

Towards 50 million Broadband in India

How should we progress?

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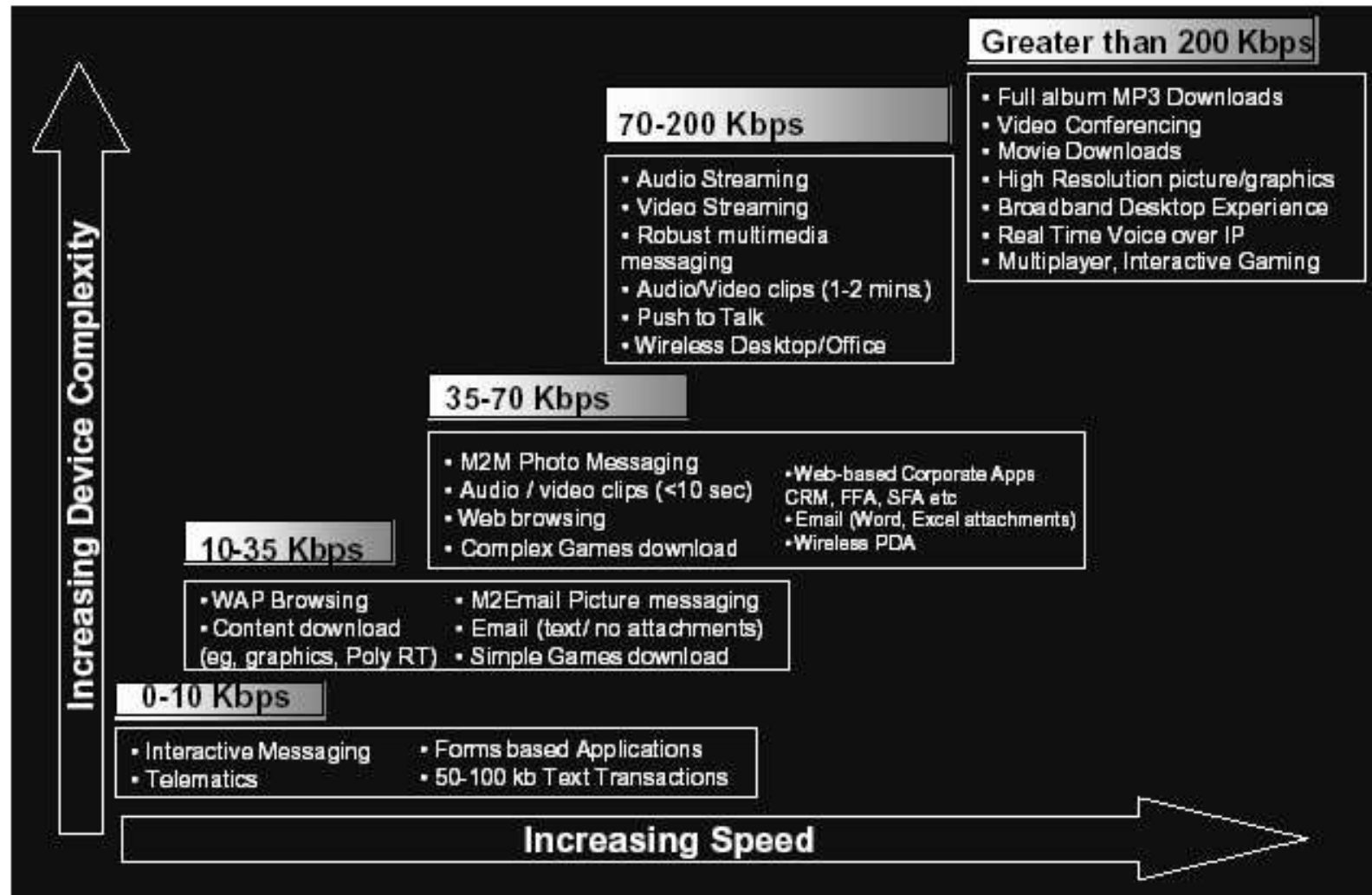
Internet is Power

- 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?

