mbps)
- To provide Virtual Private Network (VPN) service to the broadband customers
- To provide dial VPN service to MPLS VPN customers.
- To provide multicast video services, video-on-demand, etc. through the Broadband Remote Access Server (BRAS).

Key Objectives

- To provide a means to bill for the aforesaid services by either time-based or volume-based billing.
- It shall provide the customer with the option to select the services through web server
- To provide both pre-paid and post paid broadband service

Services available through Broadband

- **High speed Internet Access:** This is the always-on Internet access service with speed ranging from 256 kbps to 8 Mbps.
- **Bandwidth on Demand:** This will facilitate customer to change bandwidth as per his / her requirement. For example a customer with 256 kbps can change to 1 Mbps during the video Conferencing session.

Services available through Broadband

- **Multicasting:** This is to provide video multicast services for application in distance education, telemedicine etc
- **Dial VPN Service:** This service allows remote users to access their private network securely over the NIB-II infrastructure.
- **Video and Audio Conferencing:**
- **Content based Services:** Like Video on Demand, Interactive Gaming, Live and time shifted TV

What the customer needs in order to be able to use Broadband?



- BSNL's Bfone (Basic phone) connection
- Personal Computer with 10/100 Ethernet Port
- ADSL CPE (Customer Premise Equipment). This can be taken from BSNL at nominal rental per month.

Services planned through Broadband Network

- ✚ **Primary source of Internet bandwidth for retail users for applications such as Web browsing, e-commerce etc**
- ✚ **Multicast video services, video-on-demand etc. through the BRAS**
- ✚ **Allow Wholesale BRAS ports to be assigned to smaller ISPs through the franchisee model wherein the later has a separate network of DSLAMs, AAA, LDAP through a revenue scheme of BSNL**
- ✚ **Dial VPN (VPDN) user connects to NIB-II through the Narrow band RAS and is connected to its private network through a secure L2TP tunnel established between Narrowband RAS and Broadband RAS**
- ✚ **Support for both prepaid and postpaid Broad band services.**

