Fibre Optic Networks

Global design concepts to promote efficient delivery of eGov services

FIBRE OPTIC ACCESS NETWORKS

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Technological Development and the Need for Speed

Executive Master in e-Governance (e-Gov) 2007/08 Module 1, Lausanne, 7.11.2007
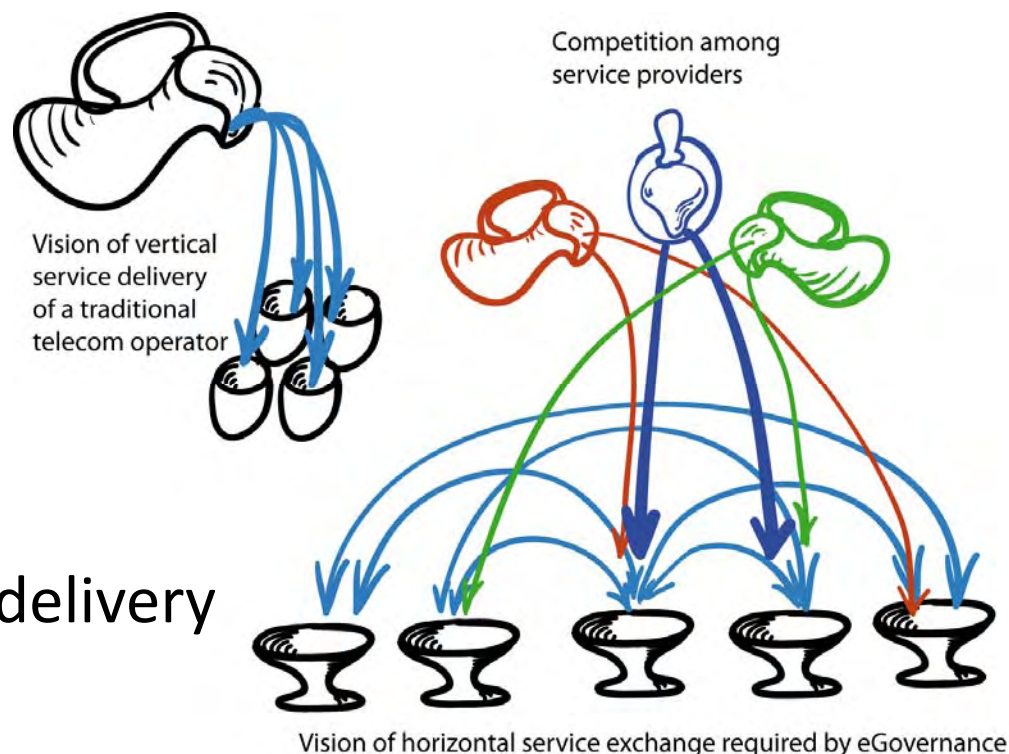
Agenda for the next hour

- Broad understanding of
  - Relations between Fibre Optic Networks and eGov
  - Access networks are more than telecom networks
    - Accessing, delivering or exchanging services
    - Fixed and mobile network telecom infrastructures
    - Topologies for fixed networks
    - Differentiation of the bandwidth needs
  - Financing the deployment of optical networks
  - Tracks for solving common problems with innovative solutions
    - Contributing to solve the Digital Divide
    - Providing citizens access to eGov services
    - Preserving the investments made

Access Networks - Background

Background

- Networks are mainly built and maintained by commercial telecom operators
  - To provide *vertical* 'Triple Play' services
  - Concentrate of profitable service markets
  - Arbitrate fixed vs. mobile deployment
  - Get financed
- Strong existing business background
  - Topology based on existing networks
    - More than 100 years old technology
    - Barriers raised to protect market

eGov and Fibre Optic Networks

- Business models independent of eGov needs
- Commercial Services do not match eGovernance needs
  - Govt provided services
  - Public information services
  - Not for profit services (NGOs or associations)
  - State cannot really govern the behaviour of telecom operators
    - regulate universal service
    - regulate competition among providers