Mapping of Services to Preferred Speeds



Mapping of Wireless Data Services to Preferred Speeds

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 only with incumbent (BSNL/MTNL)
- Coaxial Cable: Can we overcome Quality?
- 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

- BSNL going full-fledged today
- VSNL/Bharati/SIFY are putting their own cables in a limited way

Internet on Coaxial Cable

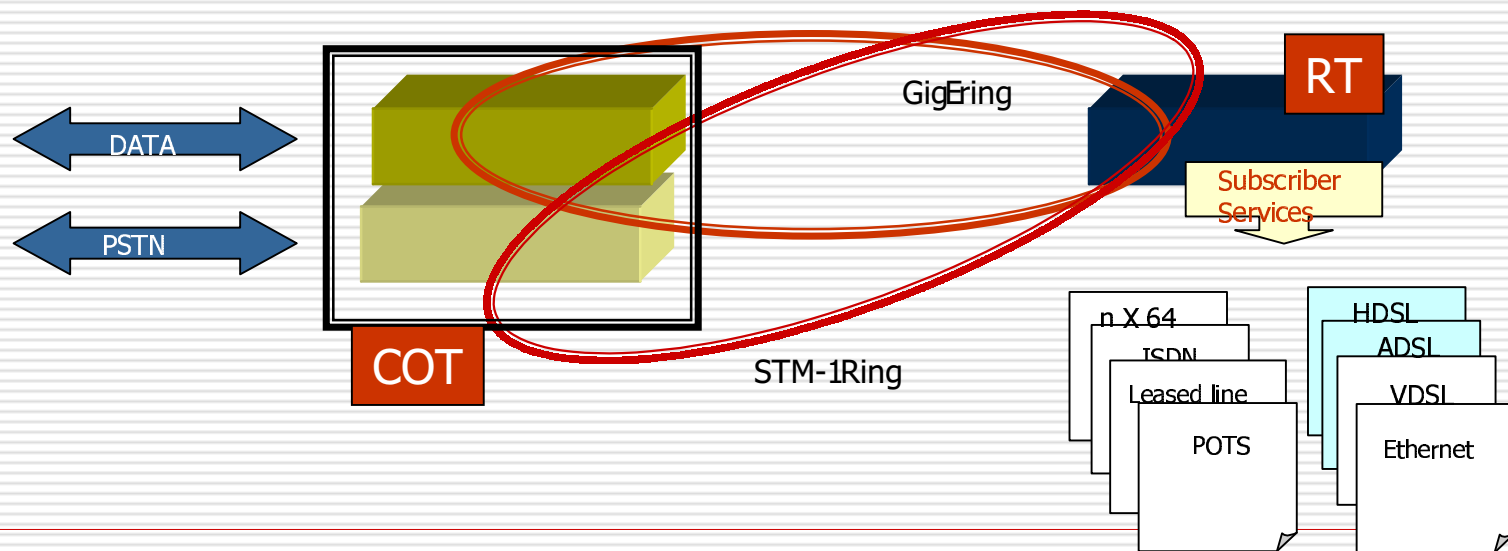
- Widely used in USA
 - 10 to 40 Mbps broadcast in forward direction and 512 kbps to 1 Mbps shared uplink

- 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?

