

Towards 50 million Broadband Connections in India

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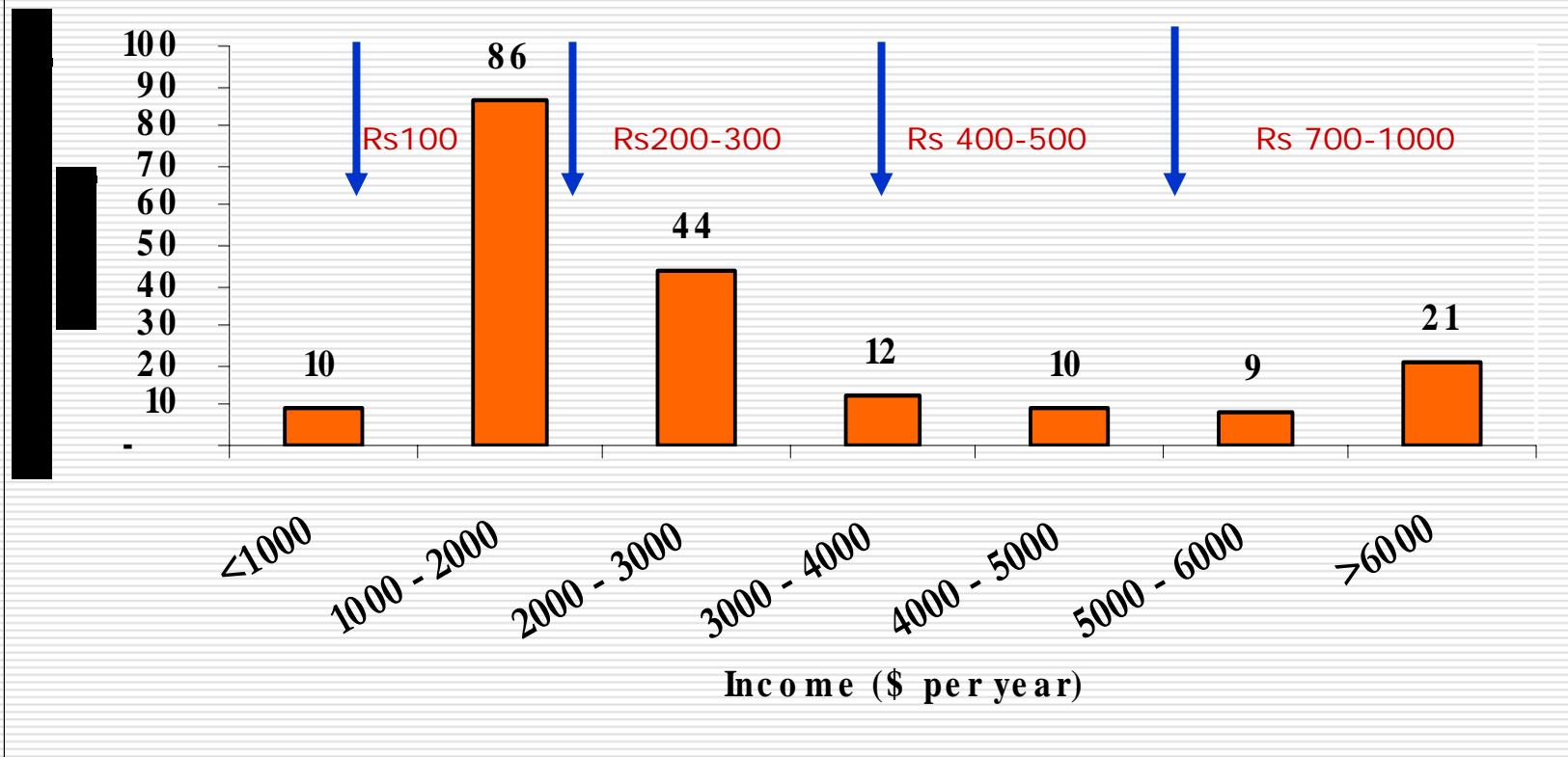
Internet is Power

- Internet is not just a means of communications, but is Power
 - is a big enabler

 - Internet in India has grown
 - but slowly
 - is expensive
 - Internet based Services (Education, Commerce and Entertainment)
 - virtually non-existent

- What does India require?