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Services Access Networks

- Do not forget that networks are only provided/ used to allow access to services
  - Usage, delivery, exchange
  - Client & server locations
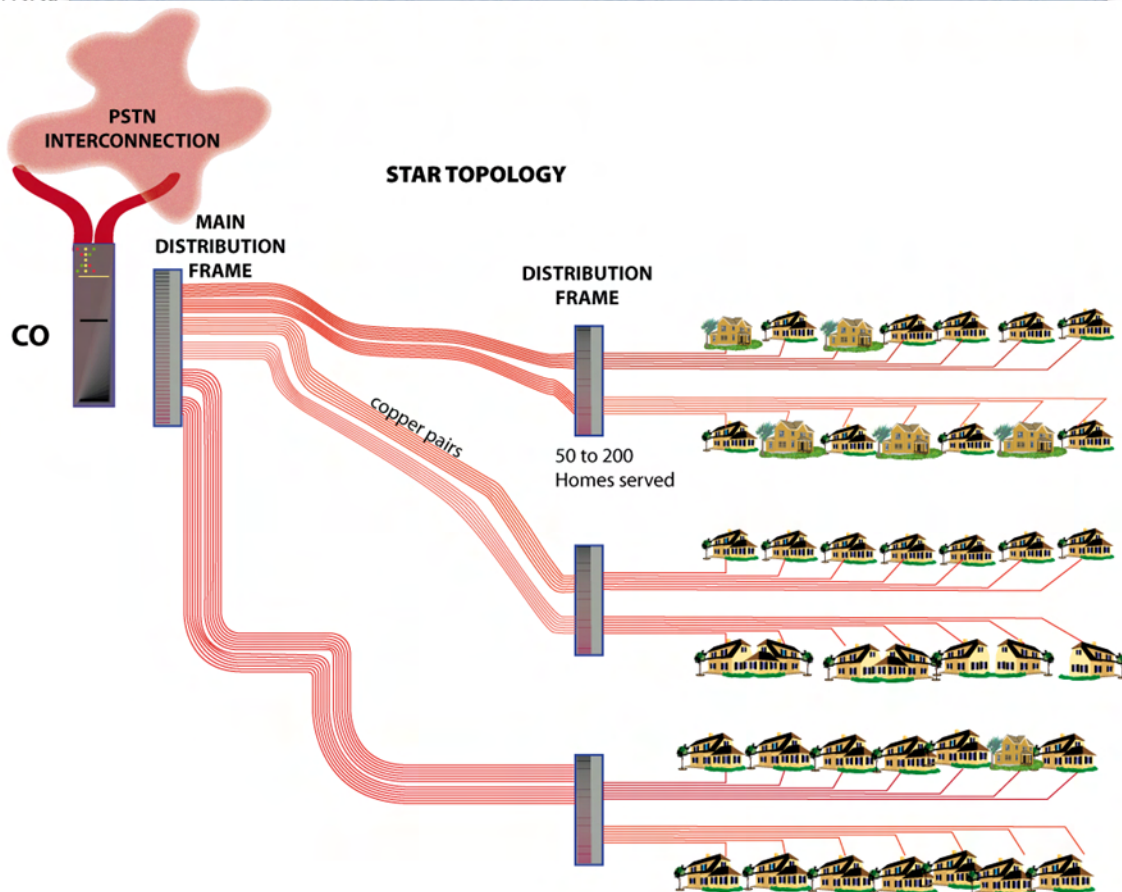 - Throughput needed to ensure sufficient quality of service delivery

Competition among service providers

Vision of vertical service delivery of a traditional telecom operator

Vision of horizontal service exchange required by eGovernance

Services Access Networks

– Manage service delivery using network tools

– Determine the location of service usage

- Best served through mobile or fixed access ?

- Public (open) or private access ?