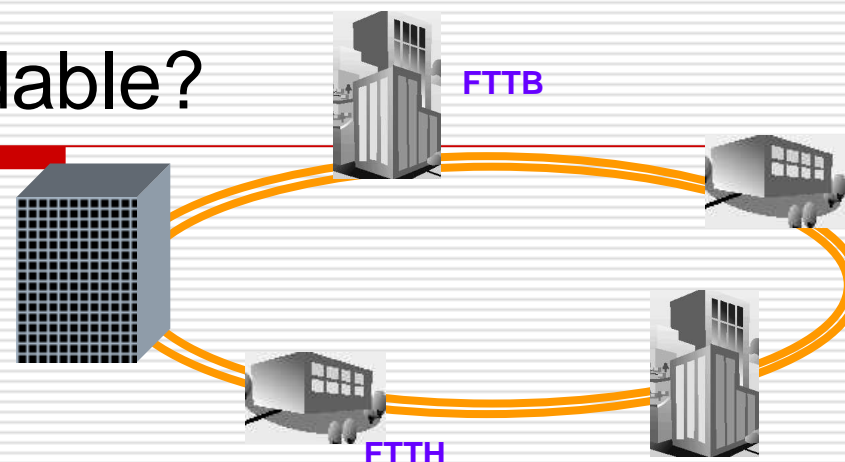
■ Depends on

- 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

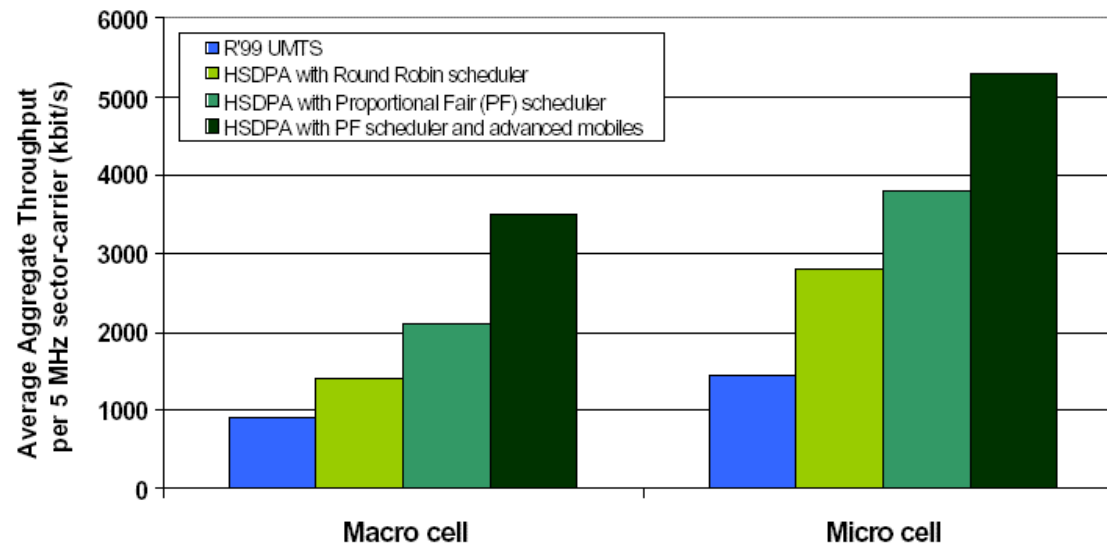
□ But can one install fast enough?



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
 - Will 3.5G (HSDPA / HDR) work?



Capacity Improvement of HSDPA

The Evolution of UMTS:3GPP Rel.5 and Beyond,
June 2004, 3G Americas

Network and device	Highest speed we experienced: download	Highest speed we experienced: upload	Vendor-rated average speed¹	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

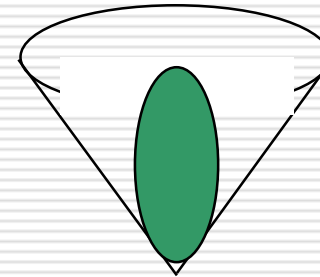
Computerworld:[http:// www.corante.com/unwired/](http://www.corante.com/unwired/)

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 quarter of this spectrum (5 MHz + 5 MHz) for data
 - shared 5 Mbps per sector in the center
 - shared 500 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



