

Avoiding the bandwidth-price dilemma using optical networking

Dave Payne, Russell Davey

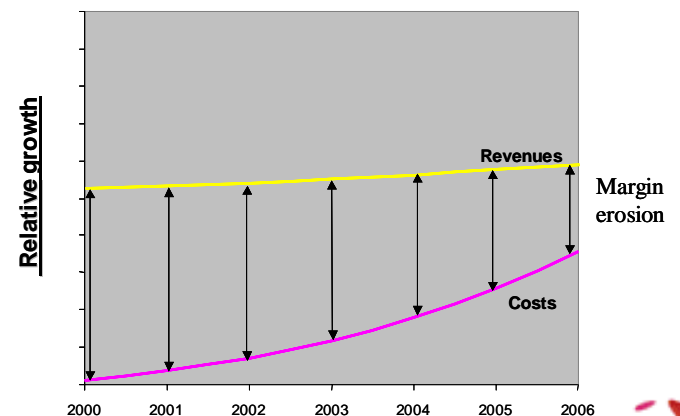
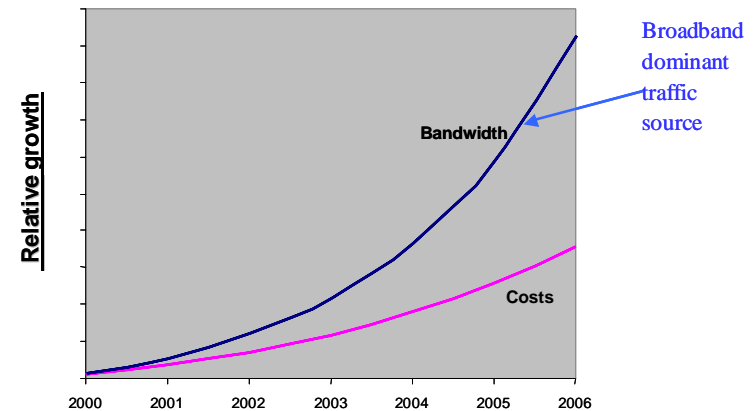


Major barrier to growth

Cost of bandwidth provision exceeds growth in revenues!

Challenges for Network Operators

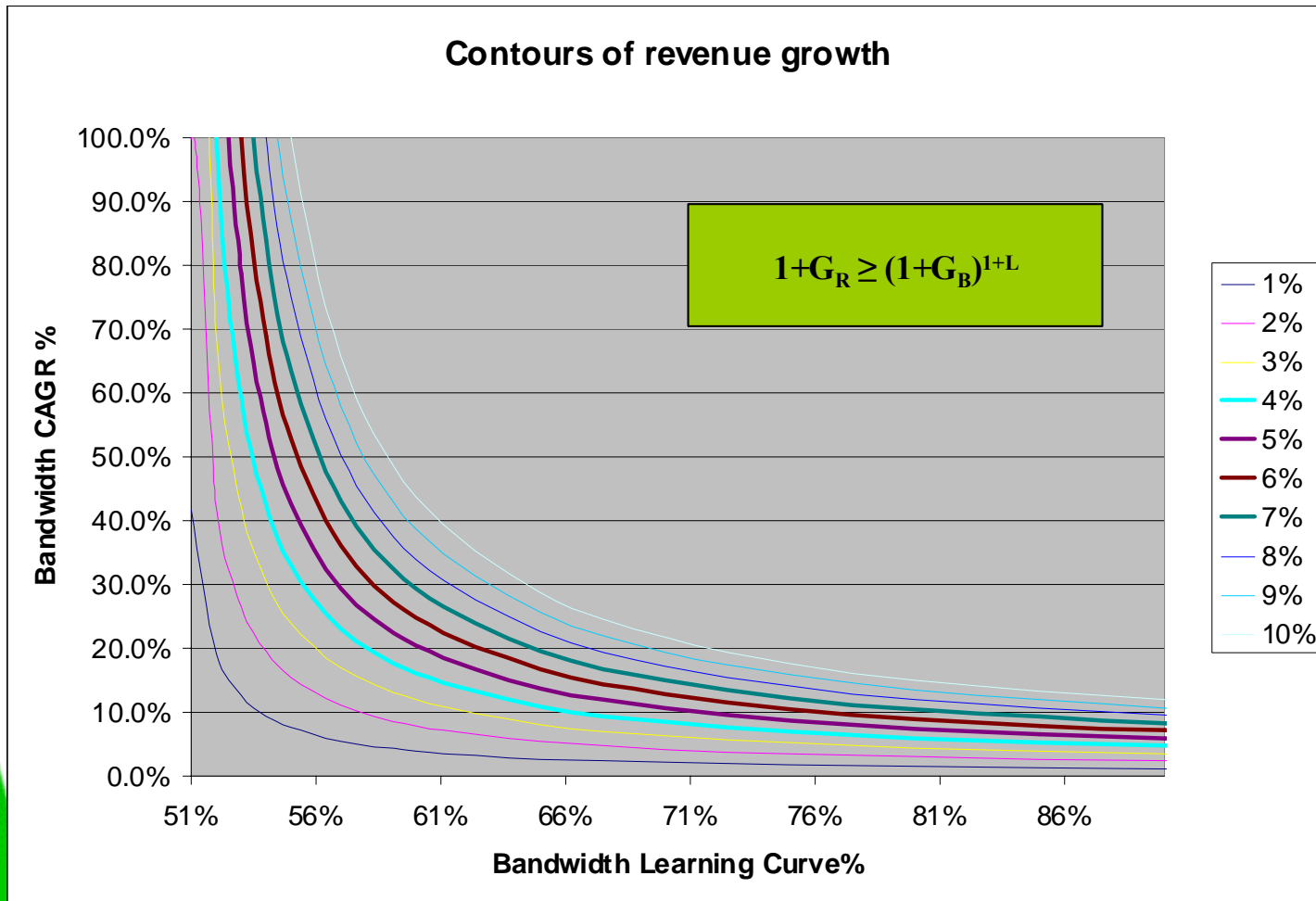
- Increasing demand for higher bandwidth services
 - eg. high speed internet, video, home working
- Revenue growth much slower than bandwidth growth
 - shrinking margins!
- Historical price decline of electronic systems, not fast enough!