Access Networks

- Mobile also rely on fixed base networks
- Constituents
  - Terrestrial infrastructures
  - Fibre optic characteristics
    - 'speed'
    - 'effective range'
    - trunk – capillarity
    - Wavelengths
      - Single usage
      - Multiplex
  - Termination
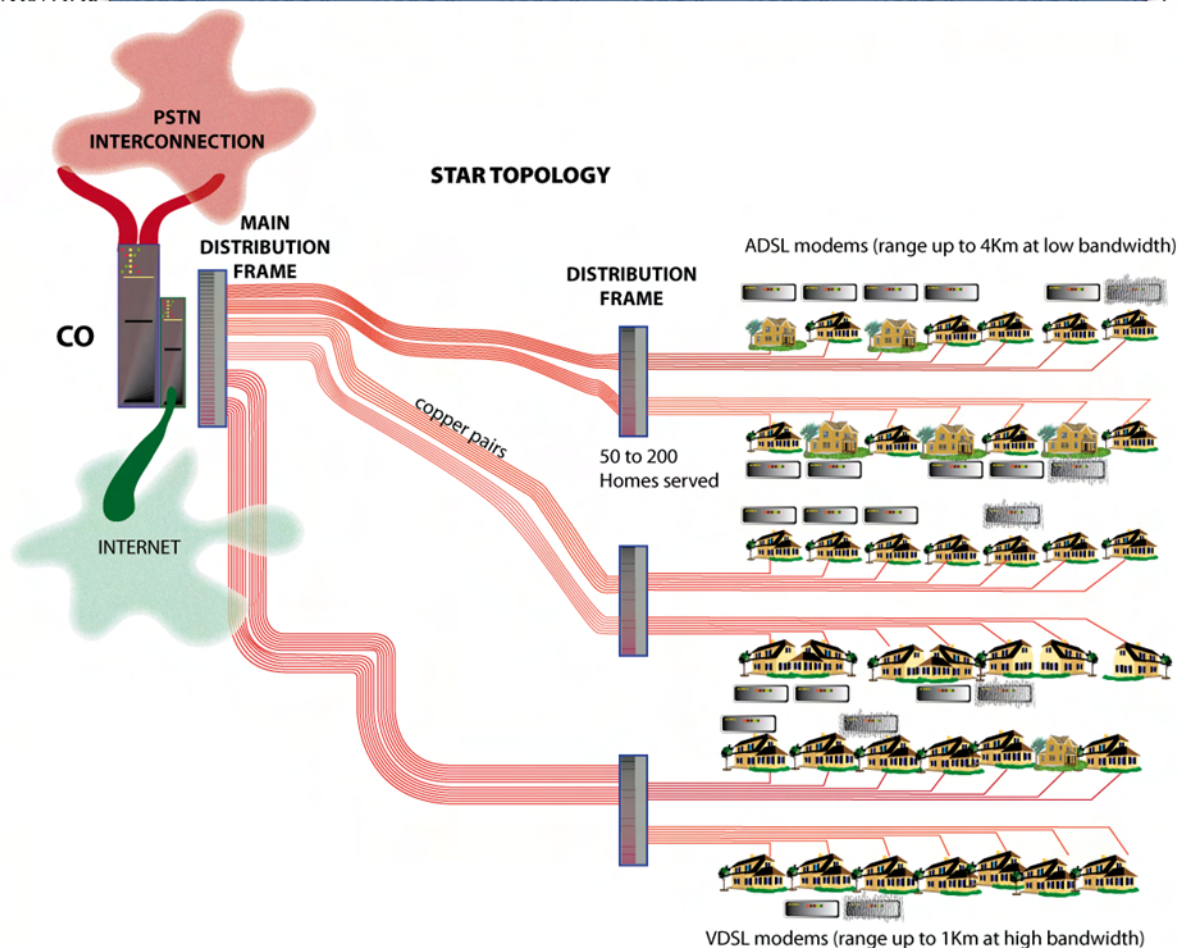 - Duration