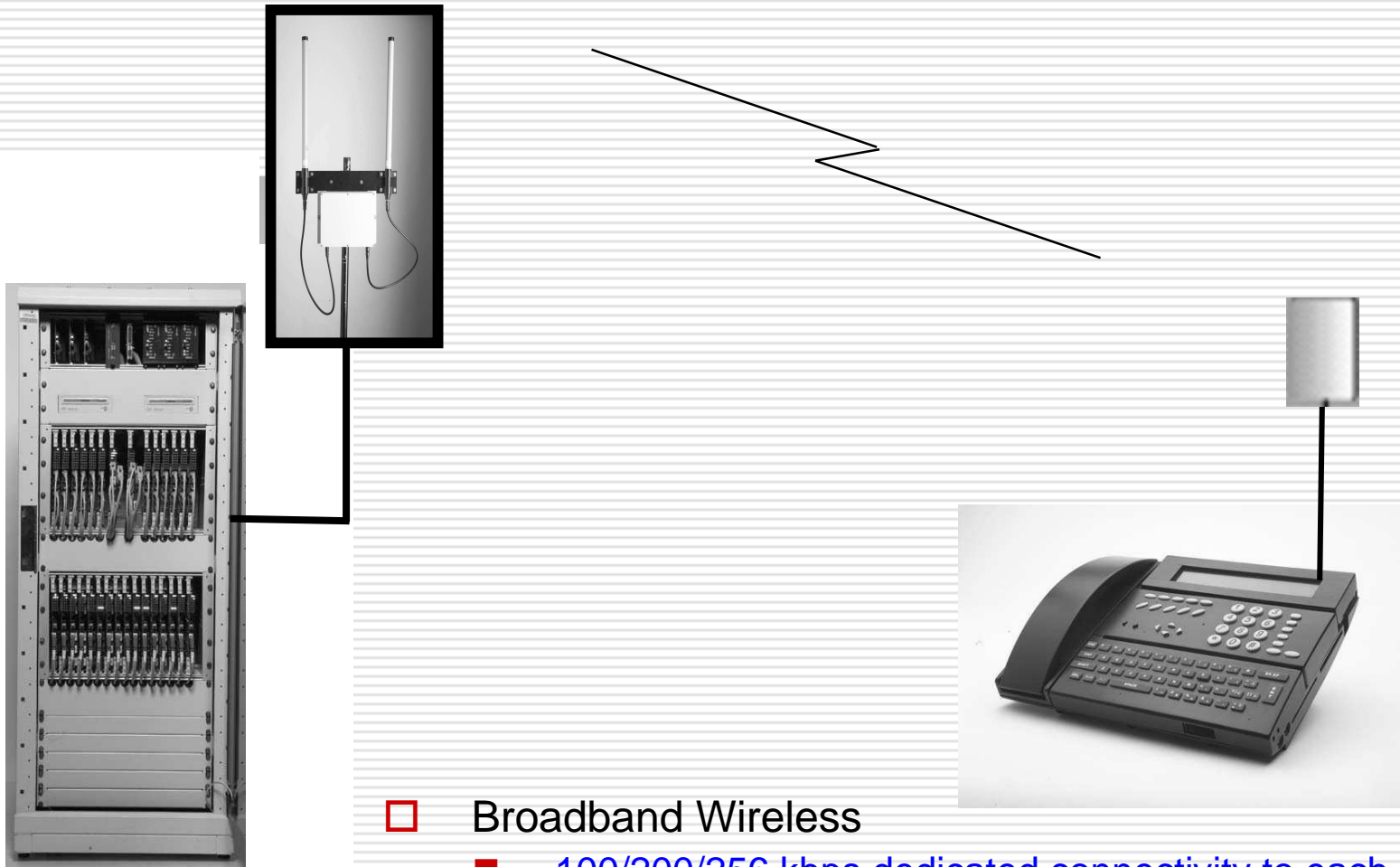
So what does one need?

- 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

Is Wi-Max / 802.16 the answer ?

- 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 reuse
 - What can adaptive antennas, DCA, beam forming, power control, adaptive coding, adaptive scheduling, frequency hopping give us?
 - And what about the **infrastructure costs**?
 - How will it work **along with 2.5G / 3G cellular**?