What level of bandwidth growth is sustainable?

- **Depends on:**
 - **Bandwidth growth rate**
 - **Driven By**
 - **Future services**
 - **Customer take up of services**
 - **Customer usage behaviour**
 - **Rate of bandwidth price decline**
 - **Revenue growth rate**

The relationship between revenue growth, bandwidth growth and price decline of bandwidth

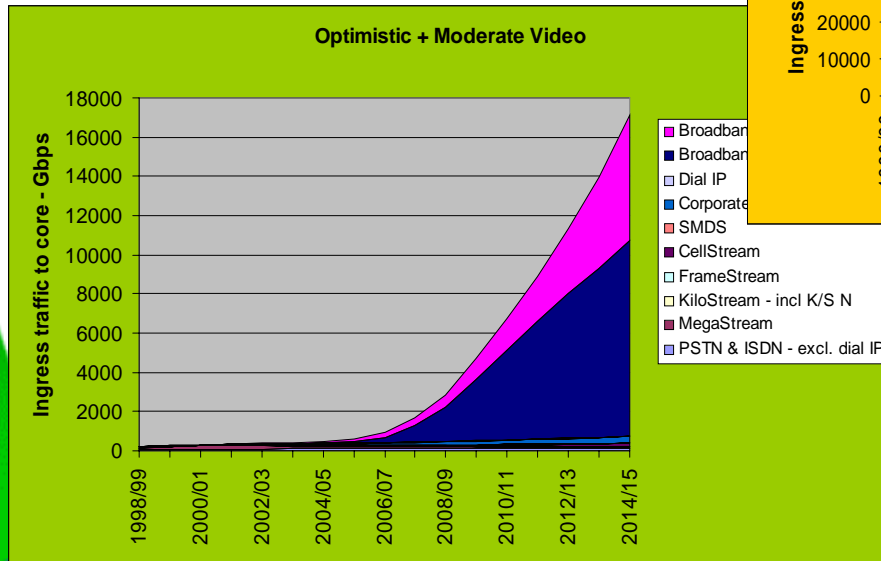
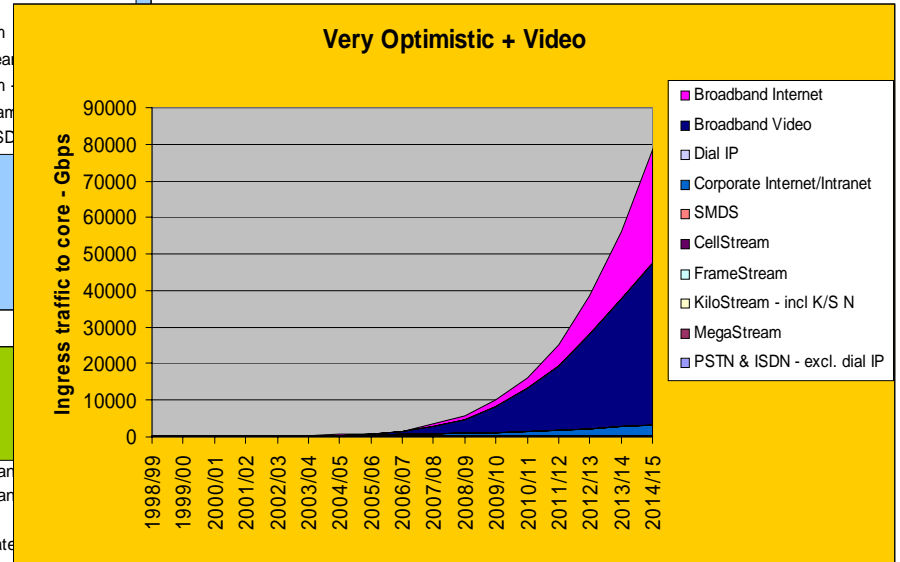
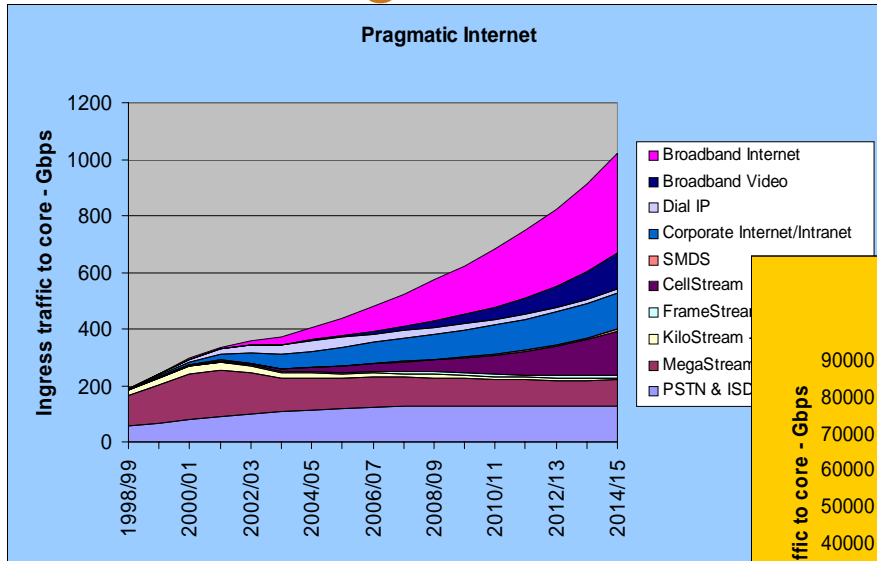


What does this mean for traffic growth?