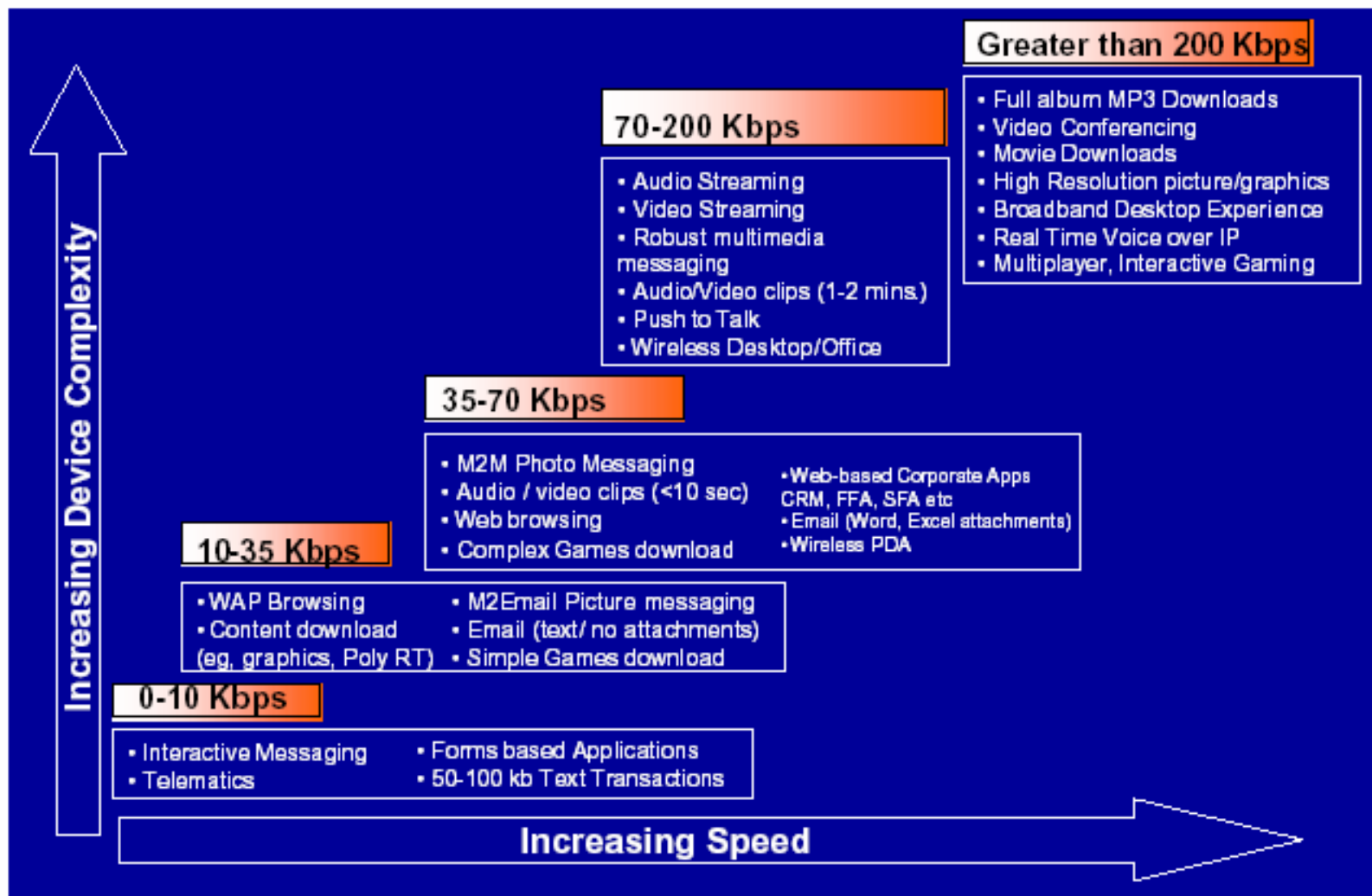
Income distribution among households



What would we like at homes/ small offices?

- ❑ Low bit-rate connection for messaging at Rs 100 (\$2) pm
- ❑ 64 kbps (*per-user average*) *Always On connection* at Rs 200 (\$4) pm
 - ❑ will enable email, browsing and some education/commerce
- ❑ 200 kbps (*per-user average*) *Always On connection* at Rs 400 (\$8) pm
 - ❑ will enable video-conferencing, some entertainment
- ❑ 1 to 2 Mbps (*per user average*) *Always On connection* at Rs 700(\$14) pm
 - ❑ will enable video on demand, entertainment
- ❑ Can we get there? and what about the [terminals](#)?

Mapping of Services to Preferred Speeds



Mapping of Wireless Data Services to Preferred Speeds



- Solar System
- Force of Gravitation.
- Formation of Earth
- Formation of Moon.
- Effect of Cooling.
- **How oceans and rivers were formed.**



See View Address Book Options Help

Chat | Address Book | Online Users

Participants

- Anitha
- Moderator**

Moderator: Good Morning Students
 Moderator: Today we are going to see about long questions
 Anitha: Ma'm I have a question

Type the message to be sent here and hit <Enter>

Bottlenecks: Progress over last year

- International Network
 - Rs 100,000 per month per Mbps (one way to/from USA)
 - if one uses a 100 kbps connection to continuously pull traffic from a US based server, the international network alone will cost Rs 10K per month !!
 - Some cost reduction: Much more to come
 - NIXI is established: Yet to fully function
 - Create Indian Content and host it in India
 - Mirror / host International sites in India
 - reduce International traffic fraction from 85% to 25% in three years

- Backbone Network cost in India
 - Rs 20,000 per month per Mbps (one way, farthest distance)
 - TRAI recommended drastic cuts; huge fibre build-ups : Much more to happen

- Access Network: connecting from PoP to home/office
 - The challenge continues

Bottlenecks: Progress over last year

- The Access Device / PC: Rs 20 – 30K is too expensive
 - New Access Devices coming up
 - TV based / monitor based / Thin Client

- Content: Entertainment, Education, Services, Transaction
 - No major progress in last one year

- Affordability: Rs 1000 for Broadband too expensive
 - Total Cost of Ownership needs to be affordable

For home/office connectivity Access is the primary bottleneck

- Access Choices:
 - Dial-up Internet: too costly and too little
 - Mobile: too costly and far too little
- DSL on Copper: available by-and-large only with incumbent (BSNL/MTNL)
- Coaxial Cable: Can we overcome Quality issues?
- Wireless: Can we provide enough bandwidth?
- Fibre to the home/curb: build may take time (with Last METERS of copper or wireless)

Digital Subscriber Loop on Copper

- What is technologically possible today?
 - ADSL: 6 Mbps downlink and 512 kbps uplink for 4 Kms cu
 - ADSL2+, VDSL: 30 Mbps downlink and 1 Mbps uplink for 700 m

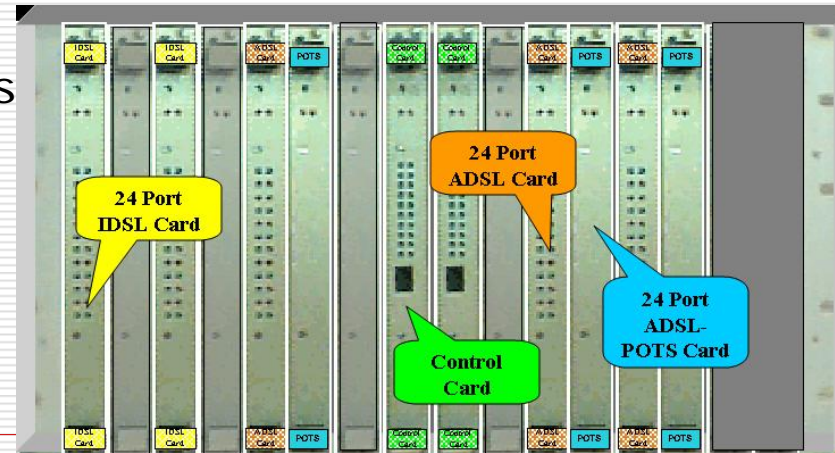
- But who has copper links to homes/offices?
 - Only BSNL/MTNL
- What are the lengths of such copper loop
 - mostly 3-4 Kms; 5% may be 700 m (connected using DLCs)
- What is the quality of such copper?
 - Poor, except when 700 m copper links with DLCs are used

- Dishnet/Bharati are putting their own (cables) fiber/copper in a limited way

BSNL provides DSL service in 95 cities using DIAS



- Always ON Internet connection at 128 kbps on not so good quality copper lines in about 500 exchanges (95 towns)
- Banyan also offers **ADSL/ADSL2/VDSL solution** for better quality copper lines