Introducing Broadband corDECT



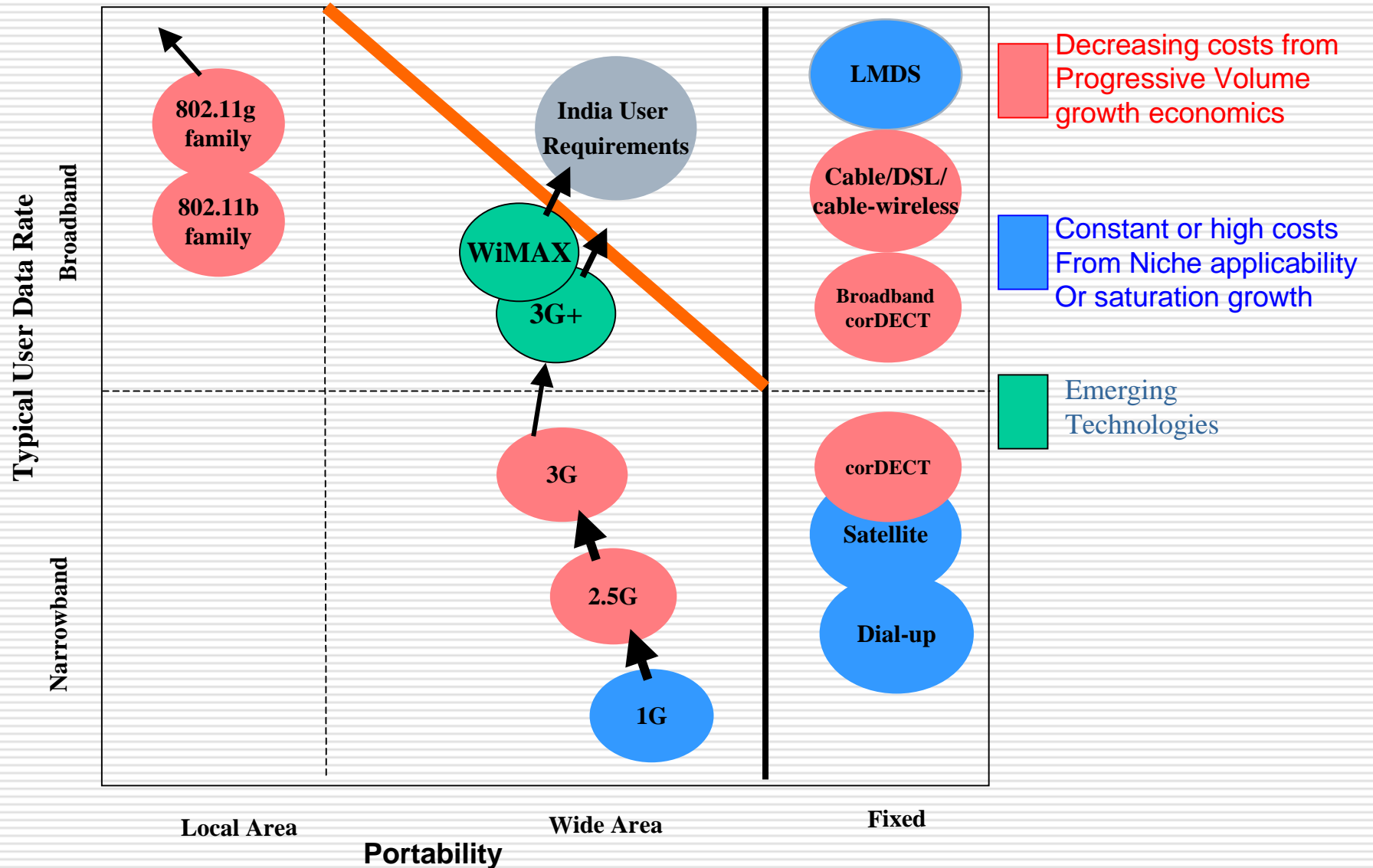
- Broadband Wireless
 - 100/200/256 kbps dedicated connectivity to each user
- WiMax: what will it give and when?