Assumptions for traffic scenarios.

	Pragmatic Internet		Optimistic + Moderate Video		Video Centric	
	2009/10	2014/15	2009/10	2014/15	2009/10	2014/15
Total broadband Internet customers (millions) (Includes Cable Modem)	9.4	12.3	10.7	14.8	10.9	16.2
Number of VDSL/Fibre customers (millions)	0	0	1.65	2.9	2.1	7.7
Video/VoD customers (millions)	0.14	0.54	1.5	3.5	2.0	8.7
Average Internet session time/day (mins)	75	80	96	107	101	126
Average Internet Session Bandwidth (kb/s)	77	114	320	1270	488	4780
Average Video session time/day (mins)	24	24	58	70	94	128
Average Video Session Bandwidth (kb/s)	2000	2000	7000	7500	7280	7400

Core Ingress Bandwidth for Traffic Scenarios



Fitted broadband growth curves & The corresponding required learning curves

The consequence

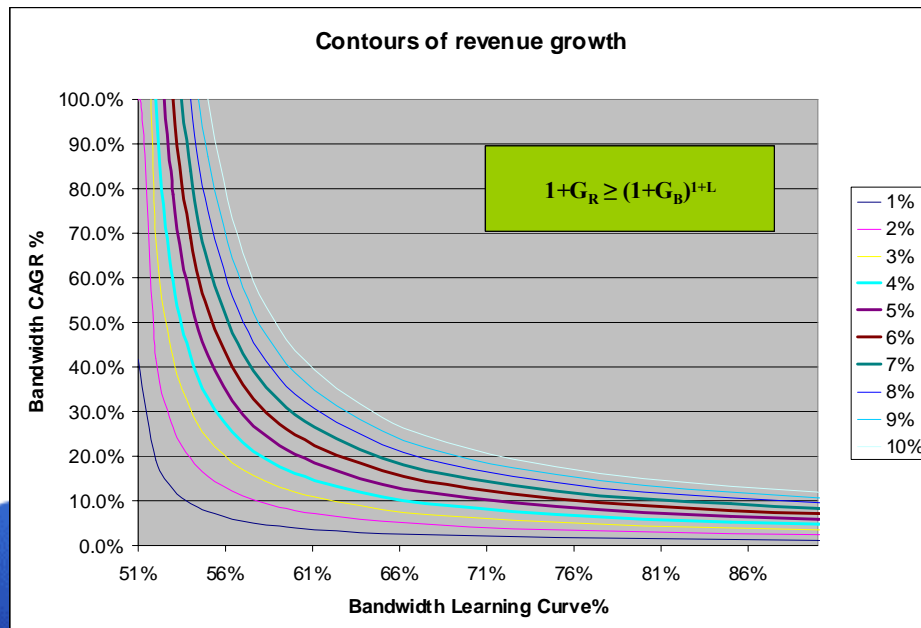
Difficult but possible

Needs new network architecture

Needs new network architecture

Scenario	Bandwidth growth CAGR fit	Bandwidth learning Curve
Pragmatic Internet	12%	~70%
Optimistic & Moderate Video	62%	~54%
Very Optimistic & Video Centric	128%	~52%

The relationship between revenue growth, bandwidth growth and price decline of bandwidth



The Problem

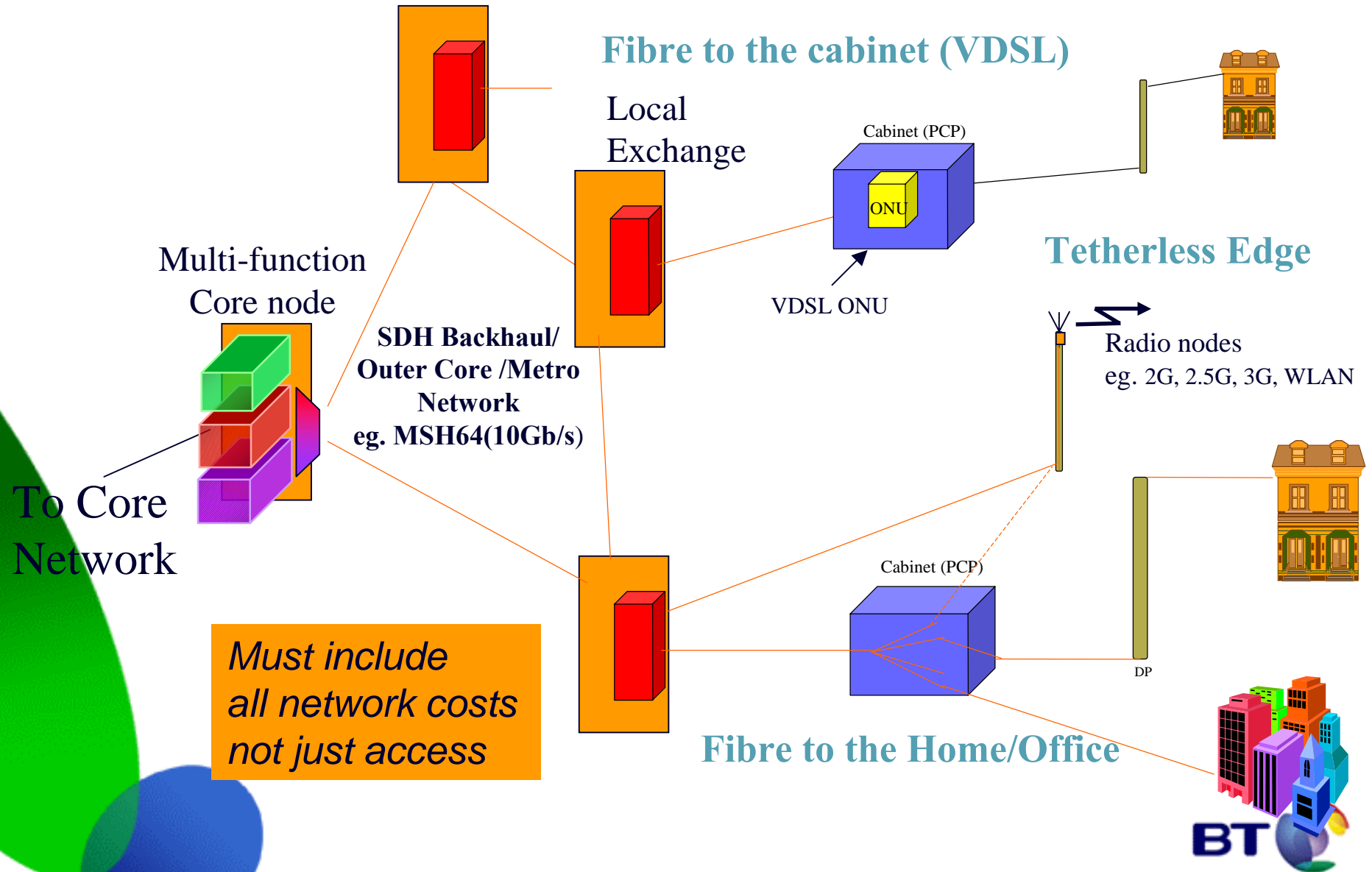
So how do we achieve required cost reduction?