Internet on Coaxial Cable

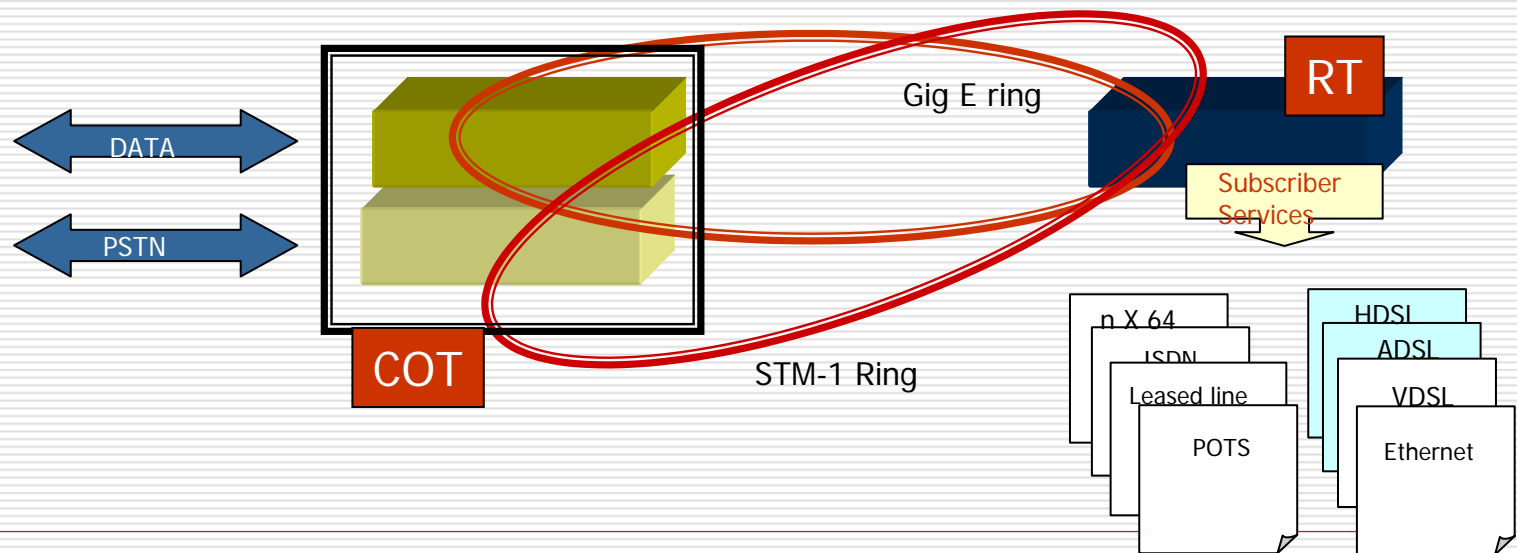
- Widely used in USA
 - 10 to 40 Mbps broadcast in forward direction and 512 kbps to 1 Mbps shared uplink

- Coaxial provides TV to 60 million Indian homes
 - at carrier charge of **Rs 80 per month** (in contrast to charge of \$ 20+ per month in most developing countries)
 - how is this possible?
 - Choice of cable, connectors, amplifiers and deployment and maintenance methodology are all designed to provide TV services at Rs 80 per month
 - Most attempts in India towards **conversion** of the coaxial plant for two-way Internet communication has been a failure

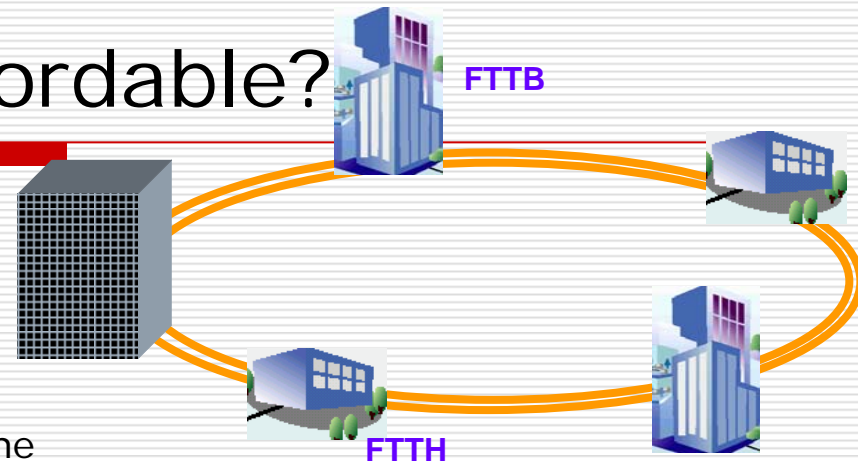
Fibre Access Network

finally beating the bandwidth game

- Fibre to the Building / Curb
 - last **Meters** on copper (Ethernet) or wireless (802.11)
 - 100 Mbps to each user possible
 - is being used today by almost all operators
 - BSNL, MTNL, Reliance, Bharati, Tata-Tele, Shyam, HFCL



But is Fibre Access affordable?



□ How deep can the Fibre go?

■ Key drivers

- Cost of Fibre Termination, Line terminating electronics and power backups
- can one have RT serving only 20 subs?

■ Depends on

- Customer Density and Affordability

■ For dense urban areas of India, Fibre to the building is the most cost effective solution

- comparable to wireless provided one can get it 1 in 3 homes

□ But can one install fast enough?

Wireless: The happening Area

can it solve access problem to homes/ small offices?

- 2.5 G Mobile: 3G-1x/GSM/GPRS
 - can deliver 100 kbps shared connection to all subs in a sector
 - may deliver 1 Mbps shared connection in future (3G)
 - still at best comparable to 56 kbps dial-up; uses huge spectrum; will be costly --- can compete with dial-up

Network and device	Highest speed we experienced: download	Highest speed we experienced: upload	Vendor-rated average speed ¹	Maximum possible speed
EDGE: Nokia 6620 cell phone	82 kbps	32 kbps	100 to 130 kbps	384 kbps
UMTS: Motorola A845 cell phone and Novatel Merlin U520 PC Card	291 kbps (phone), ² 320 kbps (card)	54 kbps	220 to 320 kbps	2 mbps

Computerworld:
<http://www.corante.com/unwired/>

Will 3.5G (HSDPA / HDR) work?

- Sector throughput 0.75 bits/sector/Hz
 - unlikely to give much more than 100kpbs avg thrupt per user