Subscriber Terminal

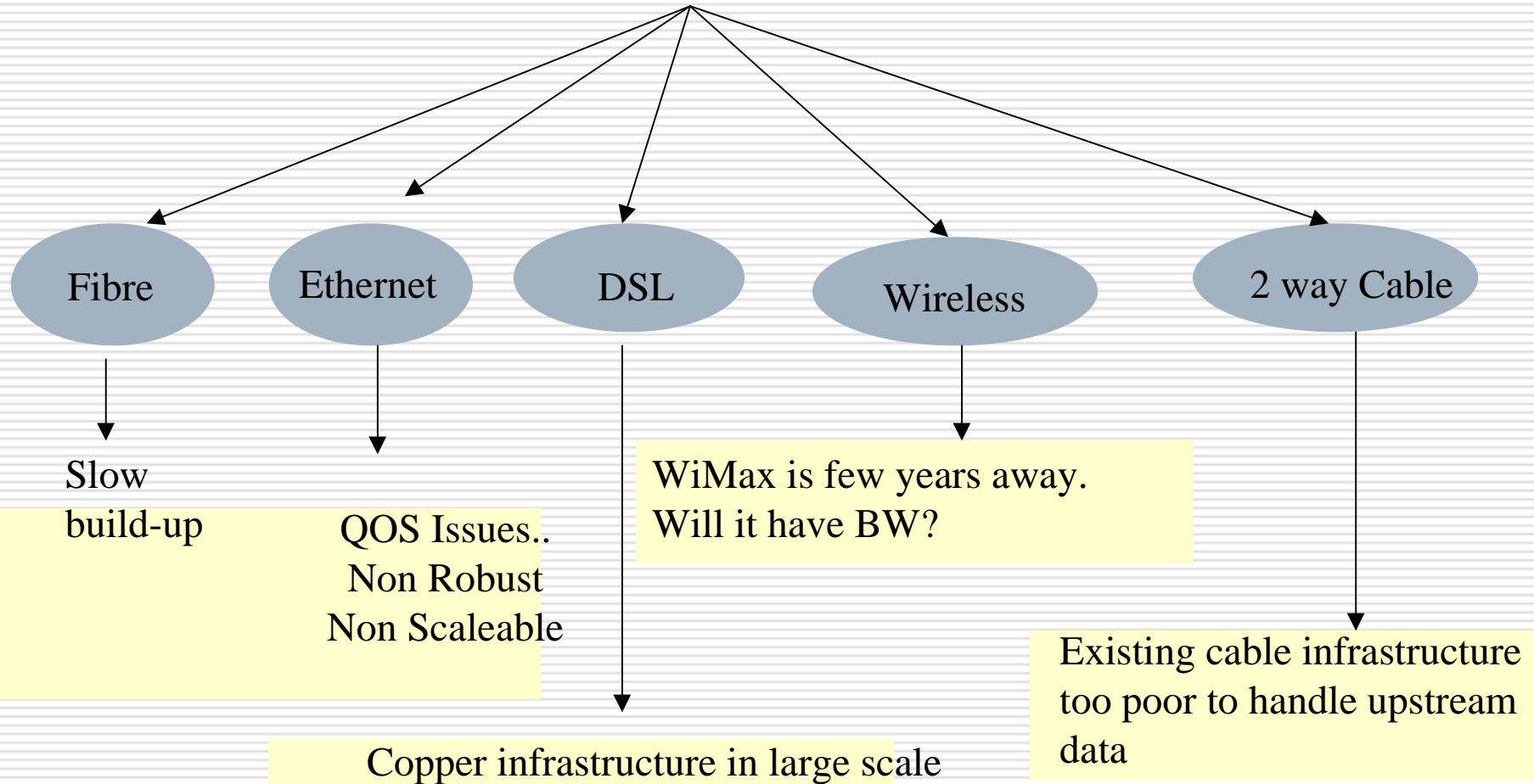
- Always ON Internet on wireless upto 256 kbps
 - On Ethernet
- modem, G3 Fax
- Full feature “phone” with in-built phone book, CLI, call charge meter, SMS, Chat, E-mail
 - In-built advanced diagnostics
 - Full feature keyboard
 - 40 character, 4 line display
 - Hands-free operation
 - Local language user interface option in future