Access Networks Topology
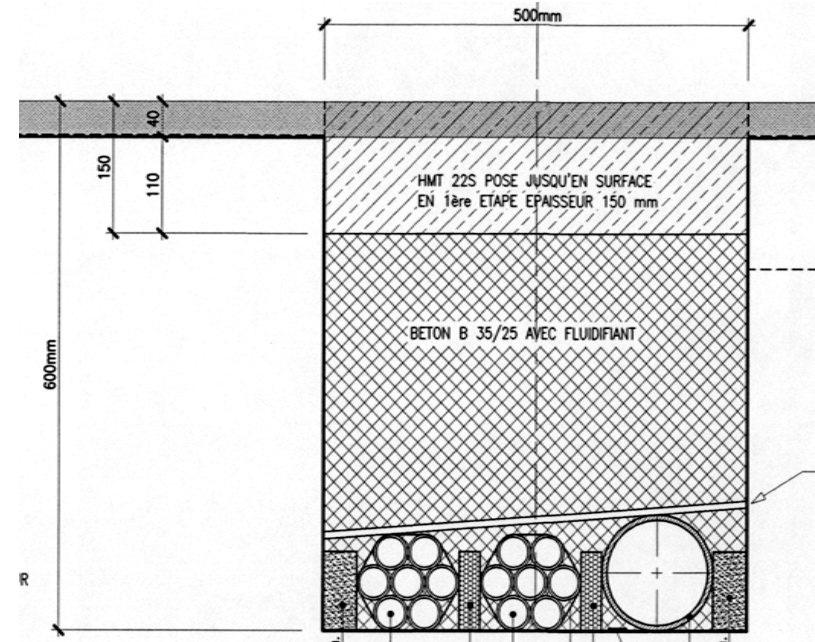
- Usually and historically dependant of
  - legacy networks
  - convergence of supporting technologies
    - examples follow
  - choice between passive and active networks
    - essentially CATV
  - vertical vs. horizontal networks
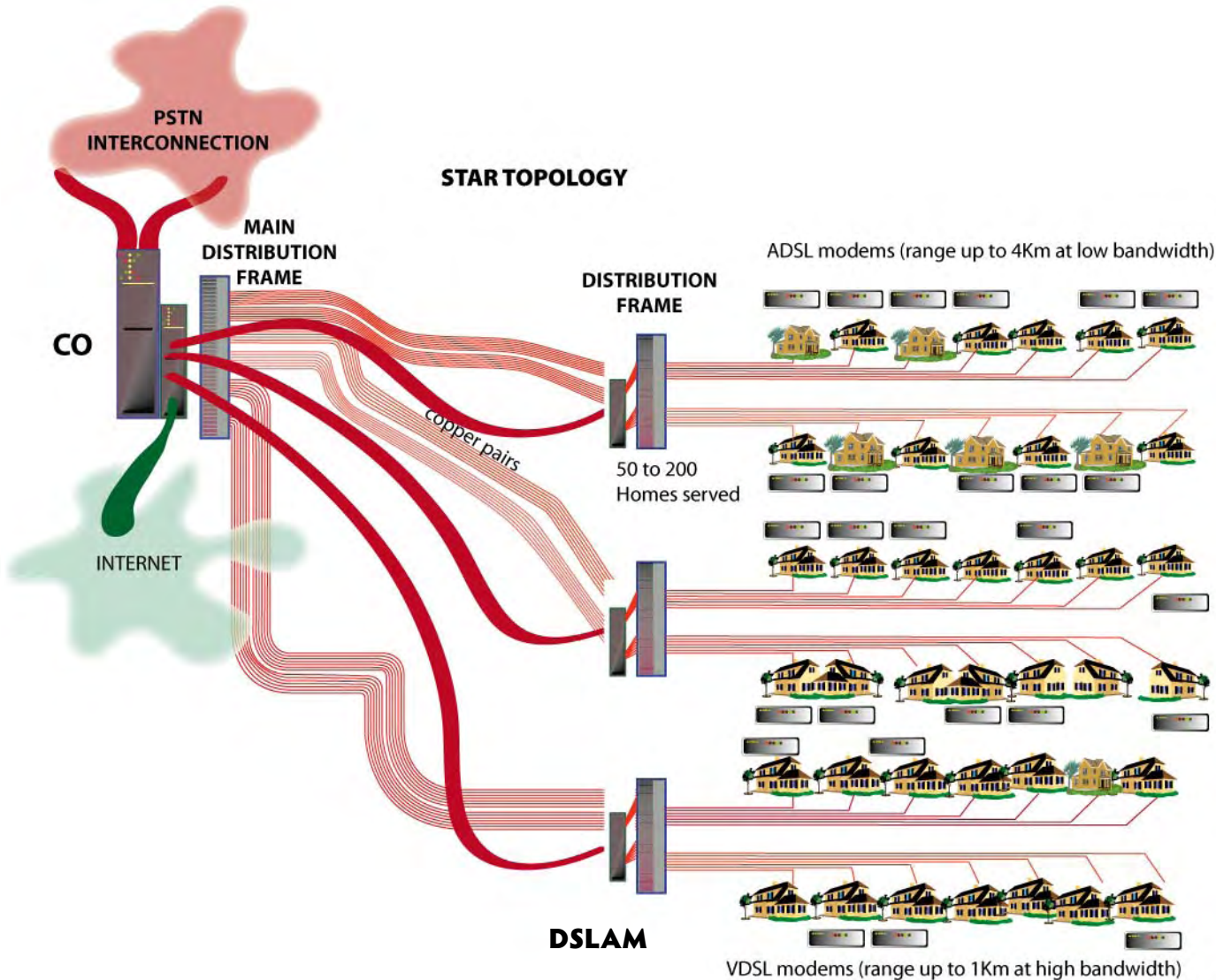   - centred on services, not customers

STAR TOPOLOGY

PSTN INTERCONNECTION

CO

MAIN DISTRIBUTION FRAME

DISTRIBUTION FRAME

copper pairs

50 to 200 Homes served

Example: Local loop (telephony) topology

Example: Local loop (telephony) topology

PSTN INTERCONNECTION

STAR TOPOLOGY

MAIN DISTRIBUTION FRAME

CO

INTERNET

DISTRIBUTION FRAME

ADSL modems (range up to 4Km at low bandwidth)

copper pairs

50 to 200 Homes served

VDSL modems (range up to 1Km at high bandwidth)