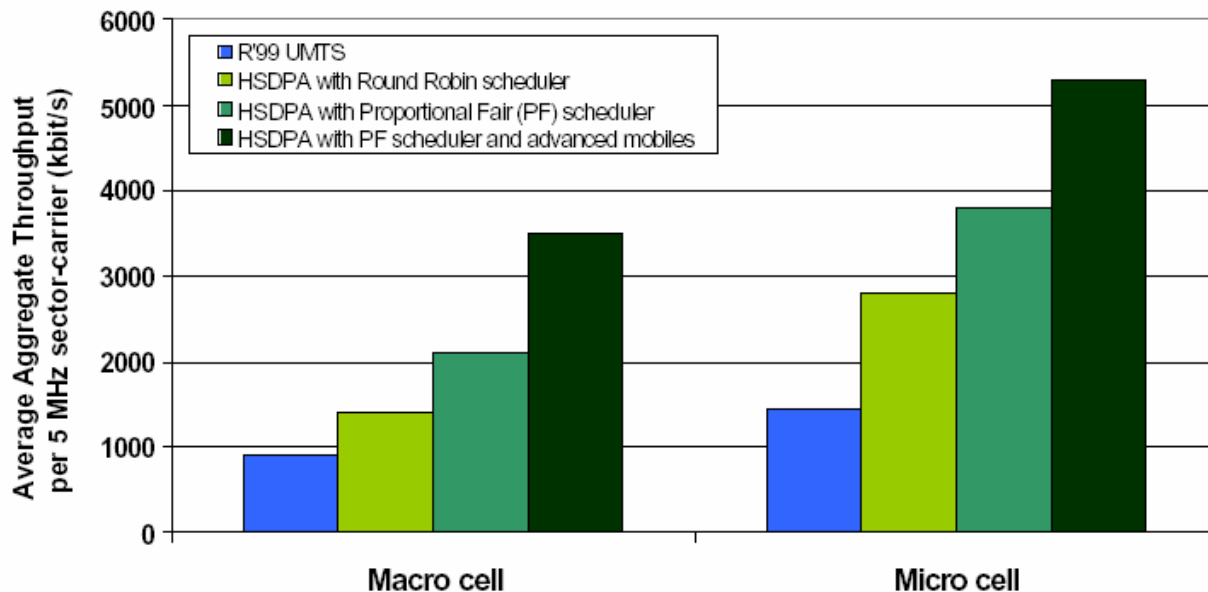


Figure 5. Capacity Improvement of HSDPA

HDR

- 3-sector cell throughput with IS-856 Rev 0:
 - 3.1 Mbps with 1 Rx antenna (pedestrian)
 - 4.1 Mbps with 2 Rx antennas (pedestrian)
 - 2.1 Mbps with 1 Rx antenna (vehicular)
 - 3.1 Mbps with 2 Rx antennas (vehicular)
- 3-sector cell throughput with IS-856 Rev A:
 - 4.5 Mbps with 2 Rx antennas with equalizer (mix of pedestrian and vehicular)

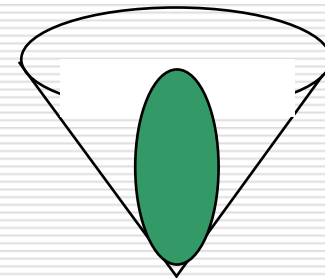
- Average aggregate throughput through simulation in 1.25 MHz Carrier in forward direction
 - Sector thruptut 0.8 bits/Hz with one RX antenna
 - 1.2 bits/sector/Hz with two Rx antenna

Data rates possible on 3G

- 3G or HSDPA or HDR can at best provide
 - 2 bps/Hz downstream per sector in the middle of a sector
 - drops to about a tenth as one leaves the center of the sector

- an operator in India is unlikely to get 10 MHz + 10 MHz spectrum
 - using half of this spectrum (5 MHz + 5 MHz) for data
 - shared 10 Mbps per sector in the center
 - shared 1000 kbps as one moves away from the center of the sector
 - only slightly better than 56 kbps provided by dial-up

 - nowhere comparable to DSL
 - providing Always On 512 kbps/1 Mbps sustained at \$8 / \$10 per month
 - tariff on downwards trend



Will operator allot more spectrum for data?

- Operator earns from same spectrum use
 - SMS : Voice : Data = 100 : 5 : 1.2
 - that too assuming dial up charges for data
 - which is very high
 - spectrum-starved operator's **priority can not be data**

	Voice	SMS	Data
<i>bitrate</i>	2x10 kbps	300 bits	40 kbps
<i>price</i>	Re 1/min	30 p per msg	30 p per min
<i>amount per kbit</i>	5 paise	100 paise	0.75 paise

50 paise = 1 cent

So what does one need?

- Right spectrum efficiency / right cost
 - Spectrum efficiency of 3 bps/Hz with a reuse of almost 1
 - throughout the sector / cell
 - and going up --- doubling for 4G
 - Broadband infrastructure cost
 - not more than 150 -200 subscribers served by an operator in one sector in 1 km radius
 - infrastructure cost to be amortised over 150 sub
 - not more than \$40 per subscriber
 - infrastructure cost of about \$ 5000 per sector
 - today it is five times higher !
 - Preferably using hand held form factor
 - must work with existing 2.5G infrastructure for voice/SMS/MMS

Is WiMax (802.16) the answer?

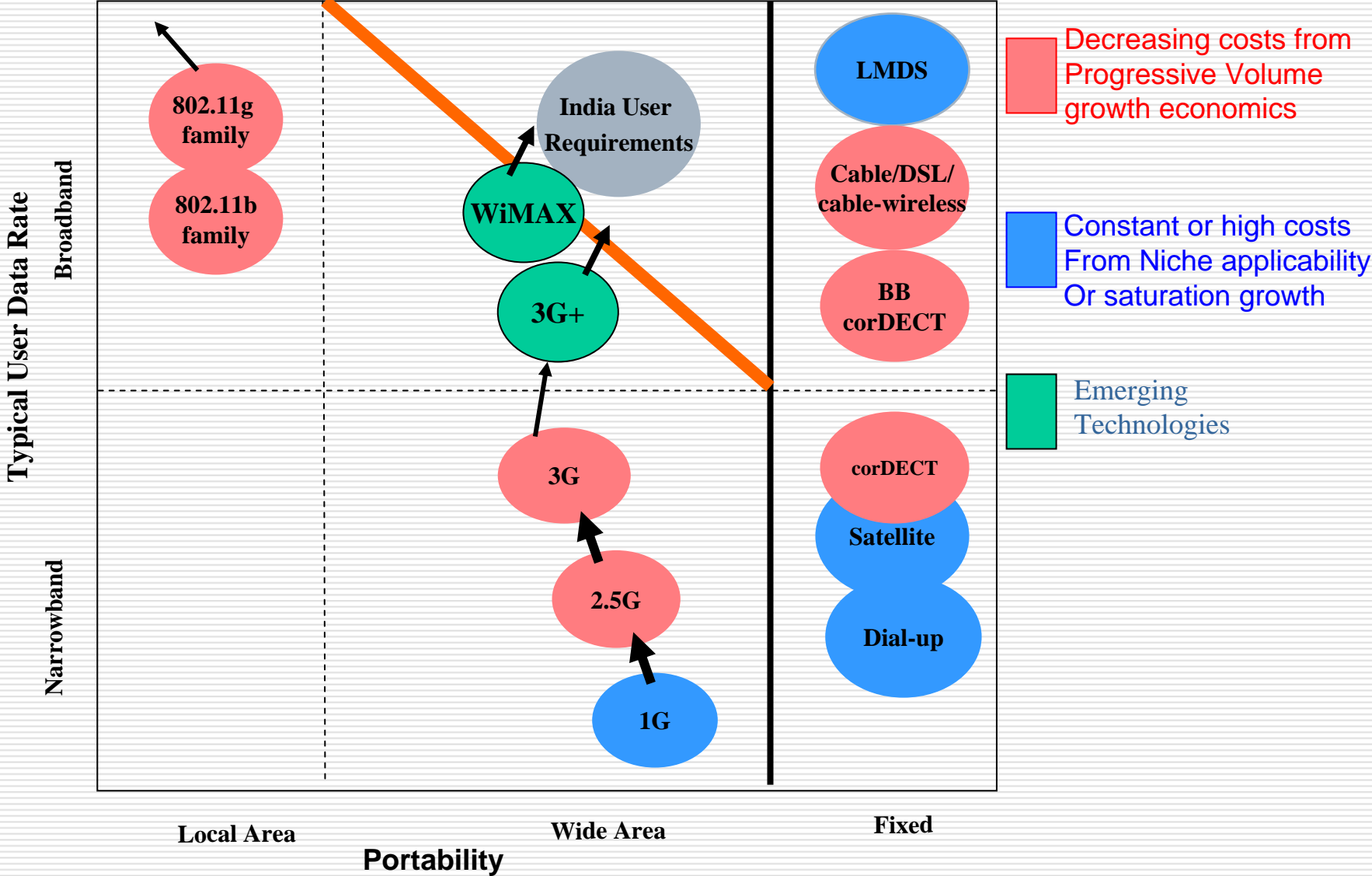
- OFDM can provide 4 to 5 bits per sec per Hz
 - But what is its reuse ?
 - 1 : 9 (3 sectors, once in three cells) or 1 : 3 or 1:1?
 - What can adaptive antennas, DCA, beam forming, power control, adaptive coding, adaptive scheduling, frequency hopping give us?
 - may amount to 500 kbps dedicated connection to each user
 - what price point and when?
 - And what about the infrastructure costs? Unlikely to work with existing infrastructure
- 4G wireless / MIMO
 - promises more: when, how much and at what cost