- No reason to suppose optical components can sustainably beat 80% Learning curve
- Answer is to eliminate equipment, interfaces and nodes from the network

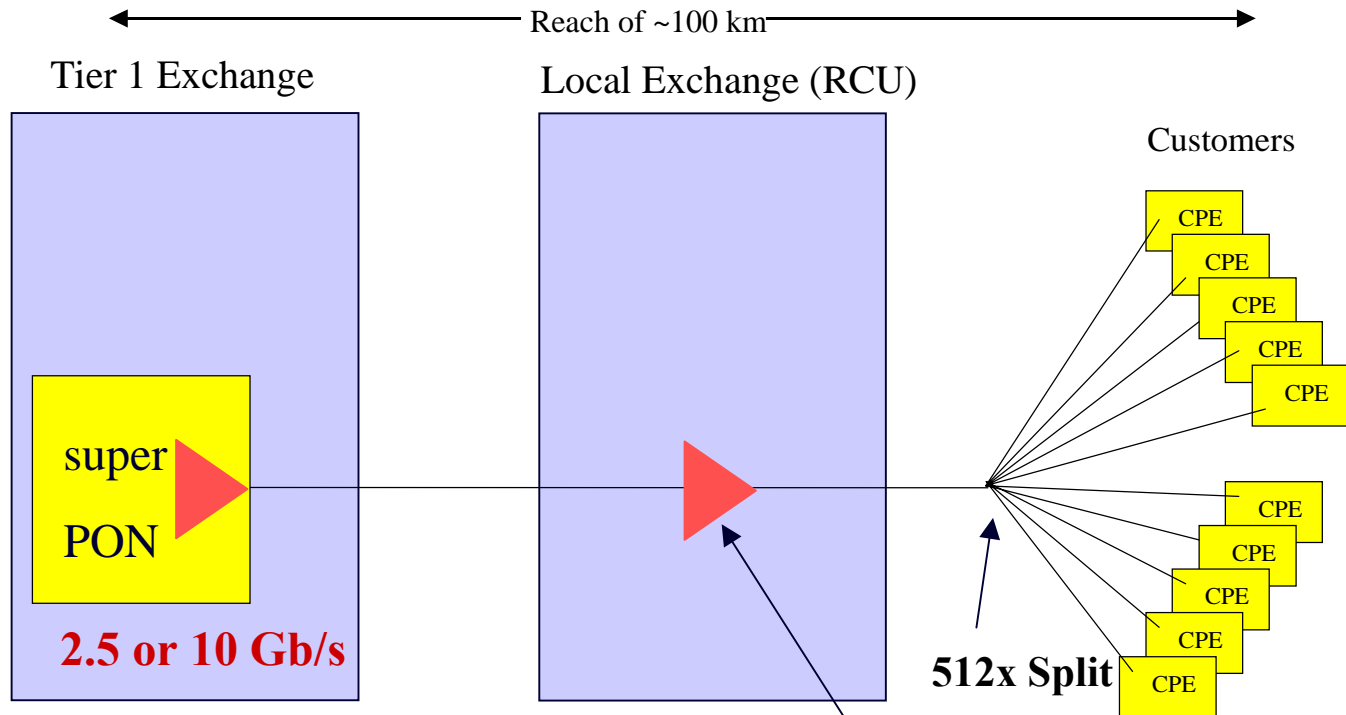
Two Components:

1. Integrate access and backhaul using long reach PON
2. Photonic intelligent inner core network

If we deployed access fibre today this is how we would probably do it



Access/backhaul integration step 1

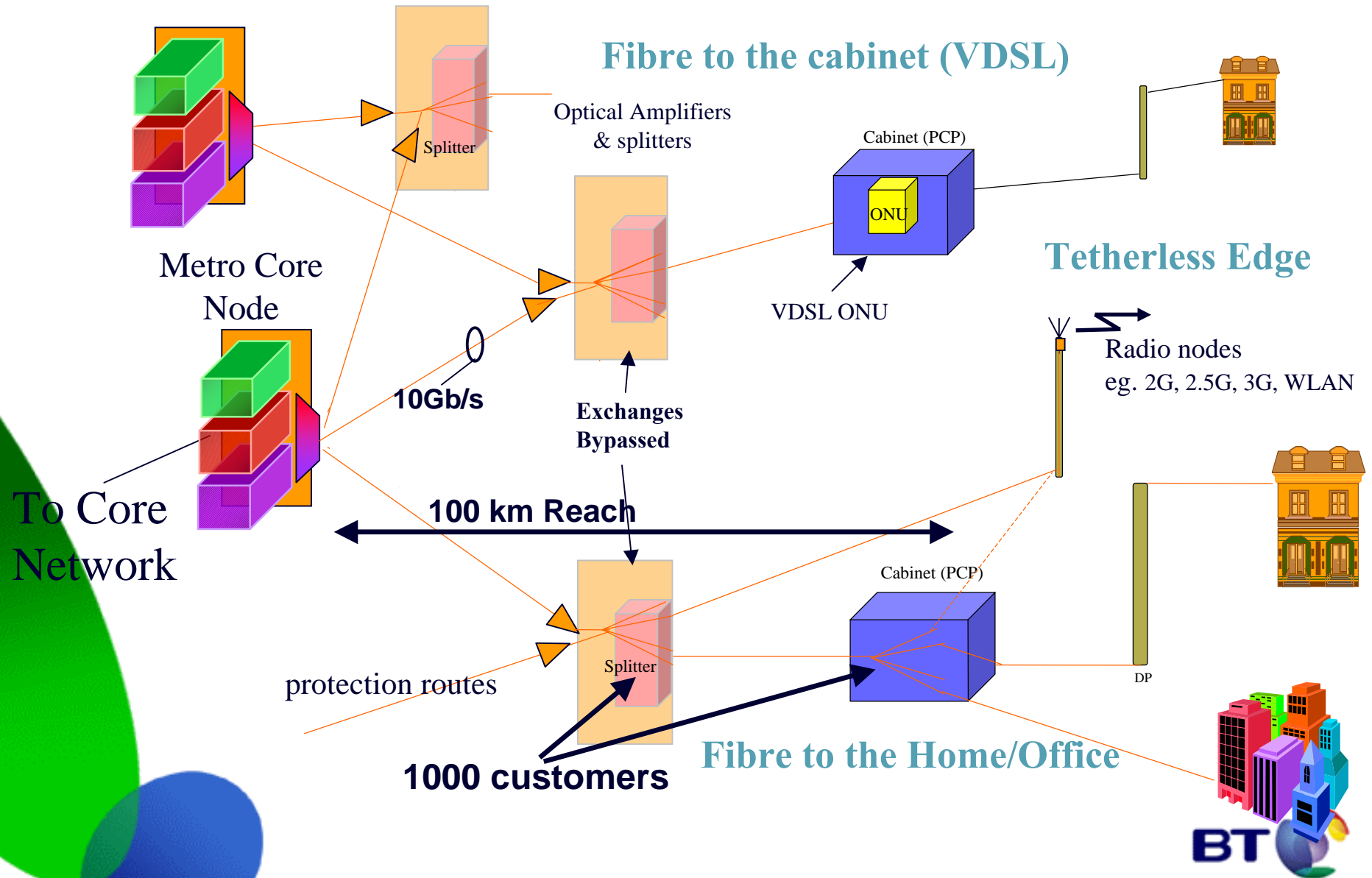


Key

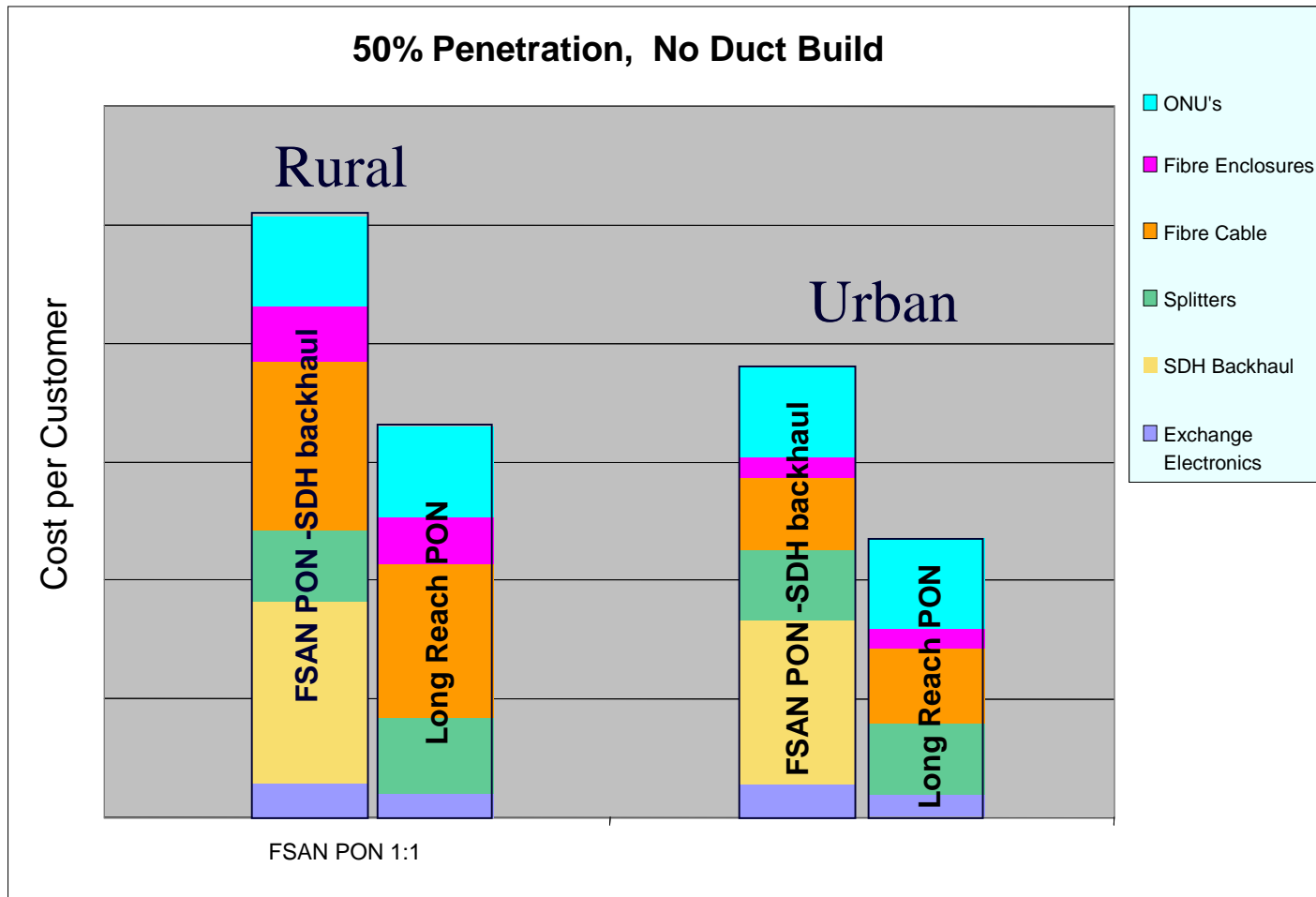
Optical amplifier

Can we make these small and low power enough to sit **outside** the exchange?