Example: Local loop (*telephony*) topology

PSTN INTERCONNECTION

STAR TOPOLOGY

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INTERNET

DSLAM

VDSL modems (range up to 1Km at high bandwidth)

Evolution of legacy networks

Tree topology from HE

Hybrid fibre/coax (HFC) CATV technology

HEADEND

TRUNK RF AMPLIFIER

TRUNK RF AMPLIFIER

500 Homes served

LINE RF AMPLIFIERS

500 Homes served

Evolution of legacy networks

Hybrid fibre/coax (HFC) CATV technology

Tree topology from HE

Capacity Enhancement with HFC

HEADEND

DISTRIBUTION HUB

DISTRIBUTION HUB

Transport Ring

DISTRIBUTION HUB

OPTICAL NODE

OPTICAL NODE

OPTICAL NODE

OPTICAL NODE

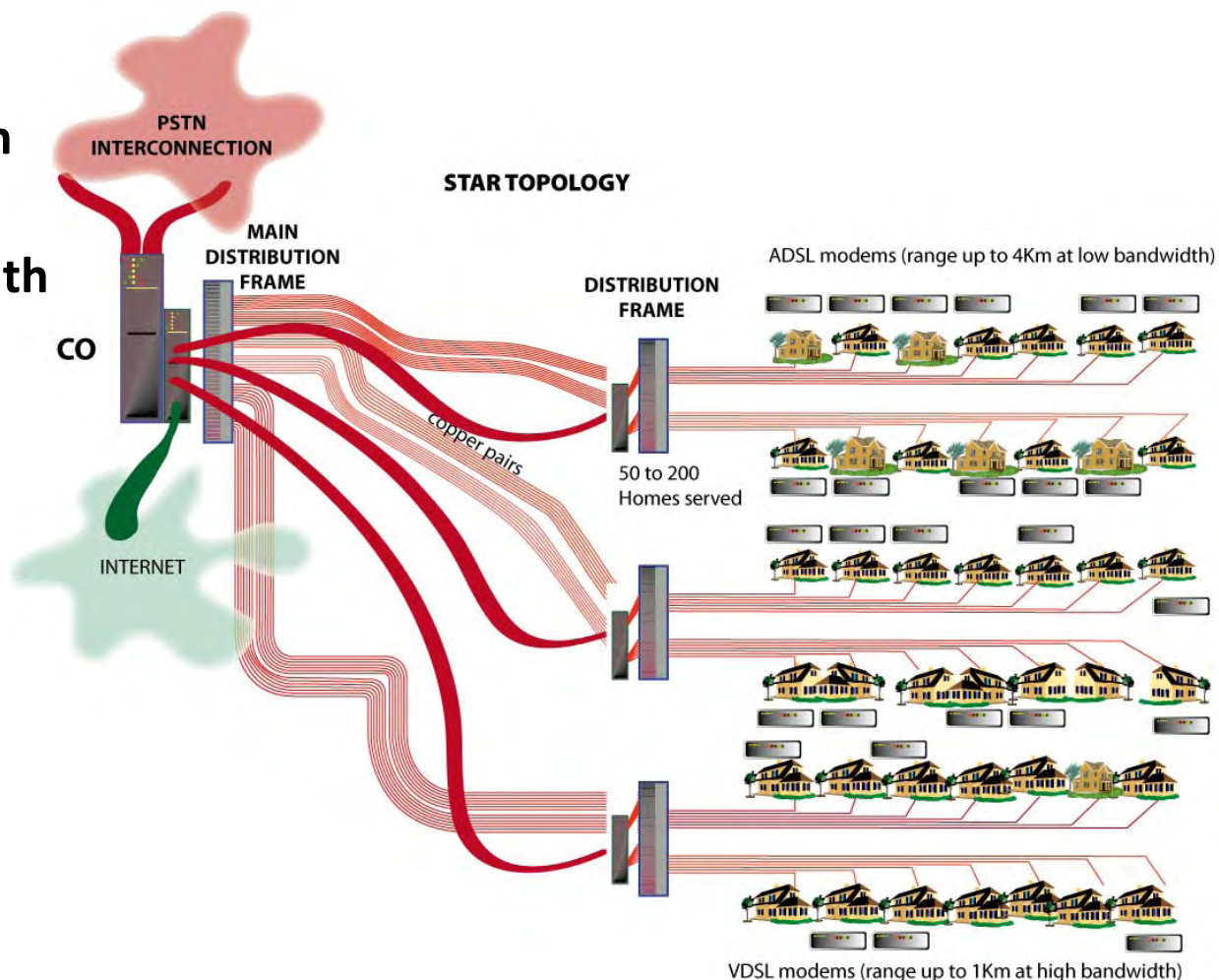500 to 2000 Homes served

LINE RF AMPLIFIERS

500 to 2000 Homes served

Classical evolution from xDSL to FTTH

Access Networks Topology

Gradually replace

- **copper pairs with fibre**
- **xDSL modems with O/E converters**
- **Keep sub-star topology**