Wireless Technologies (continued)

- BB corDECT WiLL: provides **Always On 100 /200 kbps** dedicated connectivity to each user
 - Ideal for 200 / 64 kbps (*dedicated*) *Always On connection* at Rs 400/ 200 per month
 - Always on low-bit rate(32 kbps) connection at Rs 100 pm

- 802.11 Wireless LAN
 - ideal LAN for office, homes, public places (100 meters hotspots)
 - but required fibre/DSL connection to base station
- PMP Systems (proprietary) providing 64kbps to 2Mbps connection
 - companies like SIFY provides 64 kbps at Rs 20K per month
 - shared connection to multiple users in a building

Comparison of Alternatives



Bridging the Last mile on Broadband

- Fiber to Home / Copper (Ethernet) in last meters / 802.11 in 100m
 - Slow build-up

- DSL
 - Ideal solution for incumbent (BSNL/MTNL)
 - Others do not have Copper?

- Wireless
 - Still far away: 802.16 / WiMax is **three years** away / will it have the BW?

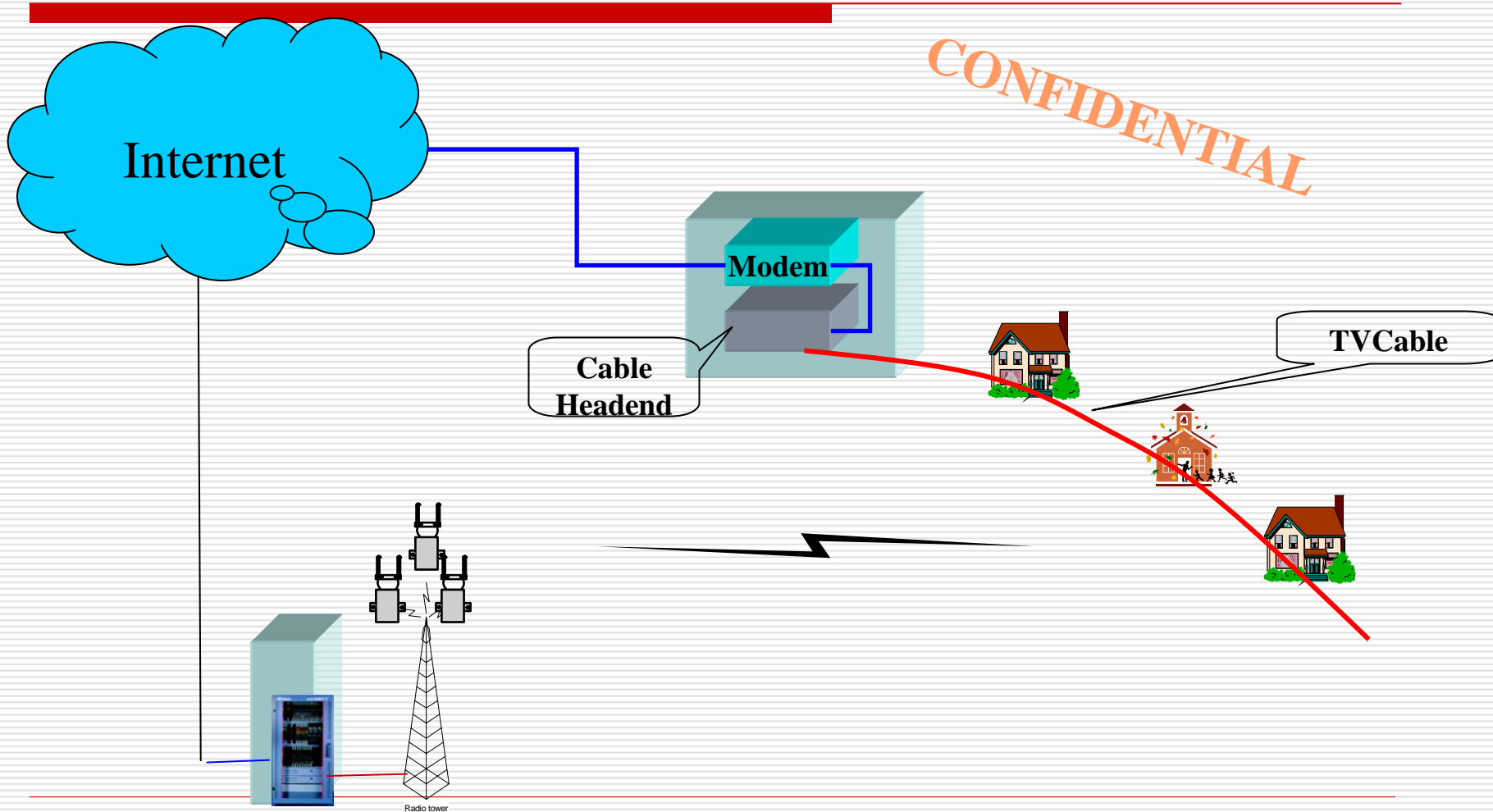
- Two way Cable
 - Existing cable infrastructure too poor for this to scale up