Components of Broadband Access Network

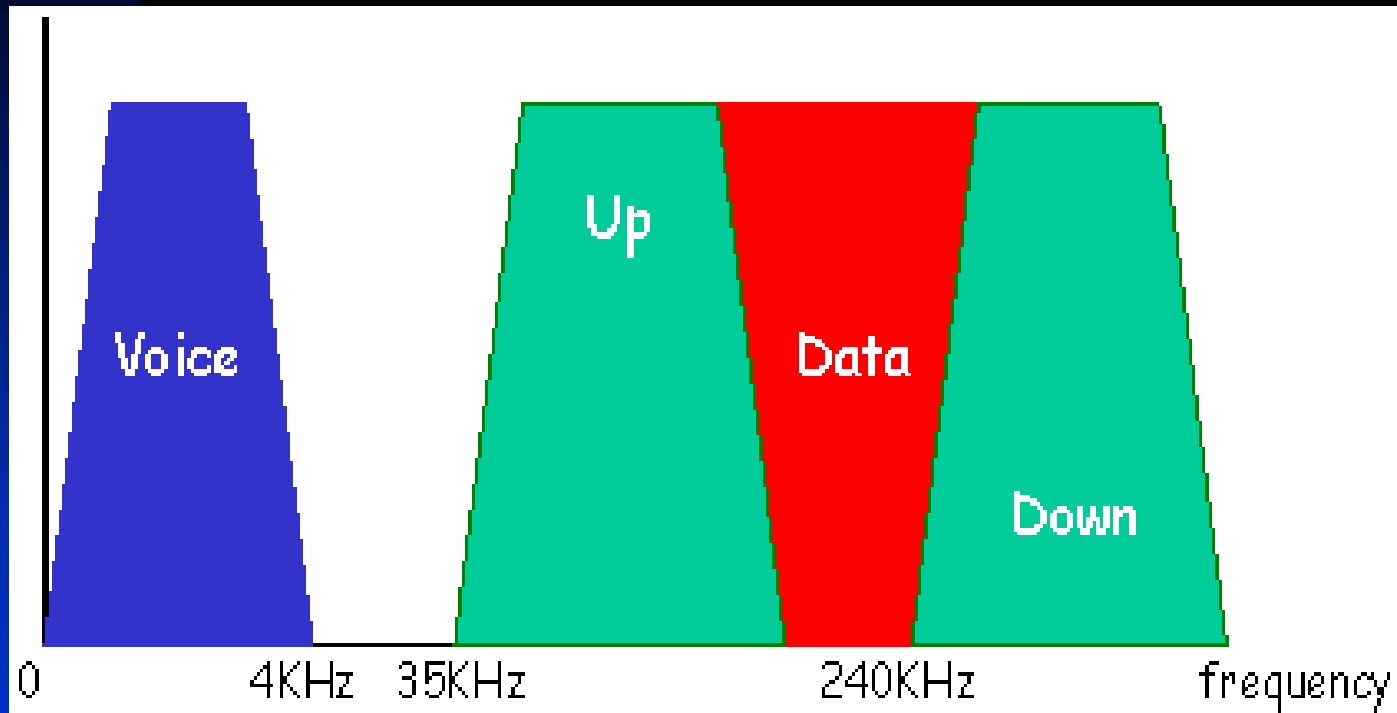


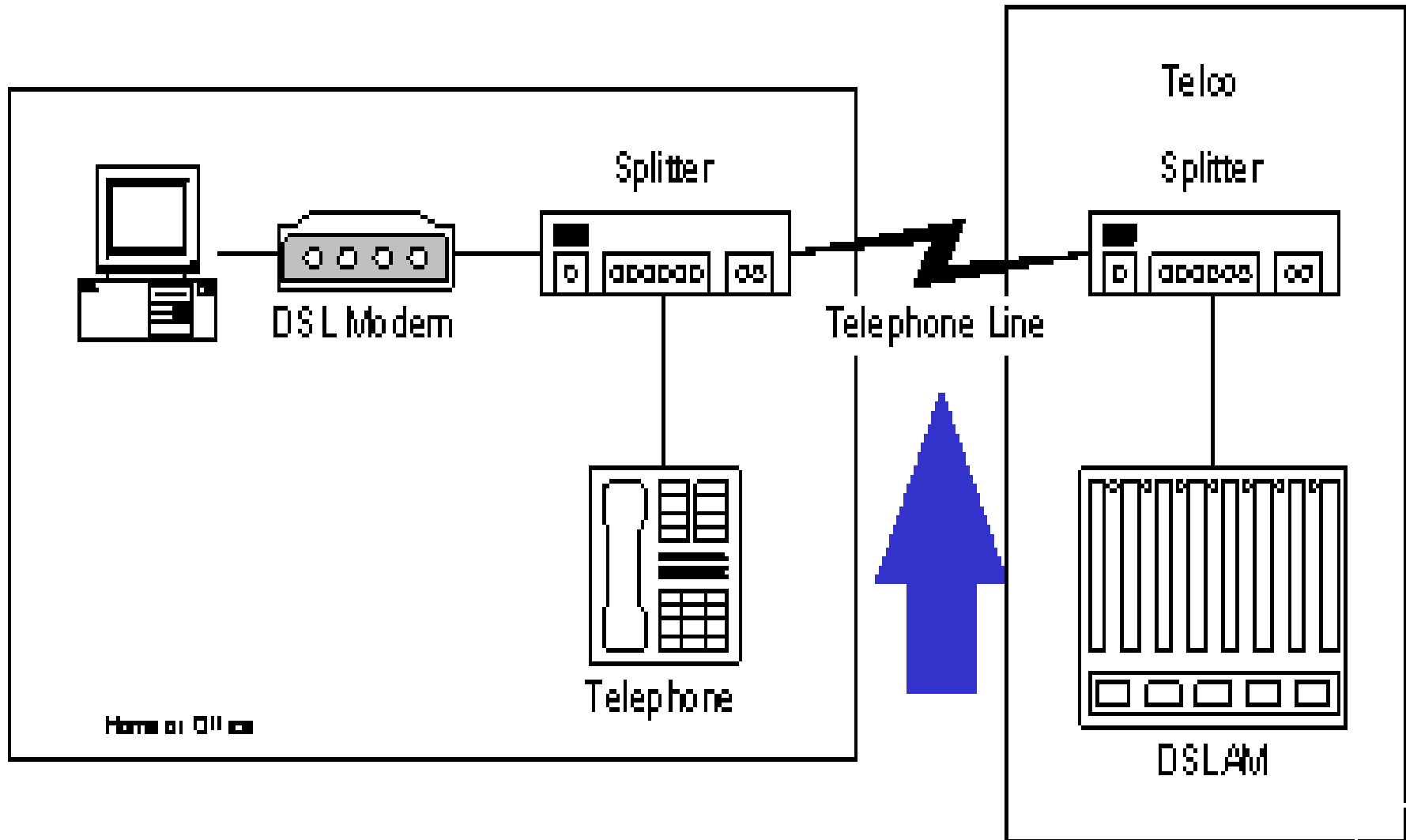
- ✚ Broad band Remote Access Server(BBRAS)
 - ✚ Gigabit and Fast Ethernet Aggregation Switches (LAN Switches)
 - ✚ Digital Subscriber Line Access Multiplexers (DSLAMs)
 - ✚ SSSS/SSSC (Subscriber Service Selection System/ Centre)
 - ✚ Servers for AAA, LDAP at NOC
 - ✚ Provisioning and configuration management at NOC
 - ✚ DSLCPEs
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Broadband over copper: the DSLs

- DSL stands for Digital Subscriber Loop.
- The diagram below shows how DSL modulates the Line Spectrum.
- Data Signal is sent at a frequency higher than the Voice (3.4 KHz) frequency.

DSL 'Modulation'





There are various technologies spawned off from DSL which perform to different expectations:

- DSL: Digital Subscriber Line
- SDSL: Single Line Digital Subscriber Line
- ADSL: Asymmetric Digital Subscriber Line
- HDSL: High data rate Digital Subscriber Line
- VDSL : Very High data rate Digital Subscriber Line
- IDSL: ISDN Digital Subscriber Line

Comparison of the DSLs

Name	Data Rate	Mode	Applications
<u>V21/V32/ V34</u>	<u>1200 bps to 28,200 bps</u>	<u>Duplex</u>	<u>Data Comm, dial up Internet</u>
DSL	160 kbps	Duplex	ISDN service Voice + data
HDSL	1.544 / 2.048 Mbps	Duplex	T1/E1 service , WAN, LAN, server access
SDSL	1.544 / 2.048 Mbps	Duplex	Same , + premises access for symmetric service
ADSL	1.5 to 9Mbps 16 to 640 kbps	Down Up	Internet Access, VOD,remote LAN access, interactive MM
VDSL	13 to 52 1.5 to 2.3Mbps	Down Up	Same + HDTV

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Multiplexing Voice and Data: DSLAM

- The DSL Access Multiplexer, popularly known as DSLAM, is employed by the Telecom Companies to code the subscriber line with the broadband data content.
- Once the ADSL copper line reaches the customer, some customer premises equipment (CPE) has to be employed to separate the voice and data signals.
- In many cases the Splitter function is combined within the DSL Modem CPE equipment, which is also known sometimes as a 'Set-top Box'.

Layer-2 Edge Network (Customer Interface)

Edge routers in 71 cities connected to the core layer either locally through the Gigabit Ethernet interfaces or remotely through dual homed STM-1 links.

- **A1 Cities-** Chennai ,Mumbai, Bangalore, Delhi and Kolkata.
- **A2 Cities-** Hyderabad, Pune and Ahmedabad.
- **A3 Cities-** Lucknow, Jullundhar, Jaipur, Indore, Ernakulam and Patna.
- **A4 Cities-** Coimbatore, Chandigarh, Allahabad, Guwahati, Ranchi,Bhubaneswar, Raipur, Mangalore, Nagpur and Vijayawada.
- **B1 Cities-** 21nodes (Vizag in A.P.)
- **B2 Cities-** 26nodes (Rajamundry, Tirupati in A.P.)

Devices in A1 Cities:

- ✦ Core Router ----- **Cisco12416**
- ✦ Edge Router ----- **Cisco 7613**

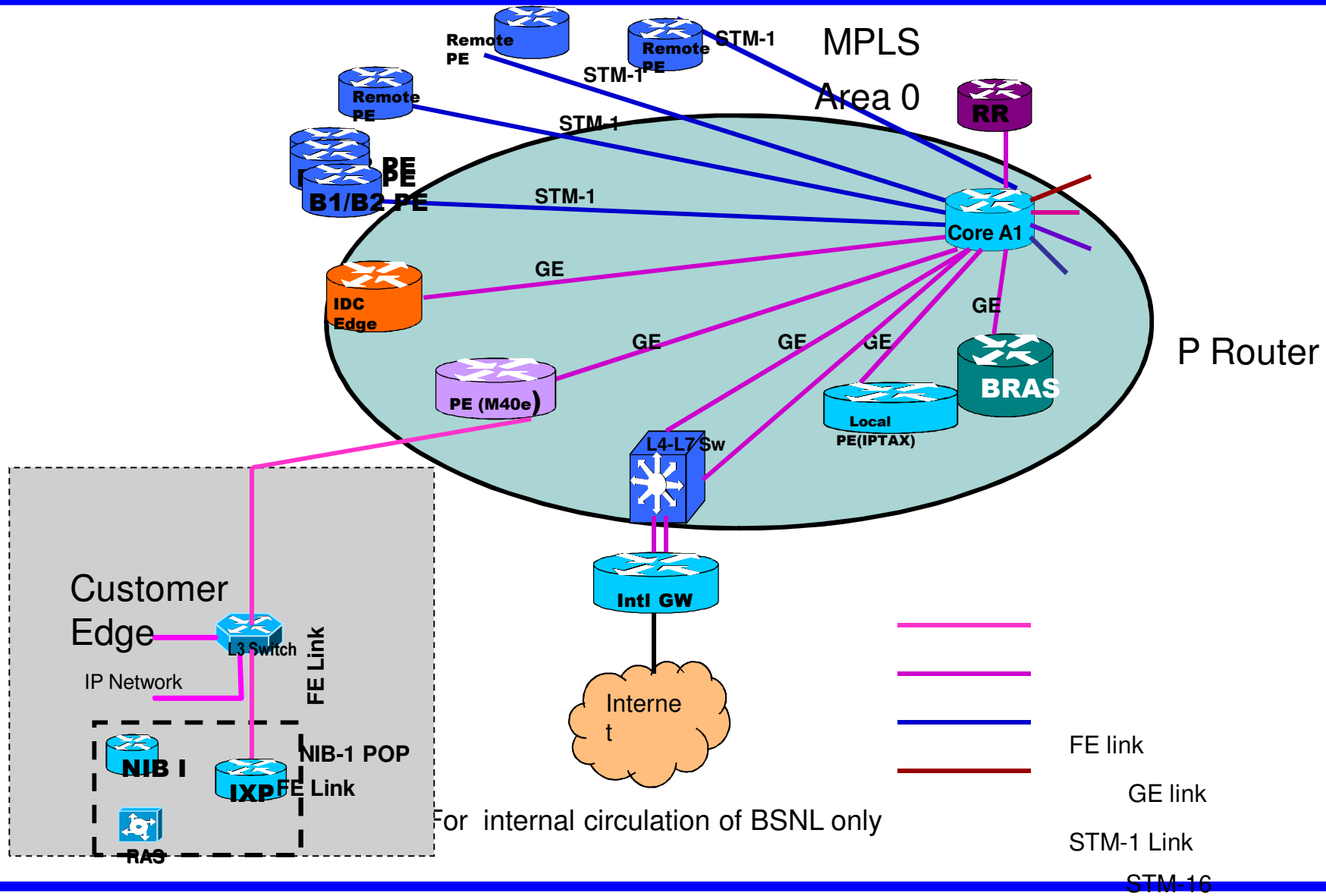
Devices in A2 & A3 Cities:

- ✦ Core Router ----- **Cisco12410**
- ✦ Edge Router ----- **Cisco 7613**

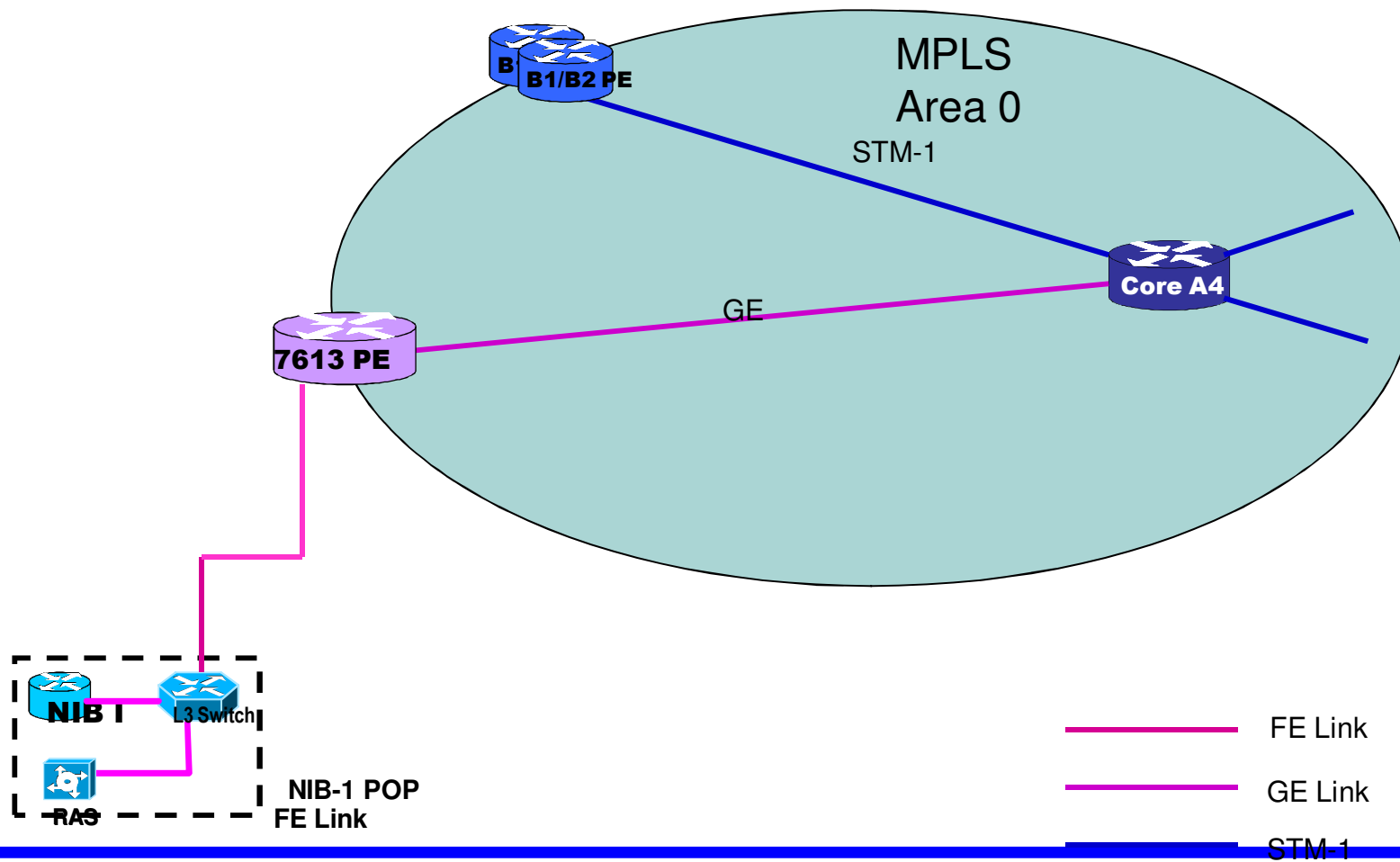
Devices in B1&B2 Cities:

- ✦ Edge Router ----- **Cisco 7613**

BSNL NIB-2 Project1 Connectivity for A1 Cities (Chennai, Mumbai)

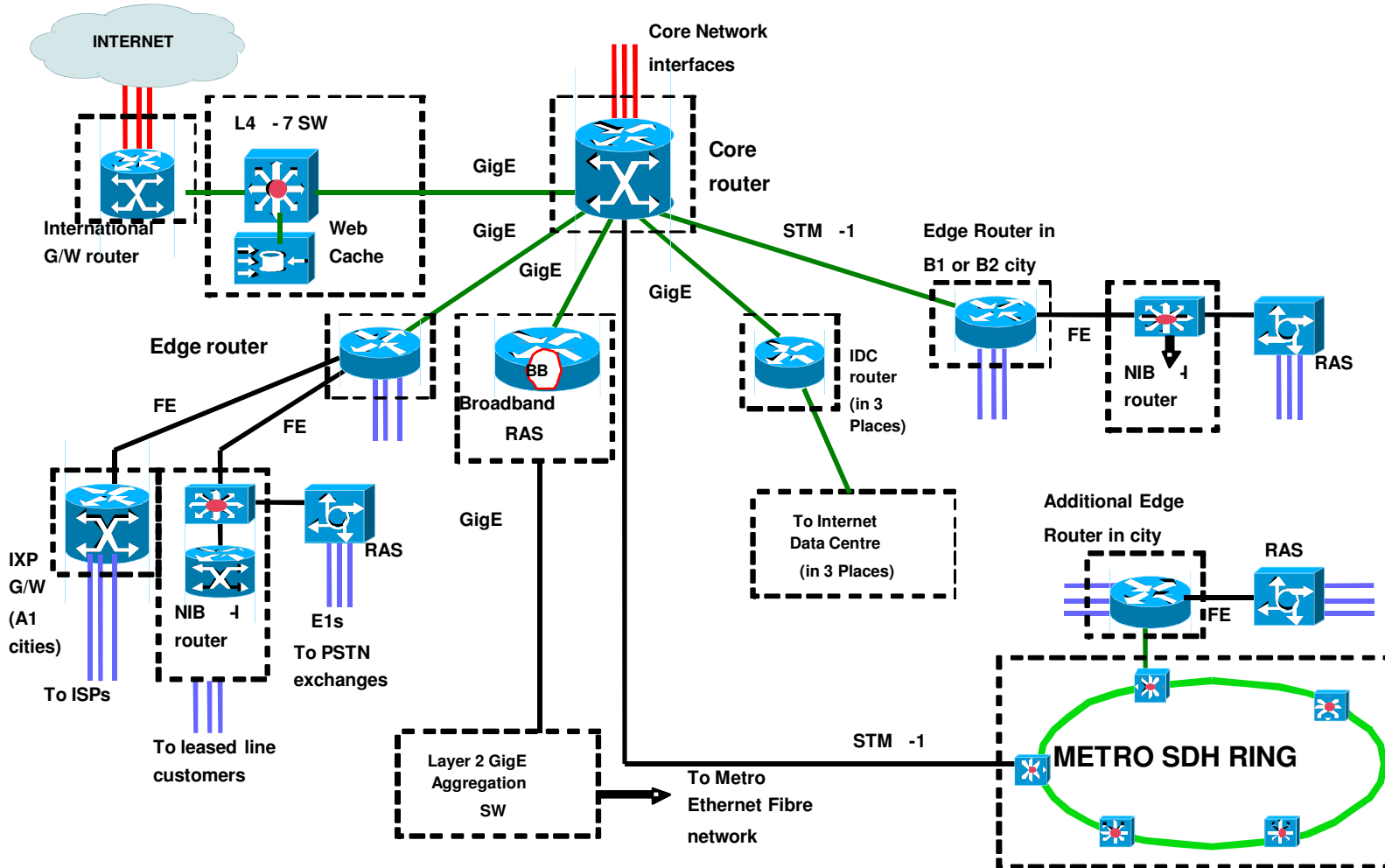


BSNL NIB-2 Project1 Connectivity for A4 Cities



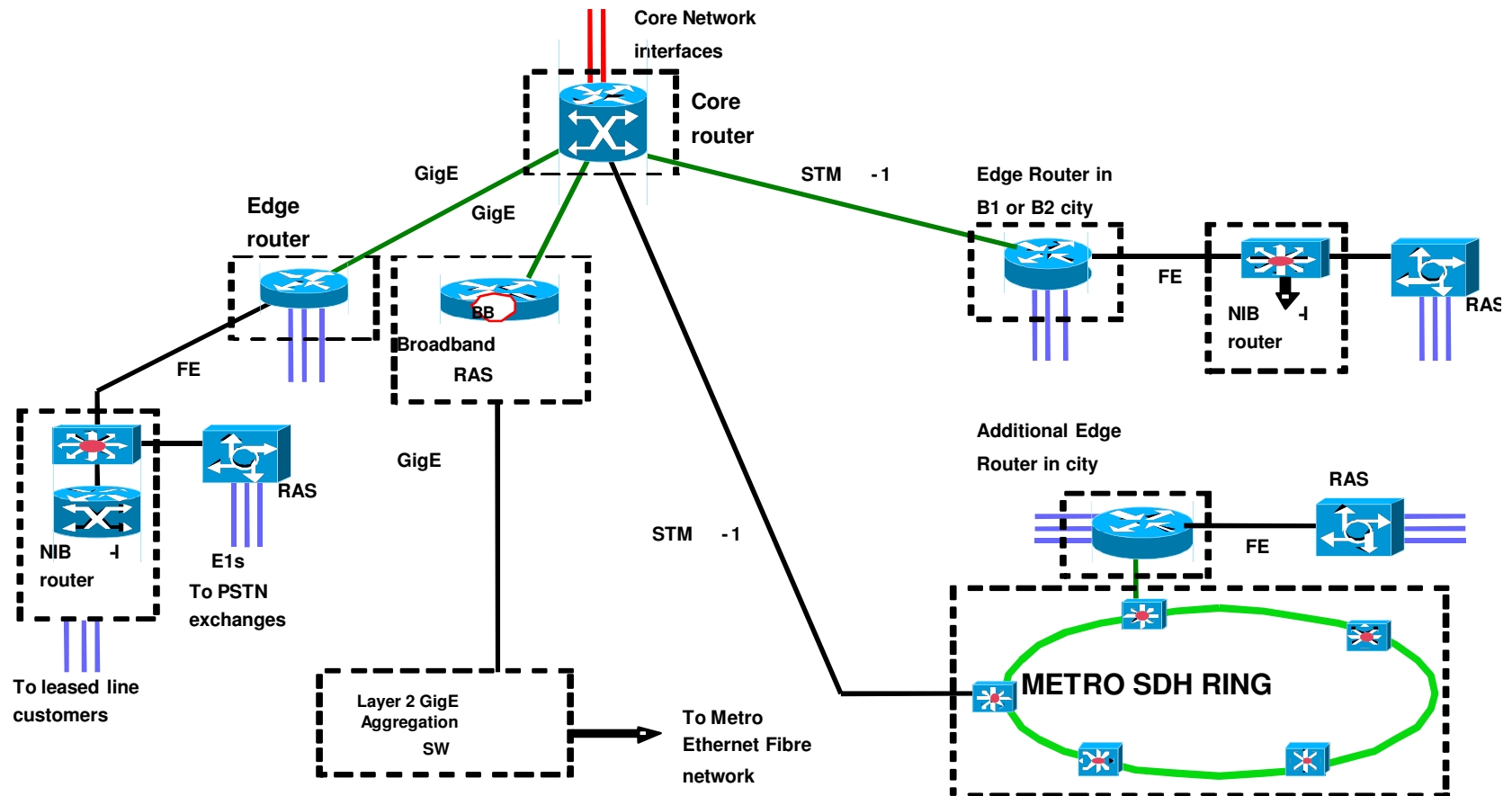
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NIB II Generalized Node Layout for A1, A2 & A3 cities