PSTN INTERCONNECTION

CO

INTERNET

MAIN DISTRIBUTION FRAME

STAR TOPOLOGY

DISTRIBUTION FRAME

copper pairs

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ADSL modems (range up to 4Km at low bandwidth)

VDSL modems (range up to 1Km at high bandwidth)

Classical evolution from CATV to FTTH

Access Networks Topology

Gradually replace

- **Coax lines with fibre**

- **RF amplifiers with O/E converters**

- **Keep bus topology (PON - Passive Optical Networks)**

OPTICAL NODE

500 to 2000 Homes served

LINE RF AMPLIFIERS

OPTICAL NODE

OPTICAL NODE

500 to 2000 Homes served

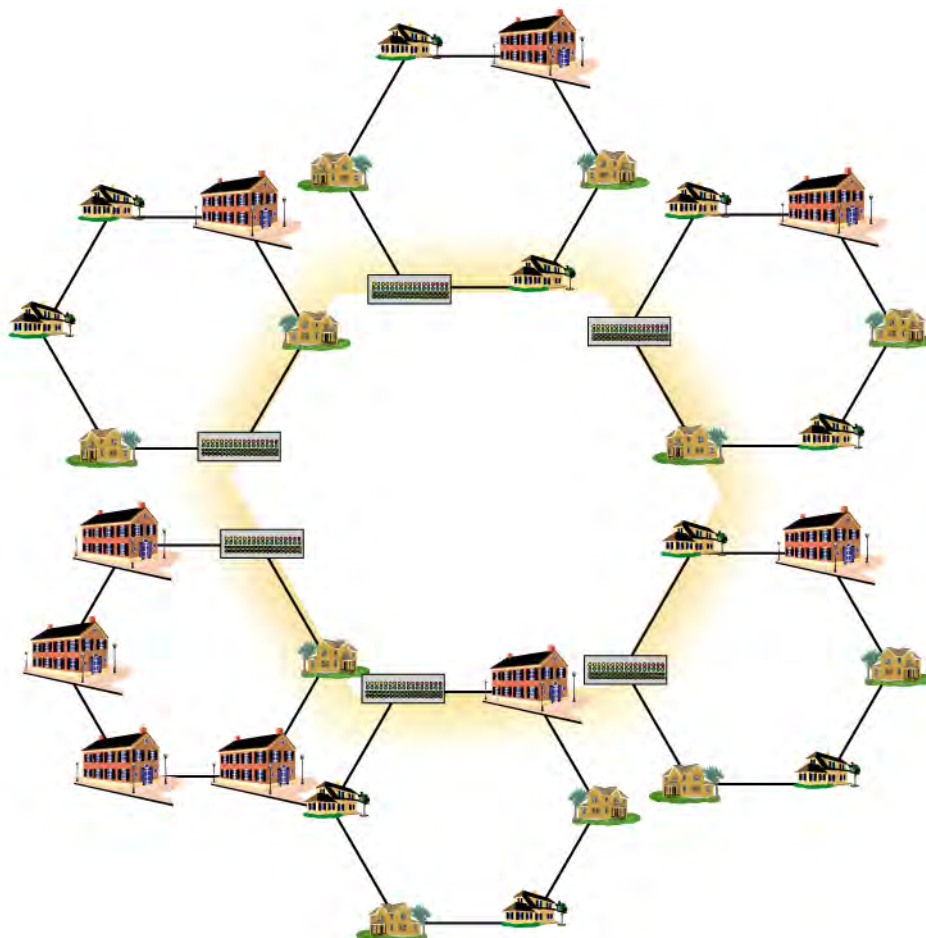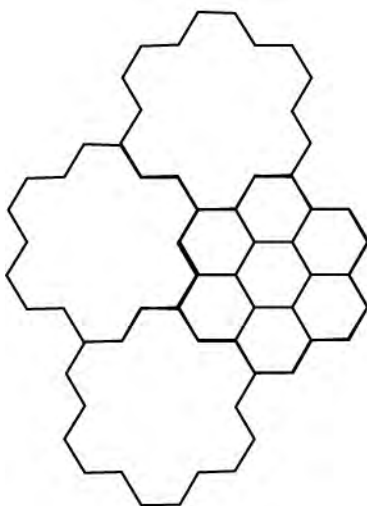**Access Networks Topology**
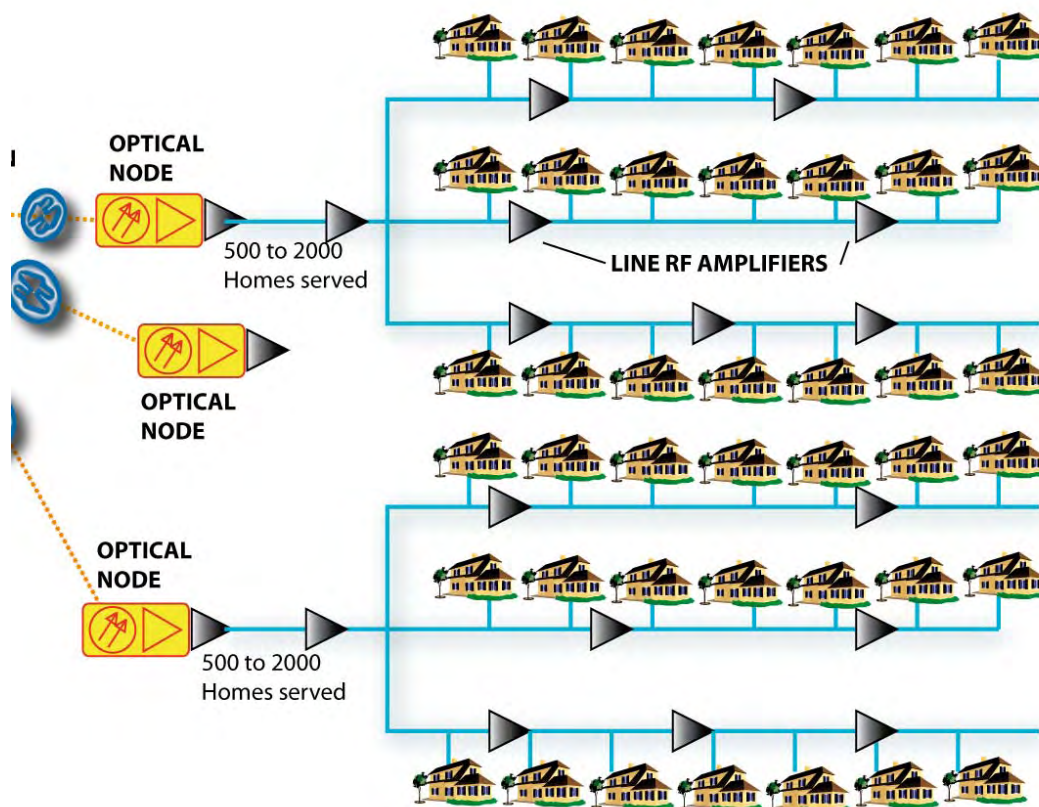
- Evolution of bandwidth need
  - Conditions
    - Broadcast- Multicast – Single Access
    - Service needs
      - text/ image/ sound/ movie
      - real time/ asynchronous access
      - usage
  - Popularity
  - Offer
    - Profitability
    - Availability (Topology)

- Bandwidth evaluation
  - service used (a measure of 'power')
  - number of simultaneous concurrent users (a measure of 'energy')
  - most probable network link between client and server
 - branch/ trunk traffic (long distance, metropolitan or local)

Digital Television

Transmission in mpeg2 at 2~3 Mbps

Transmission in mpeg4 at 19-25 Mbits/s

per receiver !

TVSD

TVHD

TV2K

MOVIE 2K

35mm

MOVIE 4K

70mm

Resolve the Digital Divide

- Two huge problems
  - The transformation of legacy networks cannot answer the challenges of the near future
  - Its cost is prohibitive

- Possible solution:
  - Separate network and services
  - Build fibre optic local area universal access networks
  - Open them to competing service providers