- Ethernet
 - What Quality ?
 - Non Robust and Non Scaleable

- **Non- incumbents require some disruptive Access Technologies**

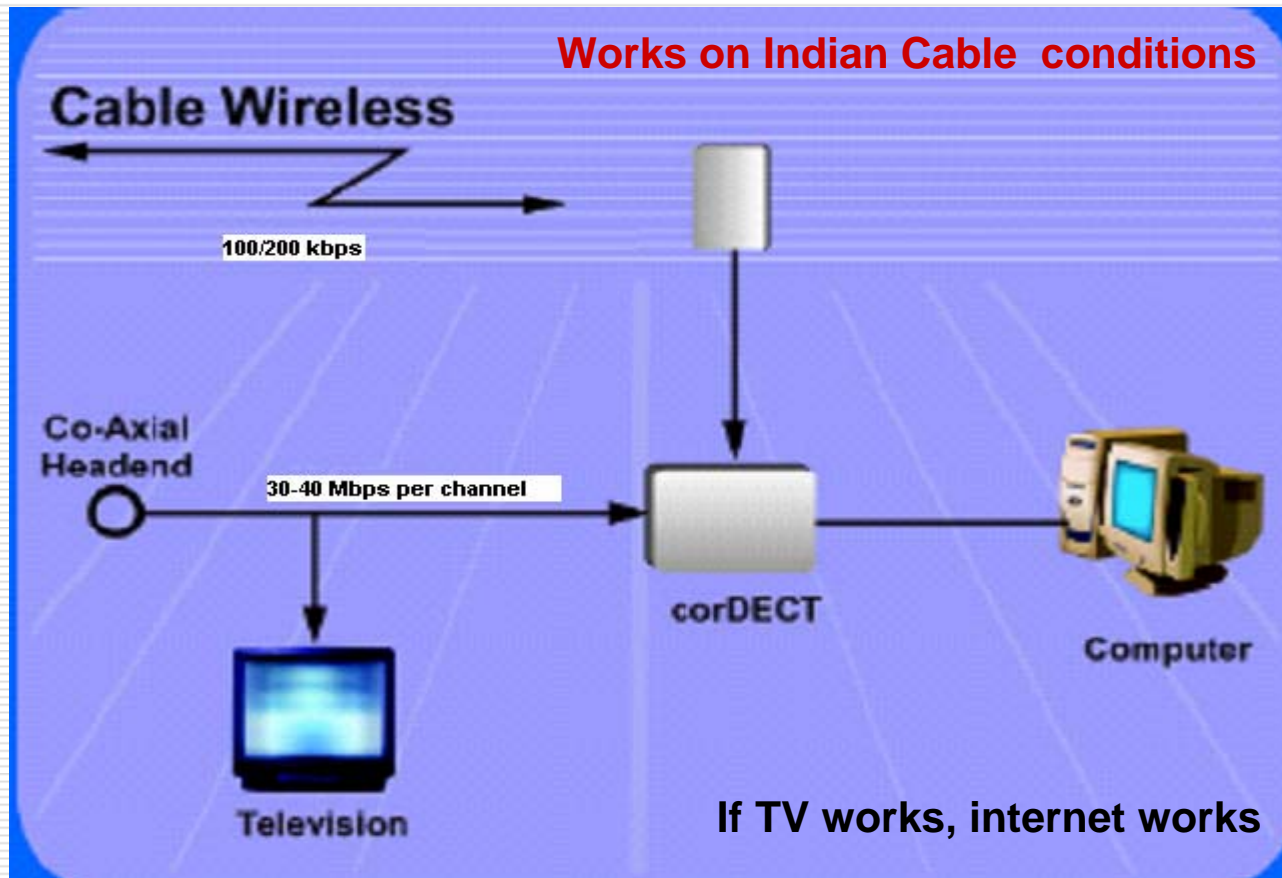
Cable Wireless :

Down Stream on Cable Upstream on Wireless



Cable Wireless

Downstream on Cable, Upstream on Wireless



Access Terminals

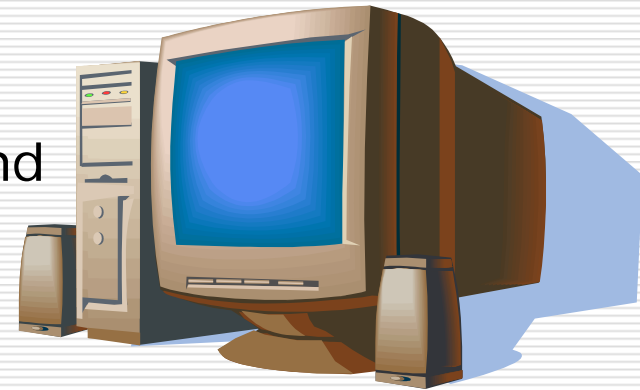
- PCs are too expensive for India's homes
 - VIA PC and AMD has brought cost below Rs 15K (\$300)
 - Software costs extra
 - still too high beyond 7 to 10 million homes

- Need new solutions: Service oriented

Introducing: Build your own Computer

- A low end Linux PC
 - Entry price Rs 7K (US\$150) [devices to reach next 25 million homes](#)
 - Initially connected to TV, later to new/old monitor
 - video player, audio player, VoIP, Video conferencing, browsing, email, word processing and telnet

- Connected to a Server on Broadband
 - All storage at Servers
 - No virus, no back-up required



Introducing: thin client as Access Device

- Thin Access Device
 - Connected to a Server on Broadband
 - Multi-media thin client functions just like a PC
 - All storage at Servers
 - No virus, no back-up required
 - Target price: Rs 4000 plus monitor

- For homes and for Mid-size companies



Introducing: METEL for corDECT

- ❑ Messaging terminals at **Rs 2K (\$40)**
 - for 50 million homes and small office

- ❑ email, SMS, information, ticket booking, banking
- ❑ smart card, magnetic card optional (another Rs 1K or \$20)
- ❑ retail transaction, remote inventory and accounts management



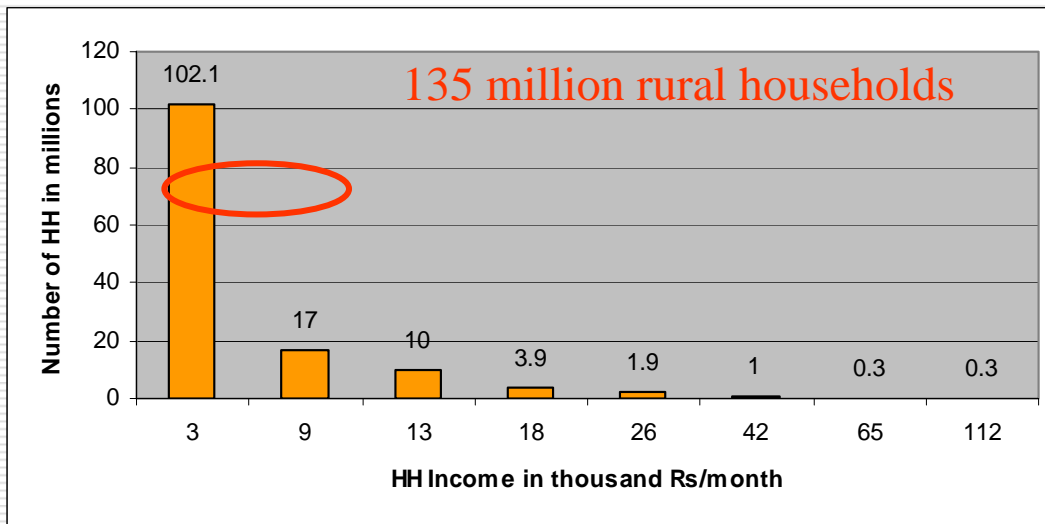
Rural India has 700 million people

- in 600,000+ villages (about 1000 people per village with per-capita income of **40 cents per day**)
 - per capita GDP of Rs 10000 (US\$ 200) per year



- Can technologies make a significant difference in life of such people?