Eliminating nodes and ports and supporting all access technologies



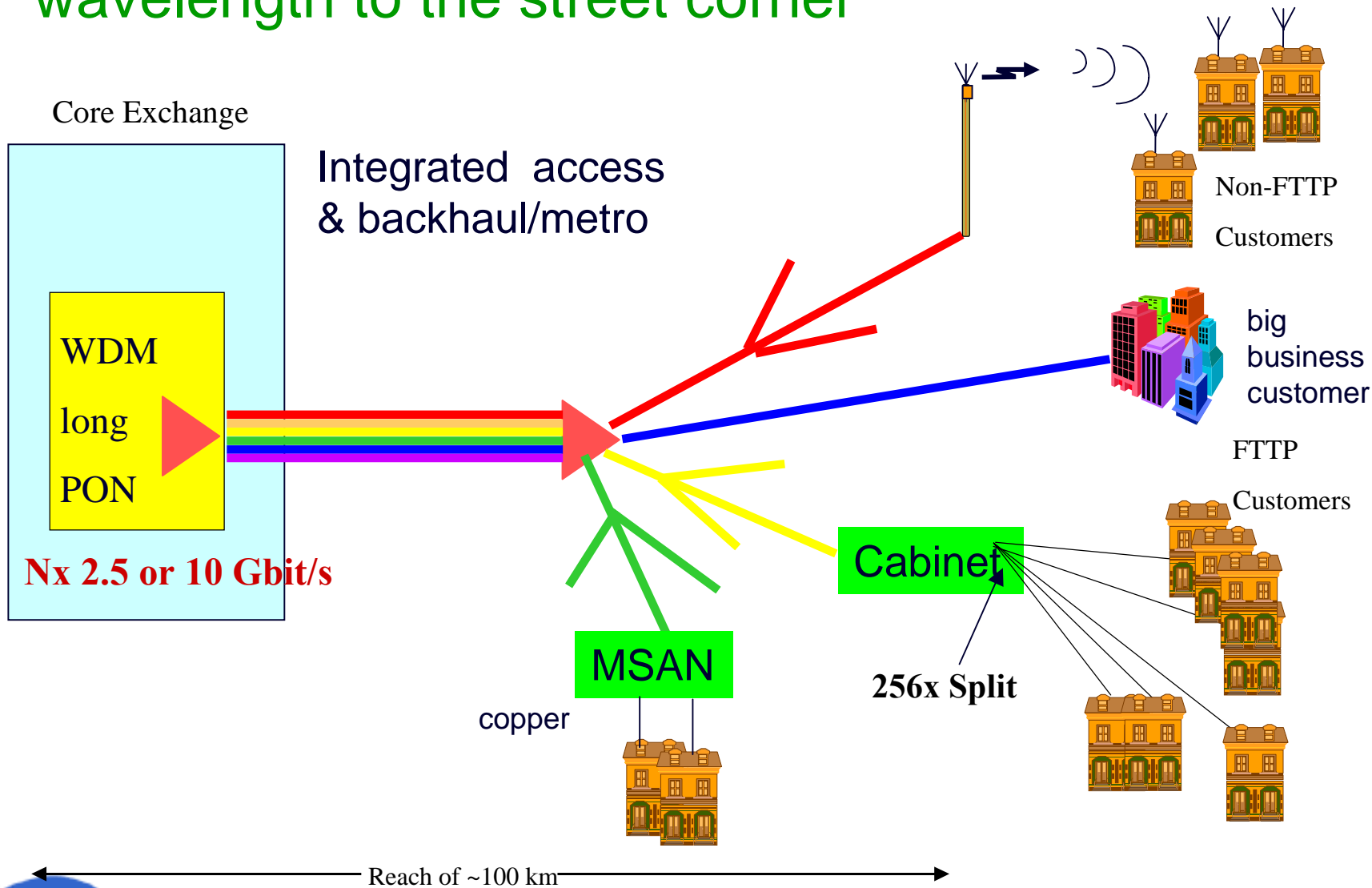
How long reach access saves capex



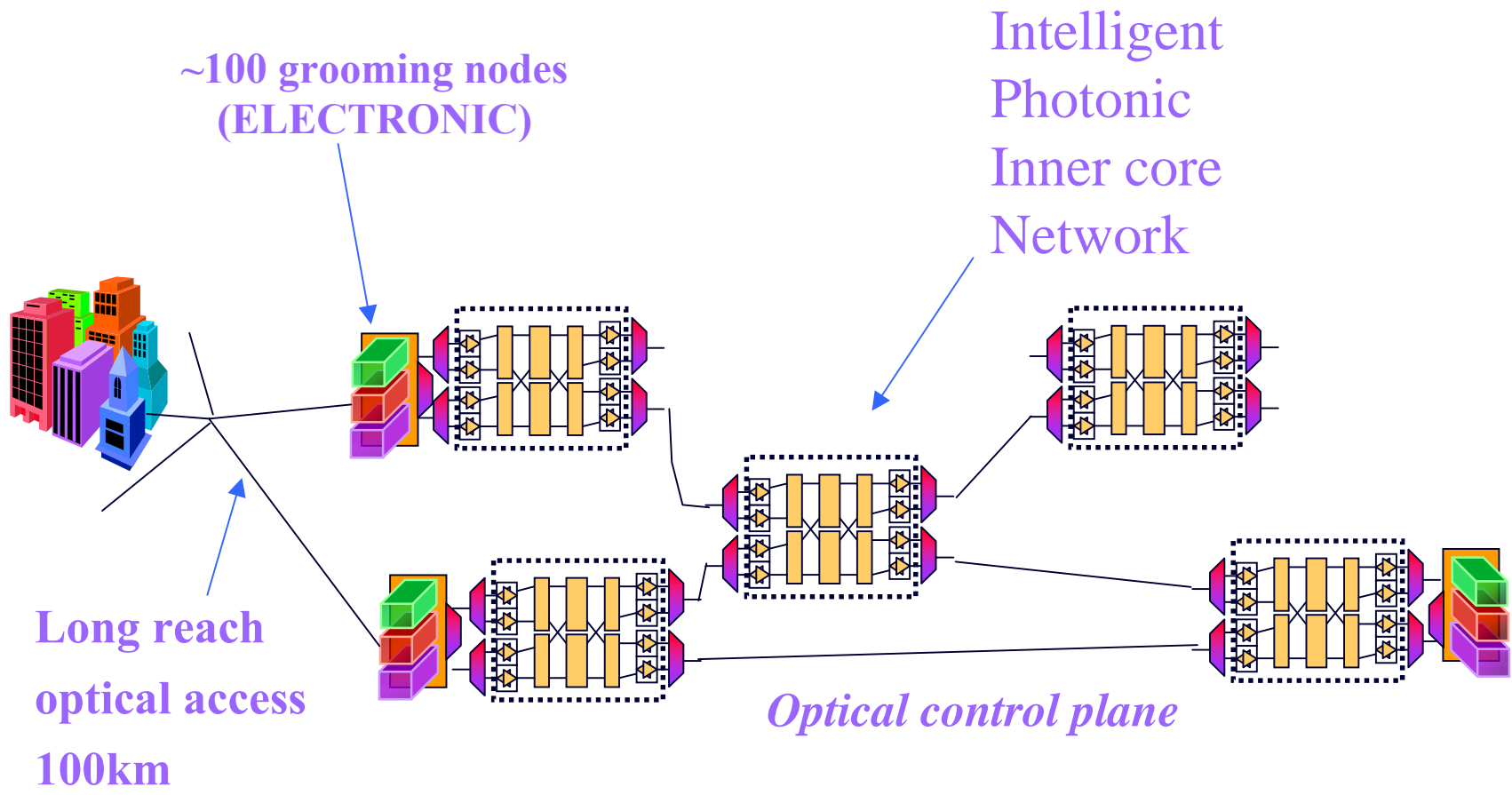