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NIB-II Node Layout for A4 cities



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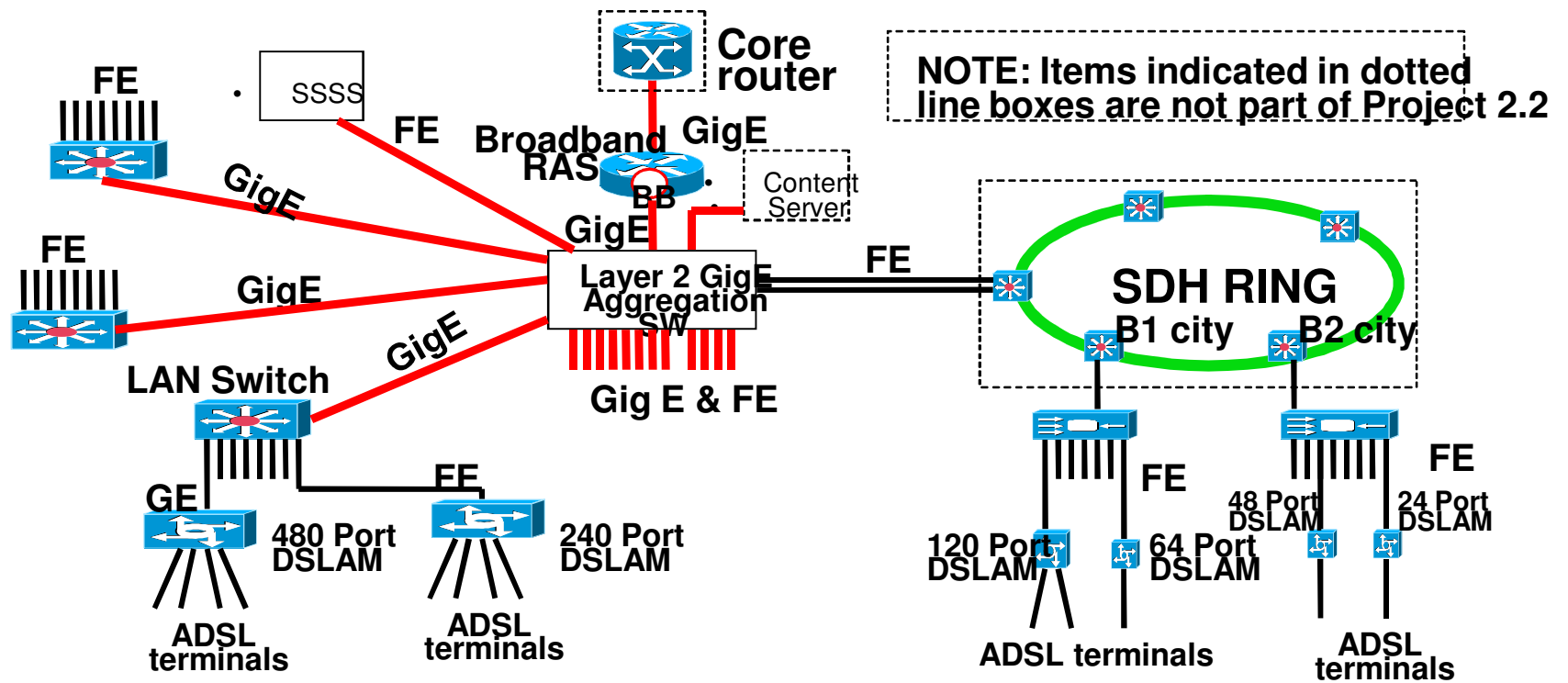
Brief Functions of DSL Components

- **DSL CPEs**: At customer premises. On end it connects telephone cable coming from exchange. At the other end, it connects to Telephone and PC through Ethernet using RJ-45 connector
- **DSLAM**: called as DSL Access Multiplexer. It has a built in splitter which splits voice and data. While voice follows the normal conventional path through exchange, data is aggregated and up linked through Ethernet Port (Gigabit Ethernet for 480 port and Fast Ethernet for lower DSLAM)
- **LAN Switch**: For aggregating multiple DSLAM and providing a common uplink
- **BRAS**: called as Broadband Remote Access Server. First intelligent device in the whole chain. It terminates the customer session, authenticates, allot IP addresses and keeps track of user session for billing along with RADIUS

Brief Functions of DSL Components

- **SSSS**: Called as Subscriber Service Selection System. When customer logs in he will be welcome with this customized screen from where he can select various range of service. This provides on demand service without manual intervention
- **RADIUS**: This in conjunction with BRAS authenticates customer, upload customer profile in the SSSS and keeps track of billing
- **LDAP**: It stores customer database viz username, password and the default services that it can subscribe to.
- **Provisioning**: This is the most critical component for ensuring quick delivery of service. It ensures end-to-end provisioning of service right from DSL CPEs to DSLAM to Switch to BRAS to LDAP

