

LMDS ALTERNATIVE FOR FULL SERVICE NETWORK

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Jean-Charles Point *Thomson Broadcast Systems*



LMDS definition

- Local Multipoint Distribution Services
- cellular like technology which uses a grid a transmit/receive site (wireless access node) to deliver voice/video/data service to the customer
- typical cell size : 1000 subscribers
- frequency used : millimeter range (US : 28/30 GHz; Europe : 40 GHz band)
- extension of MVDS

Why LMDS?

- Need for simultaneous broadcast services and interactive service provision : leads to cellular architecture**
- Necessity of fast ROI and limited IFC for local or incoming operators**

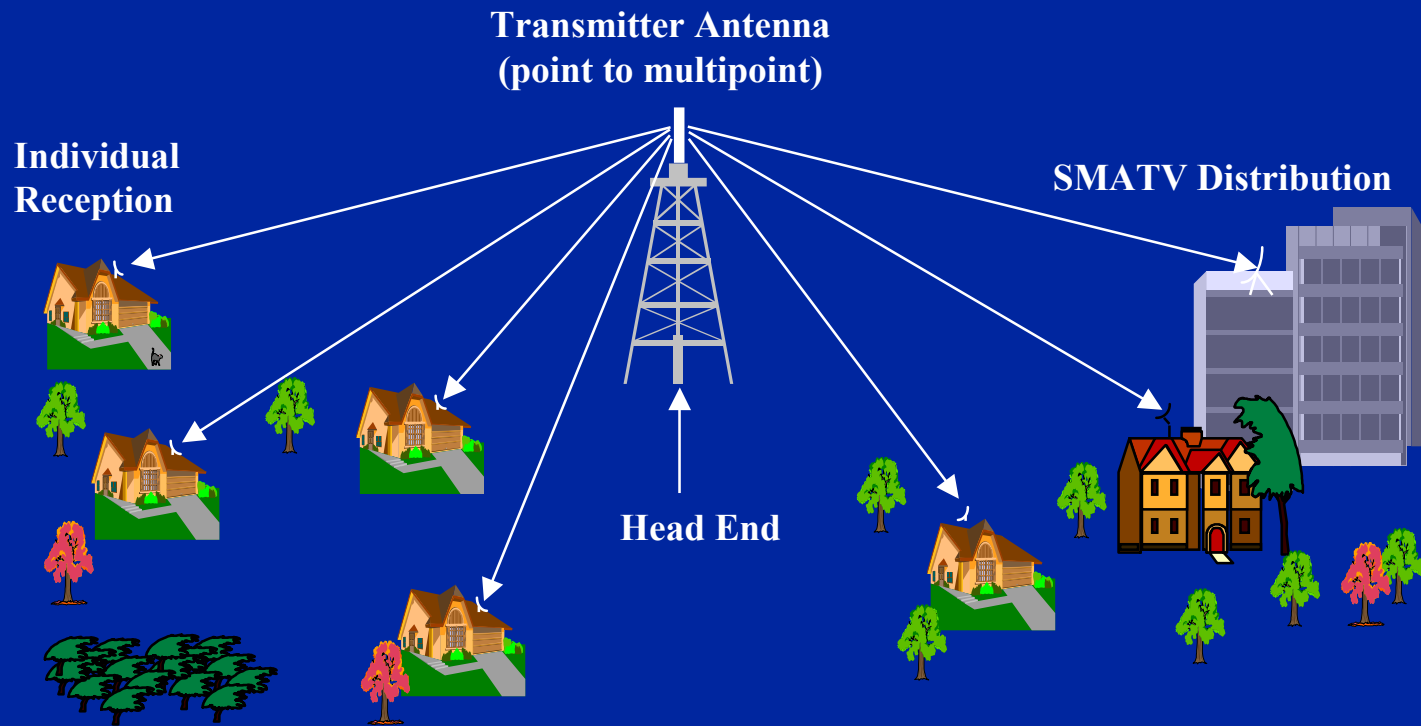
High Frequency LMDS

- **Wireless cable features at 40 GHZ**
 - **500 mW maximum transmit power**
 - **Receiver antenna size < 15 cm**
 - **Large available bandwidth**
 - ▶ **Fast deployment**
 - ▶ **Minimum infrastructure disturbance**
 - ▼ **Limited range**
- **Large bandwidth/small cell size adapted to broadband interactive service provision**