Note: cost calculations for 2.5 Gb/s system

Long reach access step 2

“wavelength to the street corner”



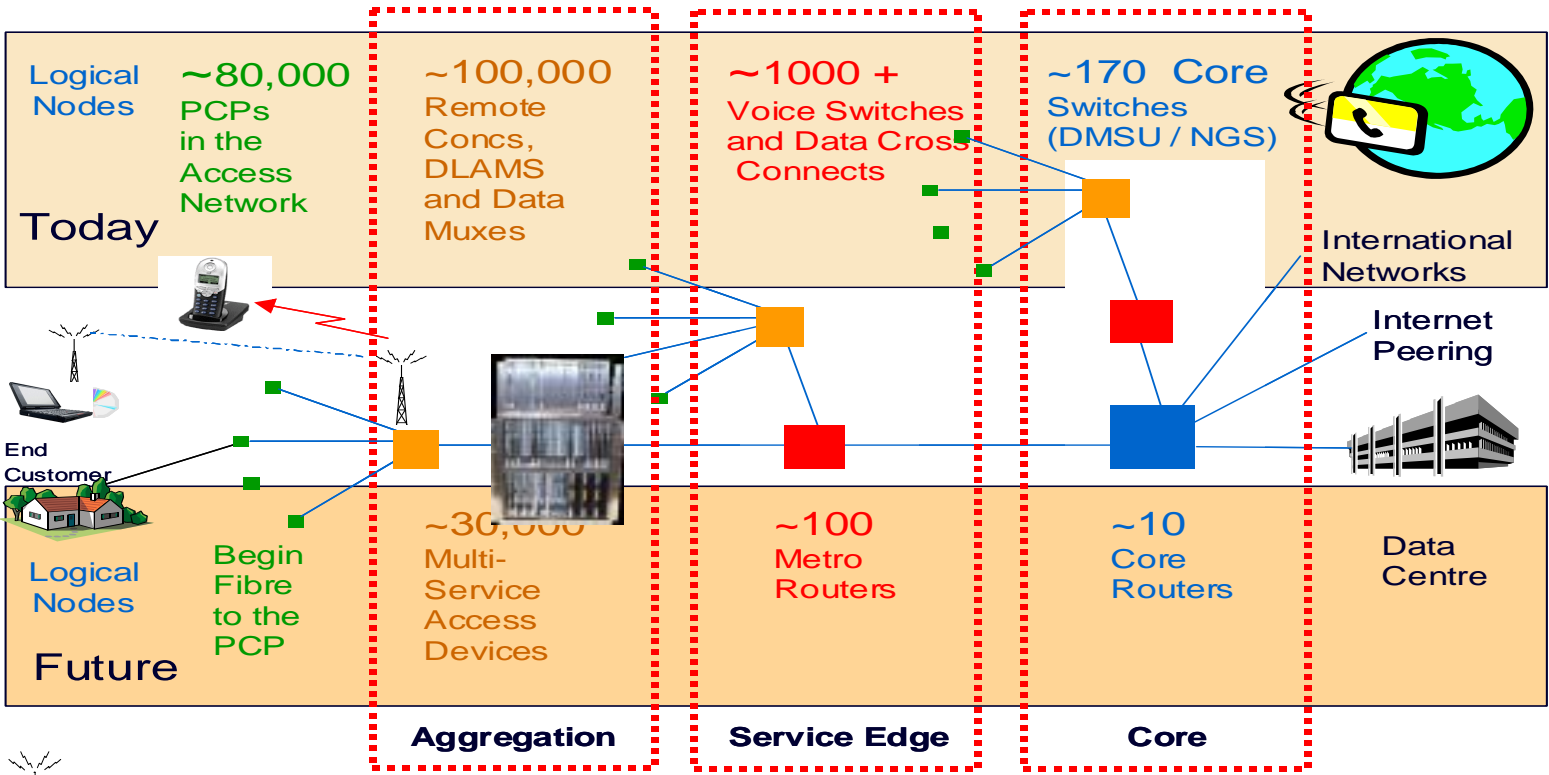
Integrated access and backhaul with photonic core