NIB II Broadband DSL Deployment



Architecture

- All A cities + NOIDA (Total 23 cities) will have one BRAS, one SSSS and one Tier 1 LAN Switch.
 - There will be no BRAS, SSSS and Tier 1 LAN Switch in any other cities.
 - All 198 cities will have DSLAMs and Tier 2 LAN Switch The DSLAMs will in general be collocated with existing PSTN exchanges which provide last mile access to customers over copper wire up to average span lengths of 3 kms
 - All DSLAMs are initially aggregated using Tier 2 LAN Switch, through one pair of dark fibre. The DSLAMs and Switch Ethernet Interface are *optical, single mode at 1550 nm. The maximum distance between DSLAM and LAN Switch shall not exceed 10 km*
 - DSLAMs of 480 ports, 240 ports, 120 ports, 64 ports, 48 ports and 24 ports type are planned.
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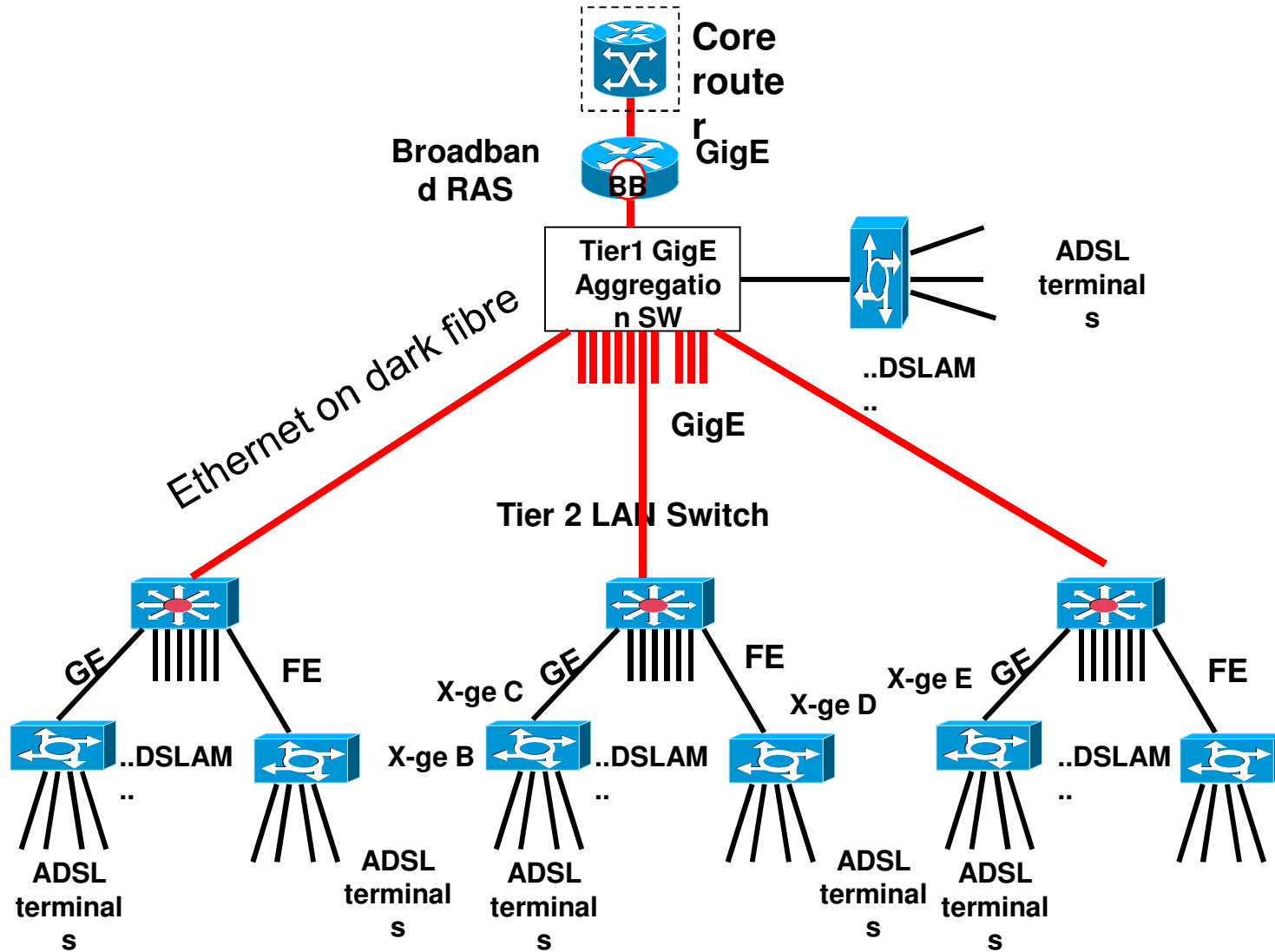
Architecture

- All DSLAMs will be aggregated through a FE interface except 480 port DSLAM, Which will be aggregated through Gigabit Ethernet Interface
 - The 240 port DSLAM will have two number of FE interface
 - The FX or GBIC module in DSLAM and LAN switch should be capable of driving upto 10km on a single mode fibre
 - The Tier 2 LAN Switch in A city + NOIDA will be further aggregated at Tier 1 LAN Switch, deployed in the same city, through one pair of dark fibre, on Gigabit Ethernet optical, single mode Interface at 1550 nm. *The maximum distance between Tier 2 LAN Switch and Tier 1 LAN Switch shall not exceed 40 km.*
 - The SX or GBIC module in LAN Switch used for connecting Tier2 to Tier1 will support 40km
 - The Tier 2 LAN Switch in B cities and other cities will be connected to the nearest A city using **Fast Ethernet over SDH (FEoSDH)**.
-