- Can it bring to them health & Education
- Can it significantly enhance their incomes?

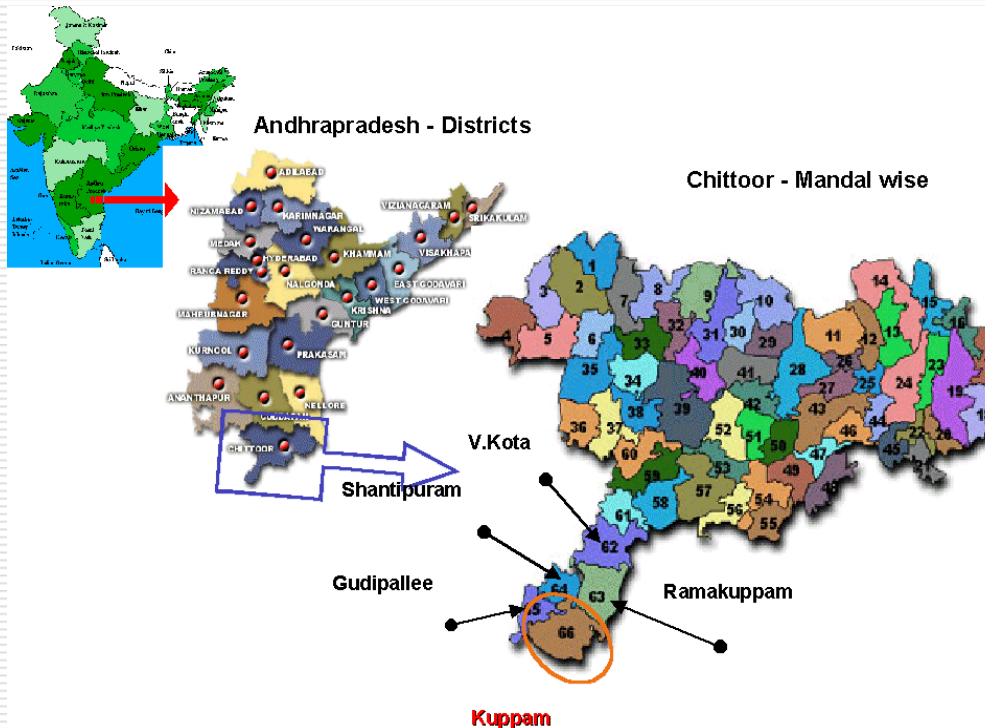
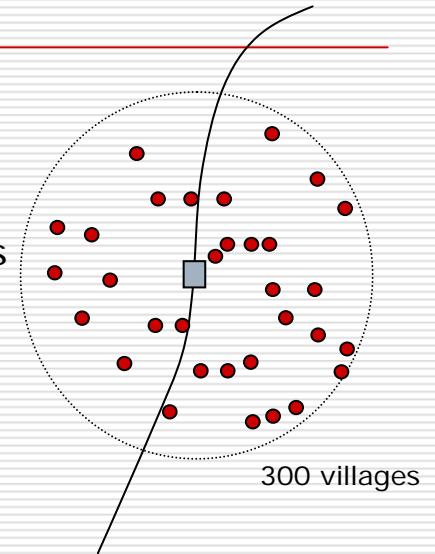


□ To Scale one needs

- Technology
- Sustainable Business Model
- Organisation **which thinks and acts Rural**

Technology: Leveraging Public Contribution

- BSNL (state owned incumbent operator) has fibre connectivity to most **County** towns
 - and fibre has almost infinite bandwidth carrying capability
 - 85% of villages within 15-20 Km radius of these *taluka* towns
 - In India, typically 300 villages in 30 Km radius

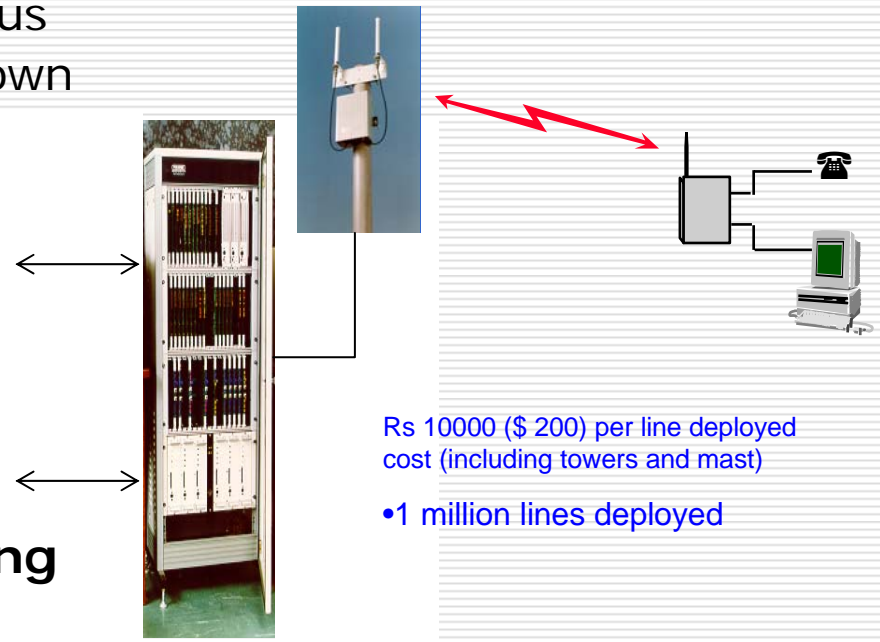


- wireless systems can connect most of these villages
 - wireless technologies are continuously evolving
 - costs come down and bit rates go on increasing

Innovative Technology to connect Rural India

□ BB CorDECT Wireless in Local Loop developed at IITM

- provides a telephone line and 100/200 kbps Internet connection in 30 Km radius
- Exchange and tower in town
 - Works at 55° C
 - Power requirement: 1 KW
 - start-up costs very low



□ Newer technologies emerging

- Promising 1 Mbps connectivity
 - with **OFDM (like 802.16 / WiMax)**
 - with **HDR and HSDPA: doubtful**