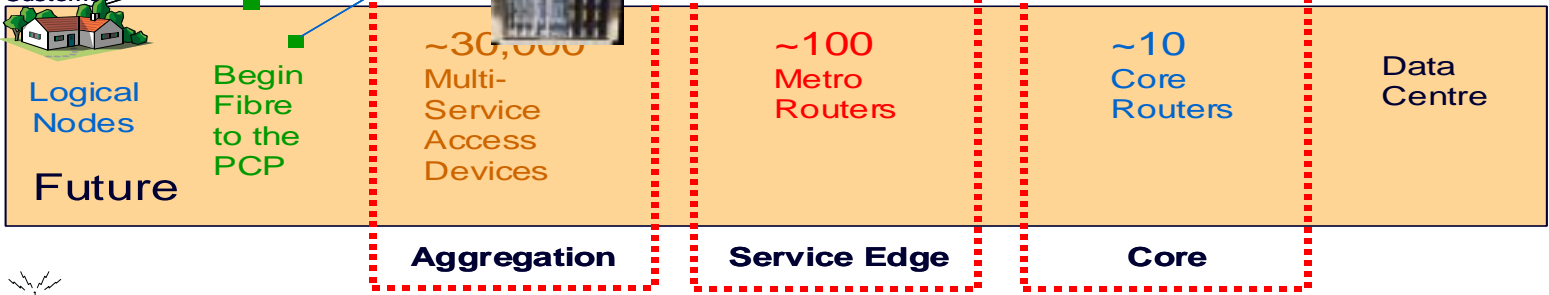
Ultimate aim: Reduce the network to ~100 exchanges

Evolution of 21cn

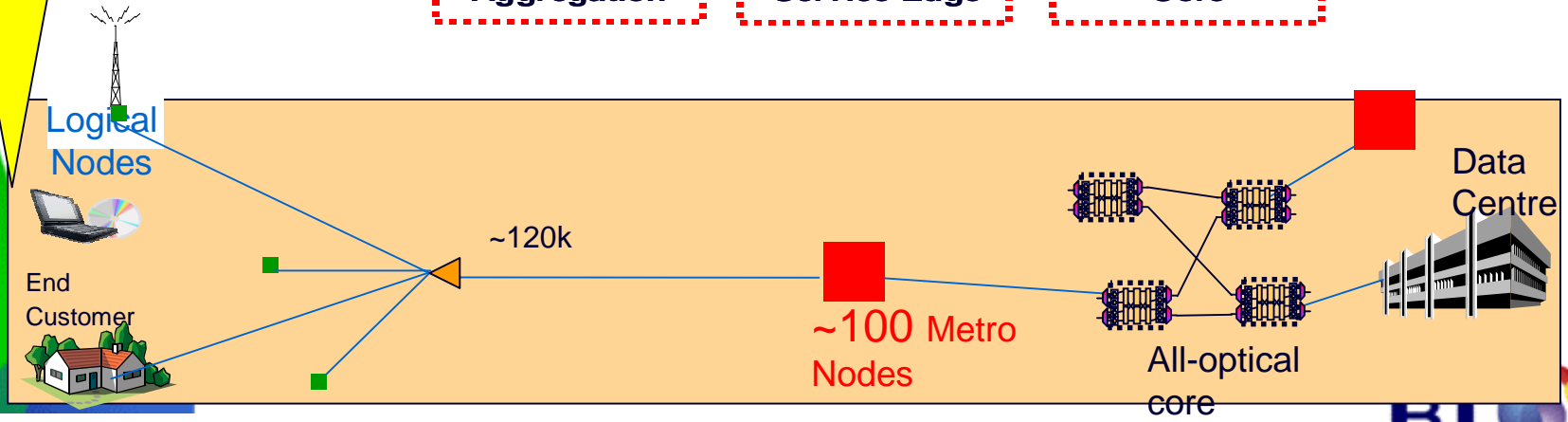
Today



21C



Vision



Advantages of Vision Network

- **Large reduction in Backhaul costs.**
 - *Could also be viable for rural geotypes*
- **Minimum costs per unit of bandwidth per customer**
 - *Could solve the bandwidth-price dilemma*
- Long reach PON provides traffic multiplexing, concentration and grooming function.
- Provides flexible bandwidth assignment.
- Provides symmetrical capacity.
- Could provide guaranteed QoS.
- Can serve all customer types and services.
- Can deliver true triple play and beyond!

END