Architecture

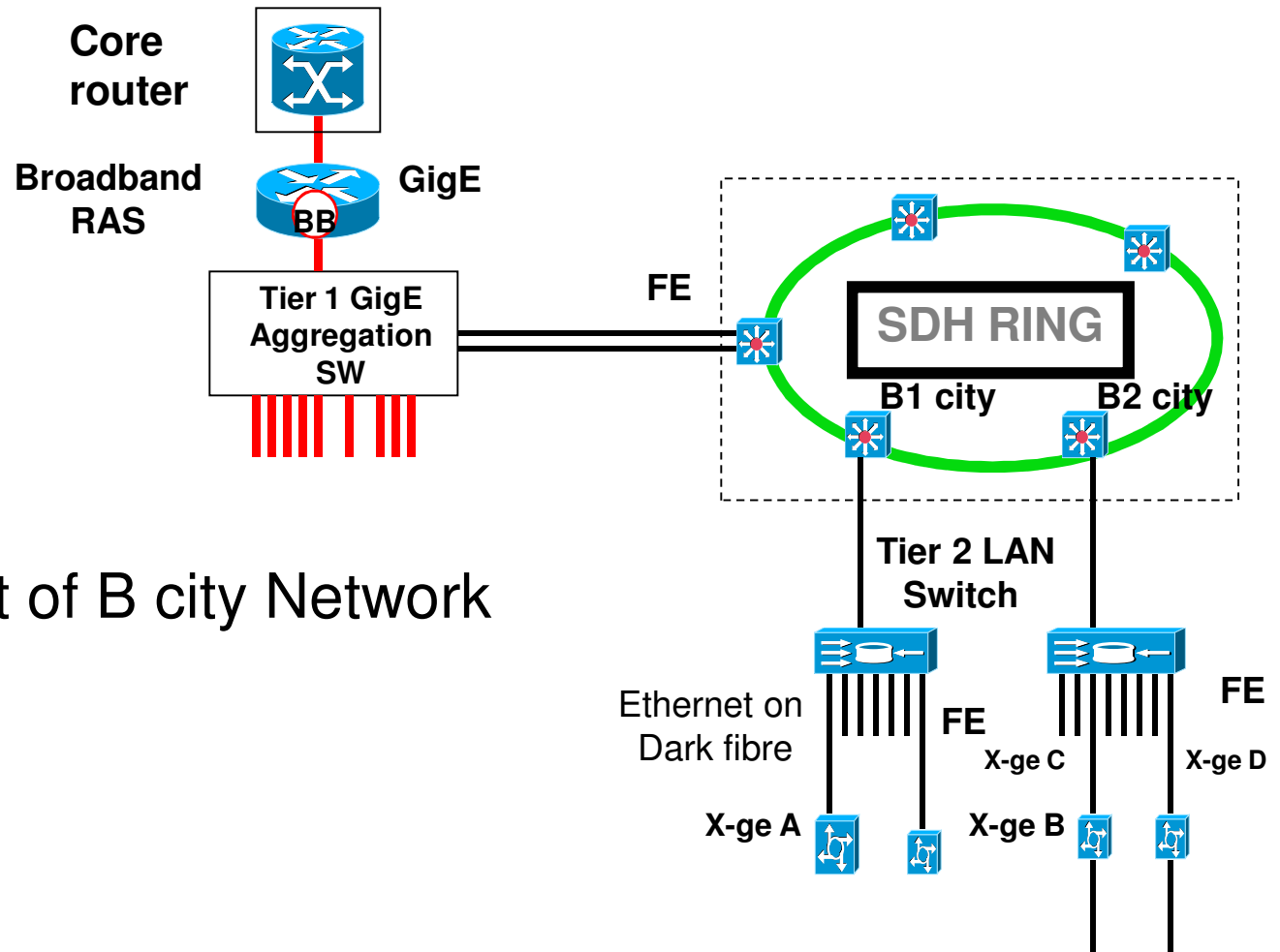
- The Tier 1 LAN Switch in A city and Noida is connected to BRAS on Gigabit Ethernet (GigE) interface, which in turn is connected to the Core Router of Project 1 of NIB-II.
- In bigger cities like A1, A2, A3 and A4, one BBRAS per city will be deployed initially
- The BRAS shall terminate the PPP sessions initiated by the customer and extend the connection further to MPLS VPN/ Internet as desired by the customer
- The broadband Network will have **Network Operation Centre (NOC)** with main NOC at **Bangalore** and **Disaster Recovery (DR) NOC** at **Pune**. *In addition, five Regional POPs (for network management) are also planned. They are Bangalore, Pune, Kolkatta, Chennai and NOIDA.*

Network Connectivity diagram for A cities



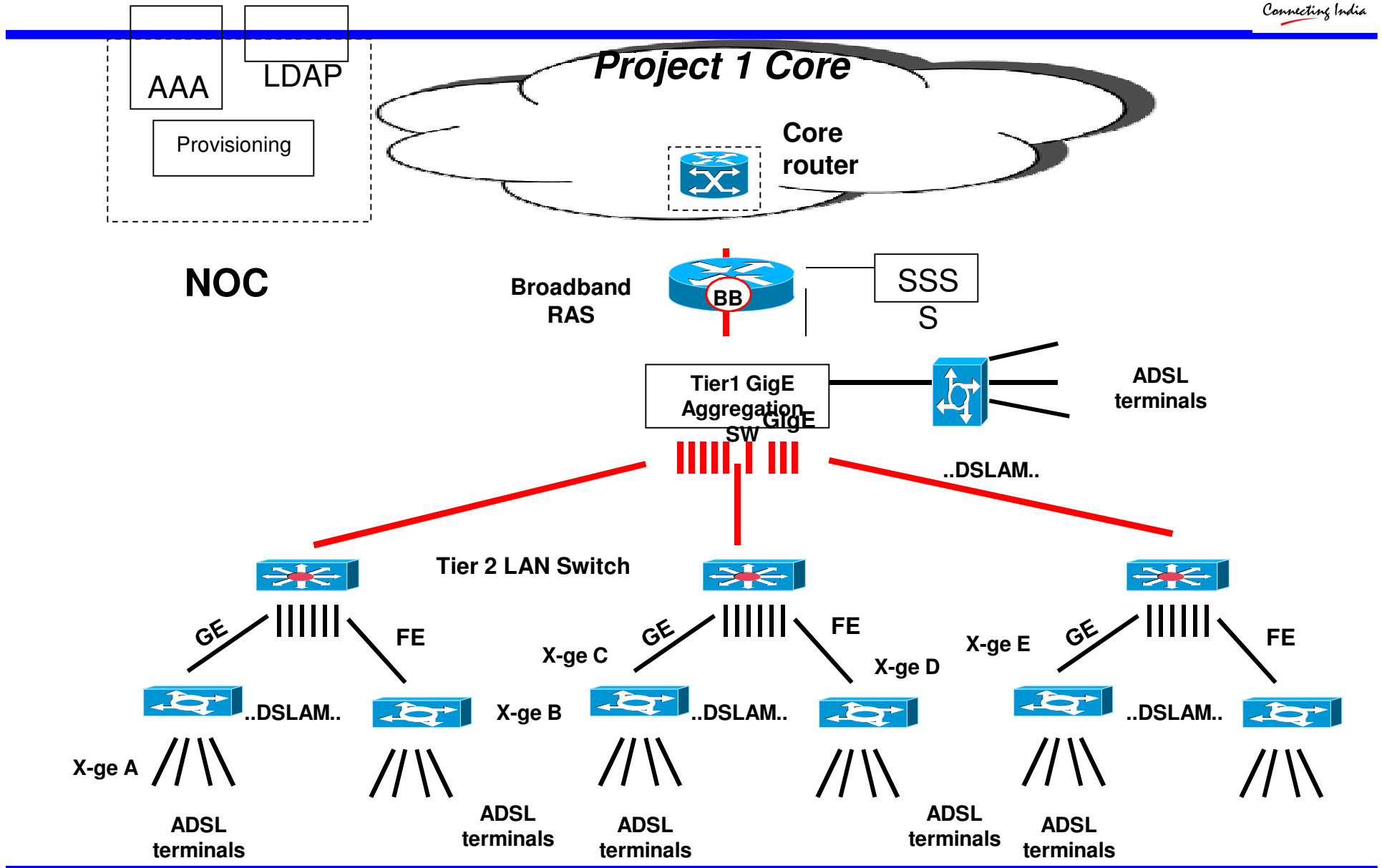
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Connectivity in B & Other Cities