Flexible topology

Finance and develop fibre networks

- Local access to hubs

- Distant access to services

- Managing access networks

- PPP

Technological revolutions
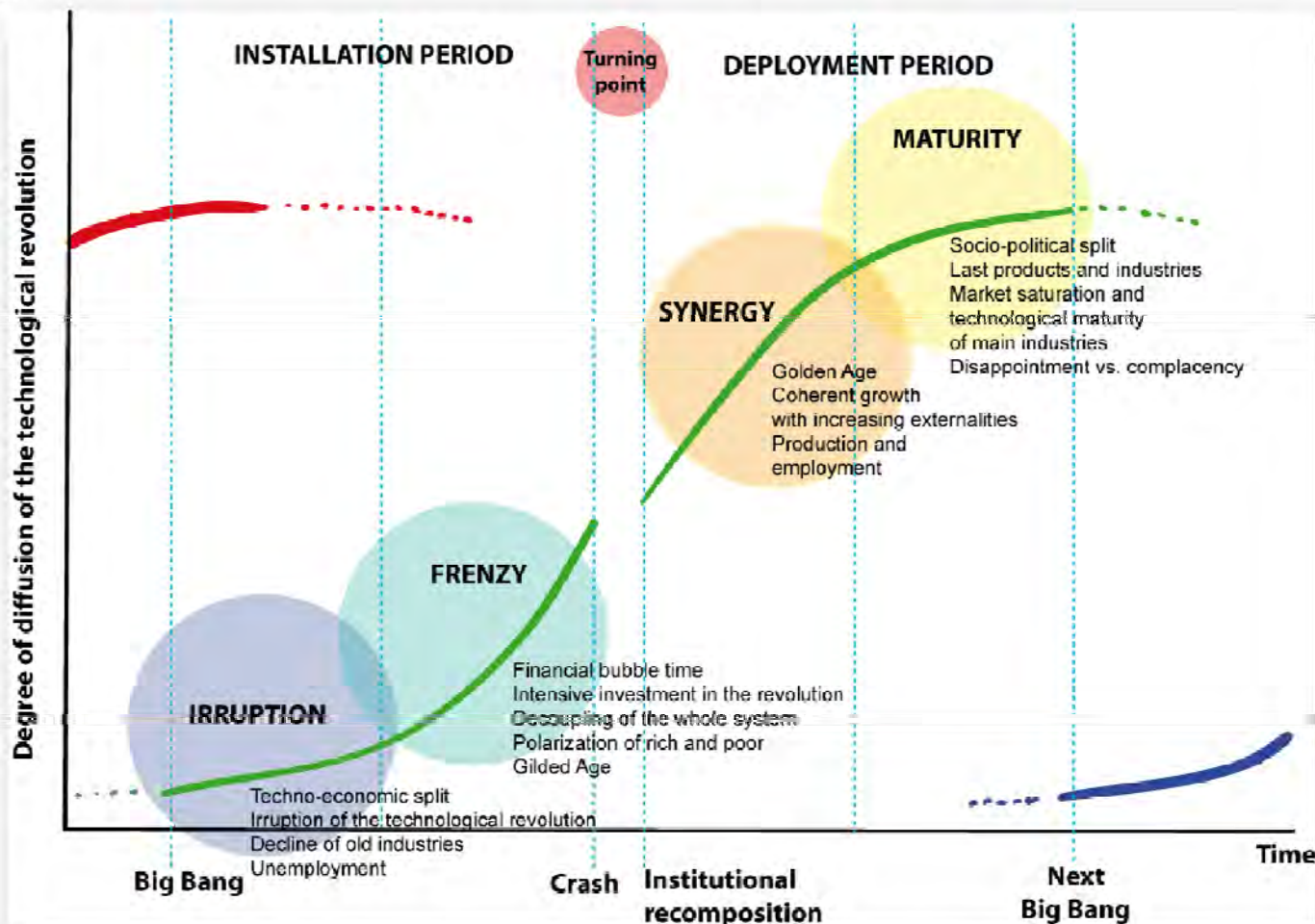
Carlota Perez; '*TECHNOLOGICAL REVOLUTIONS AND FINANCIAL CAPITAL: The Dynamics of Bubbles and Golden Ages';* Edward Elgar, Cheltenham, UK, 2002

Discussion for a conclusion

- Understanding the concept of 'universal' access networks

- Understanding the bandwidth needs

- Choosing the right network
  - fixed or mobile

- Developing financing models

- Promoting locally controlled access networks

Glossary

CATV	Community Antenna Television (or Cable TV)
DSLAM	Digital Subscriber Line Access Multiplexer
FTTH	Fibre To The Home
HFC	Hybrid Fibre Coaxial
HSD	High Speed Digital
PSTN	Public Switched telephone Network
VOD	Video on Demand
VoIP	Voice over IP
xDSL	Various transmission technology (x) Digital Subscriber Line