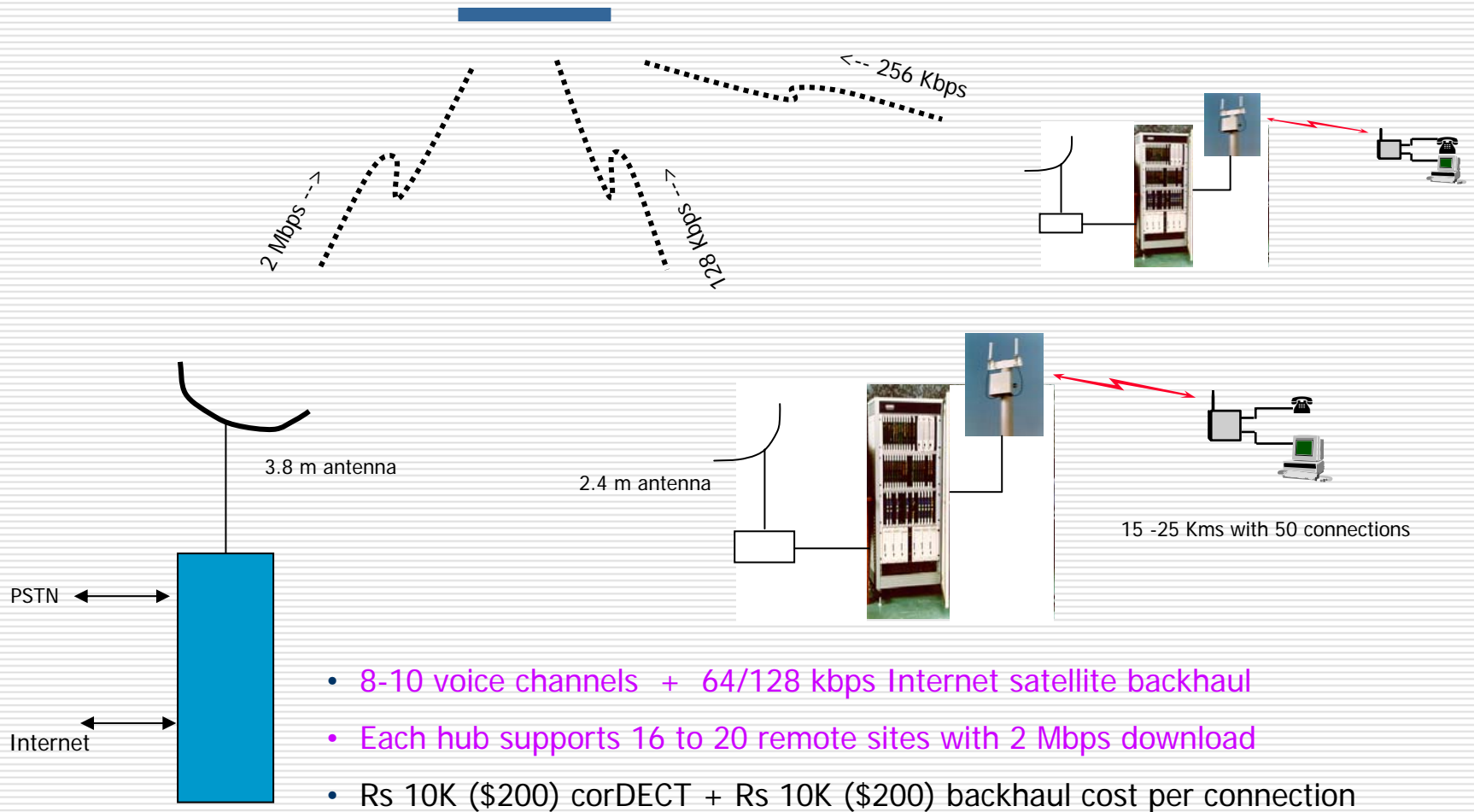
In future

- Connectivity requirement in each village
 - up to 1 to 2 Mbps or even 5 Mbps dedicated connection to each village can be served by terrestrial wireless
 - OFDM ... WiMax
 - as need goes higher, fibre or point to point wireless (microwave) may be required
 - 7 to 10 years hence

- 15% Sparse Area village will require special attention
 - double hop (satellite and terrestrial wireless) may serve most of these villages (99%)
 - direct satellite connection required in about 1% of villages

Sparse Area Communications

where there is no fibre backbone

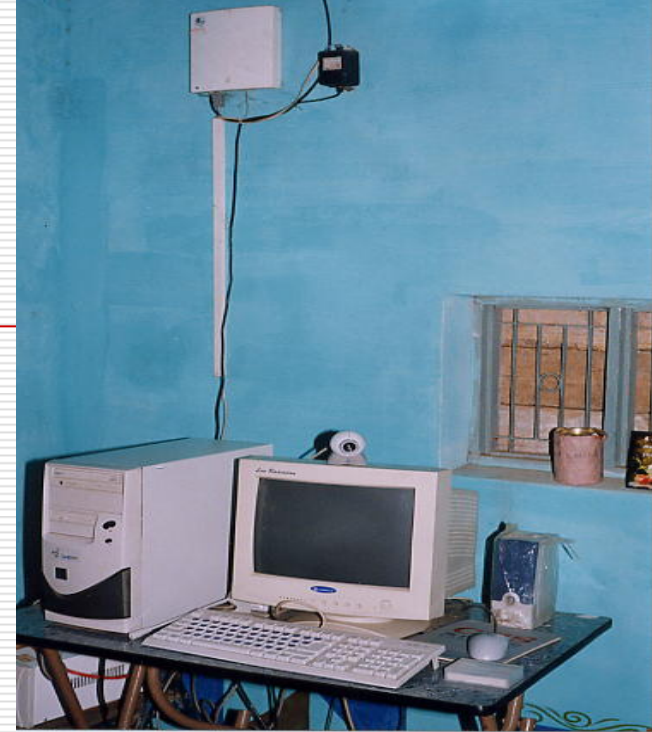


Innovative Business Models

□ n-Logue : A Rural Service Provider

- aggregate demand into a kiosk
- owned & driven by a local entrepreneur

- Rs 50000 (\$1000) per Kiosk providing telephone, Internet, multimedia PC with web-camera, printer and power back-up for PC
 - plus Indian language software, video conferencing software, training and maintenance and 6 months unlimited Internet
- set up by a village entrepreneur on the lines of urban PCOs
 - provides telephone, stand-alone Computer and Internet services
 - needs 120 per day to break even (Rs 3.50 per person per month)



To Sum Up

- To enable India with Internet, we need
 - Always On Access providing differential services at costs between Rs 100 to 700 per month
 - BSNL/MTNL can use DSL
 - new operators have only Fibre Access or cable wireless for 2Mbps Broadband connection
 - Wireless technology being watched: may be still three years away
 - Terminals widely affordable in India
 - Rural Areas would leverage higher rate connectivity