Not part of B city Network

Equipment deployment of HTL and UTS



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BRAS

- **Supports termination of DSL customers.**
- **Allotment of IP address to customer**
- **Bandwidth control using rate limiting**
- **Act as an edge router for terminating VPN traffic.**
- **Protocols: OSPF, BGP, MP-BGP and LDP**
- **Supports Lawful interception and monitoring**

BRAS Architecture

- **Deployed at the edge of the NIB-II network**
- **Installed in all the A sites (except Mumbai). Total 23**
- **Capacity of 8 Gbps (in A1 sites) and 4 Gbps (in other A sites)**
- **Can handle 480000 concurrent sessions (A1 sites)**

BRAS classification

BRAS Classification	Back plane Capacity	Processing Capacity	TEC GR Reference
BRAS at A1 sites	8 Gbps full duplex	15 Million PPS	GR/RAS-03/01 OCT 03-High End
BRAS at A2 sites	4 Gbps full duplex	7 Million PPS	GR/RAS-03/01 OCT 03-Medium End
BRAS at A3 sites			
BRAS at A4 sites	3 Gbps full duplex	3 Million PPS	GR/RAS-03/01 OCT 03-Low End

BRAS in 23 cities

City Type	No of Cities*	Customers Per BRAS			Qty Per City	Total BRAS
		Year1	Year2	Total		
		Total Subscribers				
A1	3	20000	40000	60000	1	3
A2	3	12000	20000	32000	1	3
A3	7	10000	140000	24000	1	7
A4	10	6000	10000	16000	1	10
Total Number of BRAS						23

No. of Tier 1 Gigabit Ethernet LAN Switch along with Interfaces per Switch

City Type	No of Cities	GE Aggregation switch			Total GE Aggregation Switch
		Qty	GE	FE	
A1	3	1	26	24	3
A2	3	1	22	24	3
A3	6	1	16	24	6
A4	10	1	14	24	10
NOIDA			16	24	1
Total Gigabit Ethernet LAN Switch Required					23

No. of Tier 2 LAN Switch Aggregator along with Interfaces per Switch

City Type	No of Cities	LAN Switch Aggregator per city	Interfaces Planned per Switch		Total LAN Switch Planned
			GE	FE	
A1	3	11	12	24	33
A2	3	9	12	24	27
A3	6	6	12	24	36
A4	10	4	12	24	40
B1	21	2	6	24	42
B2	26	2	2	16	52
Others	129	1	0	18	129
Total LAN Switch					359

DSLAM

- The DSLAM will provide Access from 128Kbps to 8Mbps
- The DSLAM will support for QOS features such as Committed Access Rate between CPE and DSLAM, Traffic Policing per port
- The DSLAM will work satisfactory without any degradation in performance and without using any repeater/regenerator over a distance for various access speeds for 0.5mm copper pair

Downstream bit rate	Distance
6 Mbps	1.5 Kms
2 Mbps	3.5 Kms
1 Mbps	4.0 Kms

What is Broadband MultiPlay?

Broadband Multi-Play focuses on the augmentation of Broadband Access Network to meet the **targets of 2006-2008** with planned capacity of **6 millions** supporting multi-play services like Video on Demand, IP TV, VoIP, VPN service etc with **guaranteed control of critical parameters like latency, throughput, jitter** to ensure high grade delivery of real time service, near real time, non real time and best effort”

It is similar to what has been done as part of Project 2.2 of NIB-II but is much bigger in scope (Almost 10 times) with advanced protocol (RPR) being used in the aggregation.?

Enhancement done in Multi Play

- DSLAM continue to work in star topology. Why?
- Uplink bandwidth of DSLAM is minm 1+1
GE
- For second layer of aggregation, RPR is used.
- Admission Control: Network based on DSL Forum
TR-059. Also implements hierarchal QoS
- New applications like automated subscriber
installation and on going support.

What is RPR?

- RPR stands for Resilient Packet Ring
- It combines the best of both worlds- Resilience and performance of SDH rings & Traffic flexibility of Ethernet based packet networks
- Resiliency: 50 msec switchover
- Better bandwidth efficiency
 - Spatial Re-use
 - Statistical Multi Plexing
 - Better protection mechanism avoids wastes of resources.

RPR Contd..

- Quality of service
 - 3 traffic classes are supported, assuring that low latency services such as voice and video are always given preferential treatment
- Better Fairness
 - Available bandwidth on the ring is distributed to all contributing source stations
 - Dynamic process reacting on actual traffic conditions

Network Architecture Summary

- o All A Cities have Tier 1 Switch + BNG
- o In A Cities, the Tier 2 Switch are interconnected on 10Gbps.
- o 47 B cities have Tier1 Switch + BNG.
- o Remaining B Cities have Tier 1 Switch Only.
- o In B Cities, the Tier 2 Switch are interconnected on 1Gbps.
- o The Cities with BNG (Total 69) are referred as Broadband Aggregation Point (BAP).
- o The STM-1 link from 'OC' is to be aggregated to the nearest Tier 1 switch of A/B/OC Cities (105).

Services Planned

- **DATA BASED**
 - *High Speed Internet access – Killer App.*
 - *VPNs*
 - *Multicasting*
- **VIDEO BASED**
 - *IP TV – BROADCAST*
 - *VIDEO ON DEMAND- (Most Expensive to provide)*
 - *Bandwidth on demand (User based / Service based)*
 - *Multicasting*
 - *Video Conferencing*
- **VOICE BASED**
 - *VOIP*

Services Planned Contd..

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