Summary

- MMDS regulatory environment**
- Standardisation status
- Services requirements
- Hybrid Fiber - Wireless architecture
- Cell planning
- Installation cost
- Introduction scenarii
- Conclusion

MMDS System Overview



MMDS Regulatory Environment

- Frequencies available for MMDS depend upon national spectrum constraints

□ High Frequency MMDS (> 12 GHz)

- 27.5-28.35 GHz, 31 to 31.3 GHz

- Recent allocation in USA for Local Multipoint Distribution Systems (LMDS)

- Extension planned to 40 GHz band

- 40.5-42.5 GHz (downstream)

- European harmonised frequency band for MMDS

- Upstream under discussion (either both end or high side)

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Transmission standards

- ❑ **DOWNSTREAM** : DVB- MS; uses QPSK modulation
- ❑ **UPSTREAM** :
- ❑ **DVB - RC** :
 - standardisation in progress
 - compatibility with HFC standard (ETS 300-800)
- ❑ **DAVIC** :
 - spec frozen; incompatible with HFC and downstream
 - TS
- ❑ **Both DVB/DAVIC adopt TDMA/FDMA access modes**

DVB-RC main features

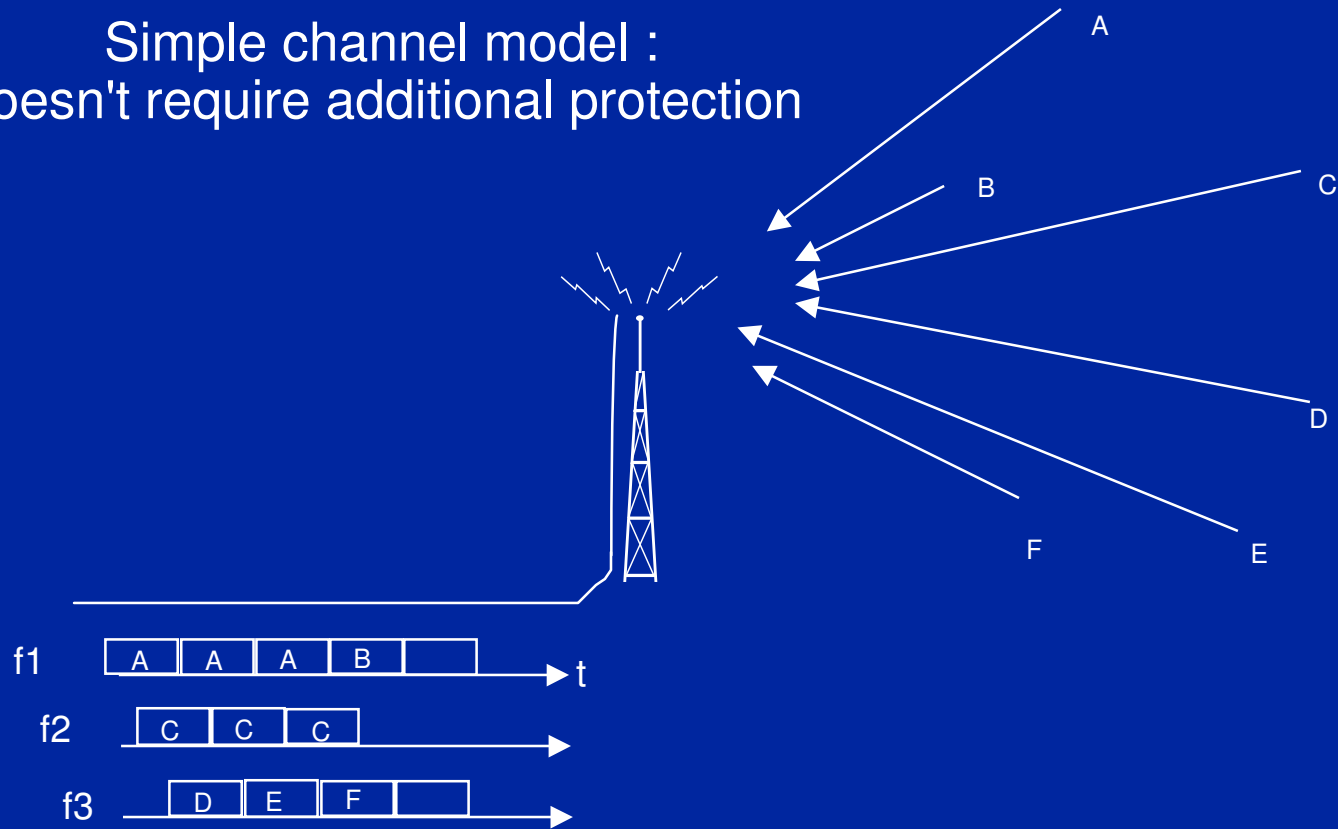
- ❑ upstream carriers : 3 Mb/s bit rate; DQPSK
- ❑ downstream carriers : either 3 Mb/s bit rate, **or ± 30 Mb/s bit rate, if using downstream in band carrier**
- ❑ MAC layer can support both **data and voice services**
- ❑ basic cell : **ATM**