Comparison of Alternatives



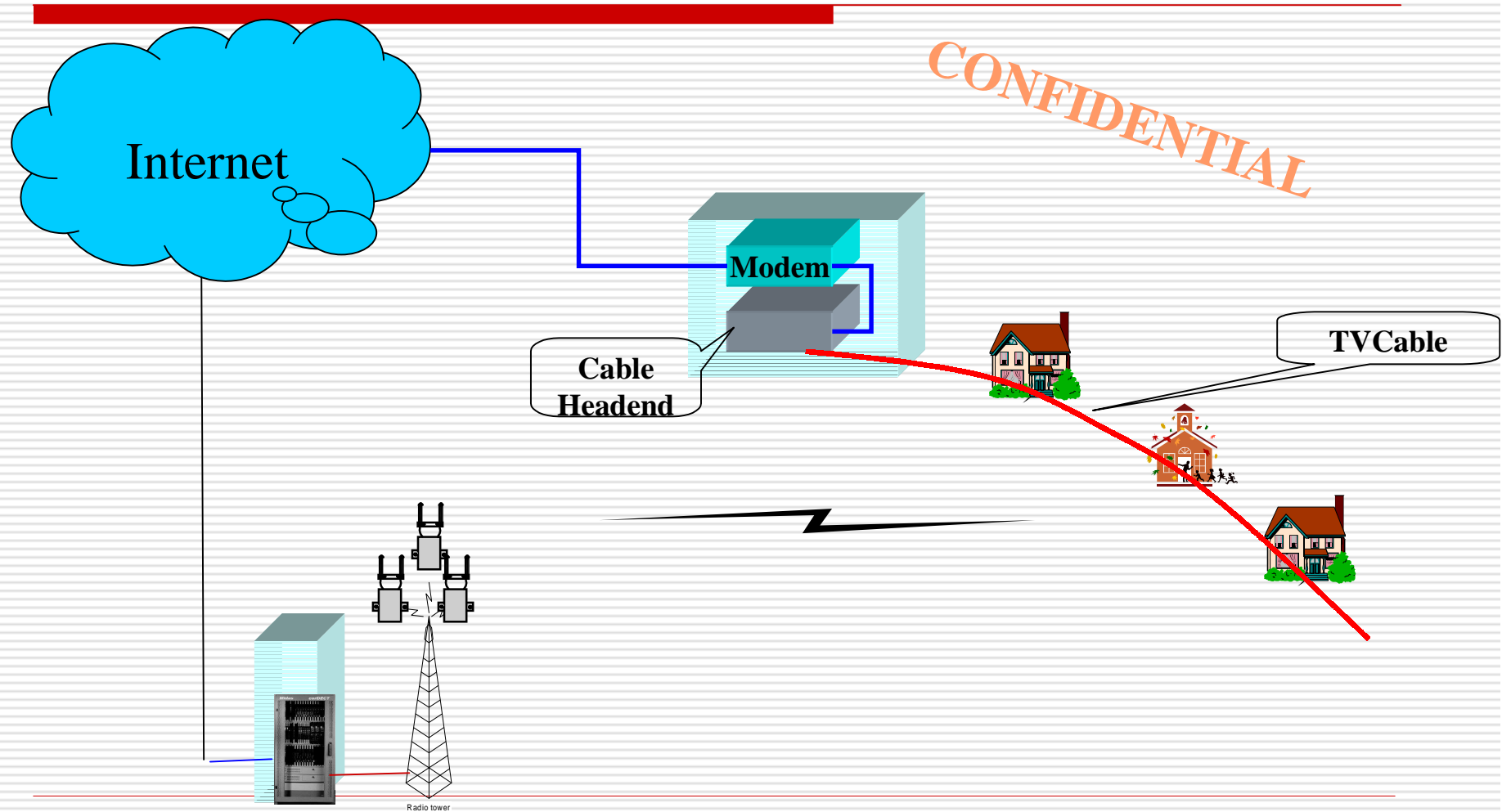
Broadband Access Solutions



Non- incumbents require Disruptive Access Technologies

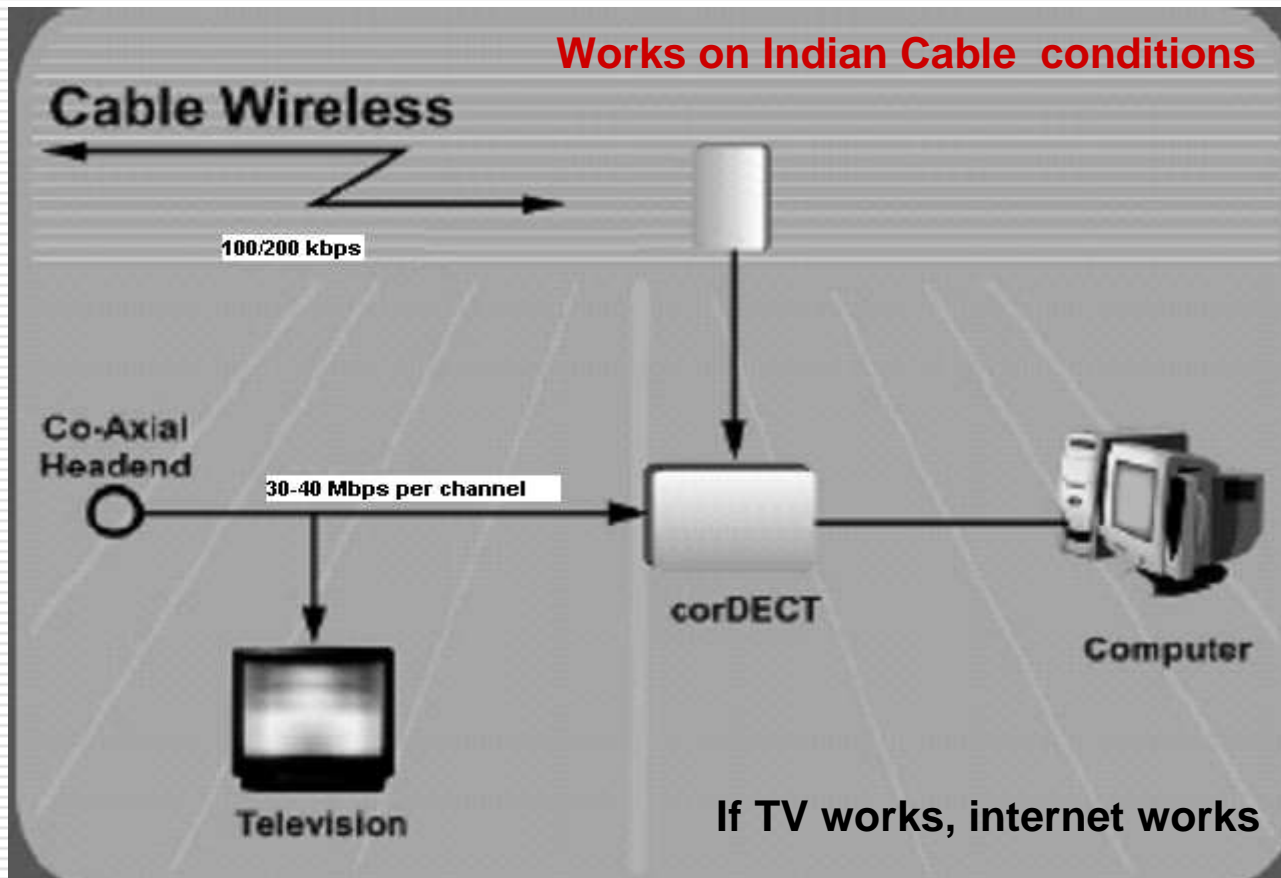
Cable Wireless :

Down Stream on Cable Upstream on Wireless



Cable Wireless

Downstream on Cable, Upstream on Wireless



An Innovative solution for broadband

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: thin client as Access Device

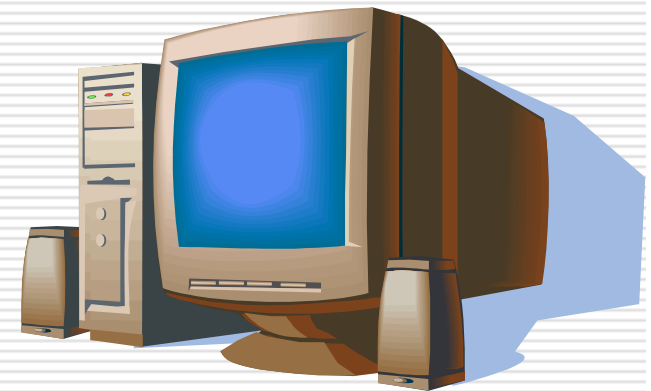
- Thin Access Device
 - Connected to a Server on Broadband
 - Multi-media thin client functions just like a PC
 - All storage at Servers
 - No virus, no back-up required
 - Target price: Rs 4000 plus monitor

- For homes and for Mid-size companies



Introducing: 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



Video Server

- 50 simultaneous video streams (MPEG4) at 1 Mbps
 - Using a low cost server priced Rs 125 K

- 400 simultaneous video streams with fully redundancy
 - Servers priced around Rs 500K

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 for 2Mbps Broadband connection
 - Cable wireless is a **new disruptive technology solution for our needs**
 - Terminals widely affordable in India
 - **Novatium Solution needs to be watched**