Differences with HFC specification

- Unique word : 0x 00 FC FC F3
- frequency_offset_value in Range and power calibration message : permits to realign NIU frequency
- Symbol counter for upstream alignment

TDMA/FDMA scheme

Simple channel model :
doesn't require additional protection





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Interactive service requirements

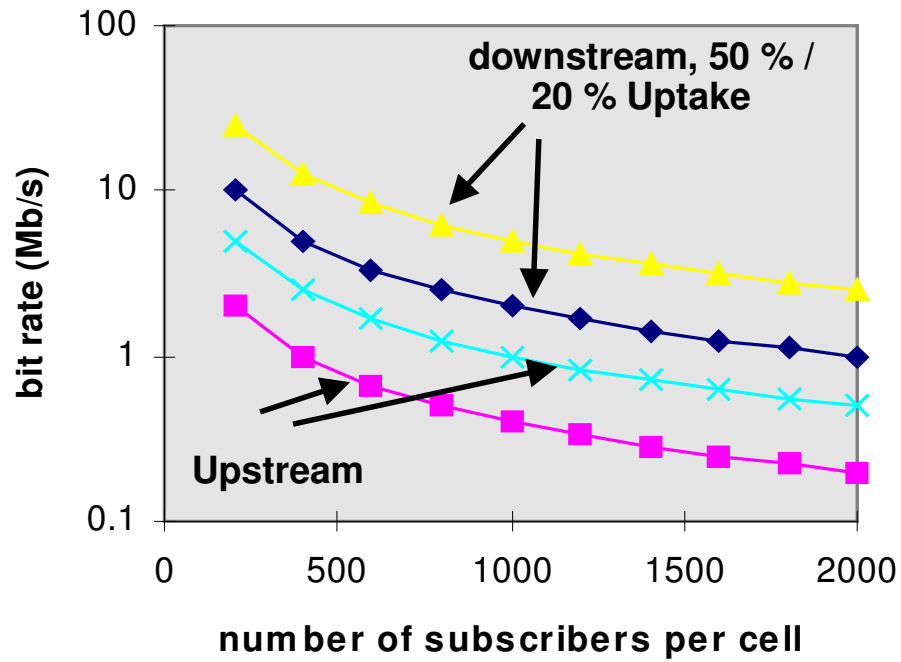
- Telephone : 10 - 15 kb/s
- Internet : 10 kb/s
- Visiophone : 64 kb/s
- max mean bit rate per customer : 100 kb/s
- Sub / cell : 1000 to 2000 : 200 Mb/s considering 100 %uptake (200 MHz using QPSK)
- Conclusion : available upstream bandwidth can cover both residential and professional applications

LMDS performance objectives

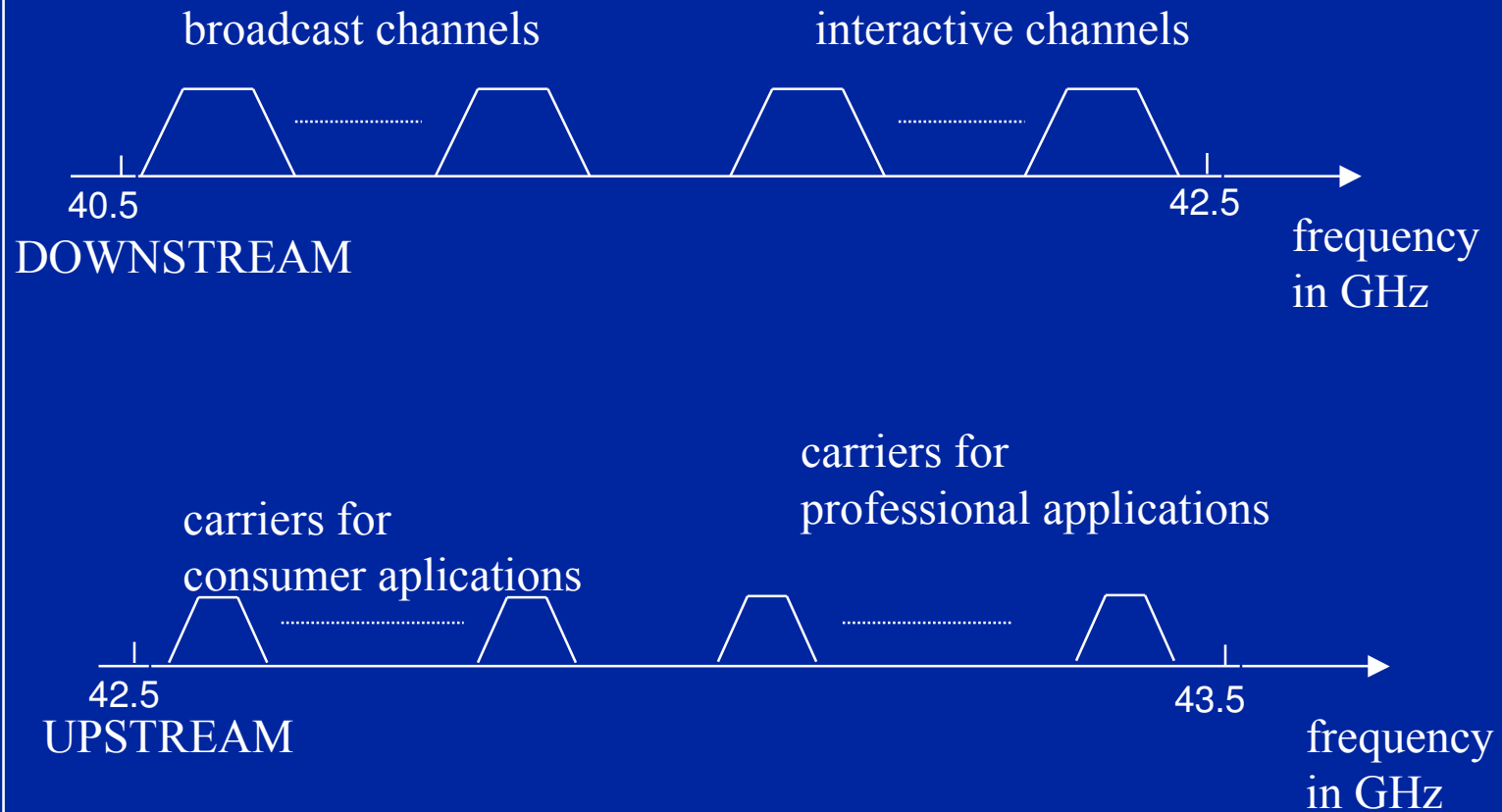
- Available downstream/upstream bit rate per cell :
1Gb/s / 200- 400 Mb/s for 1000 homes
- Permits to provides high QoS for residential services
(telephone, visiophone, internet, etc..)
- Can support simultaneous professional services



Mean bit rate per subscriber

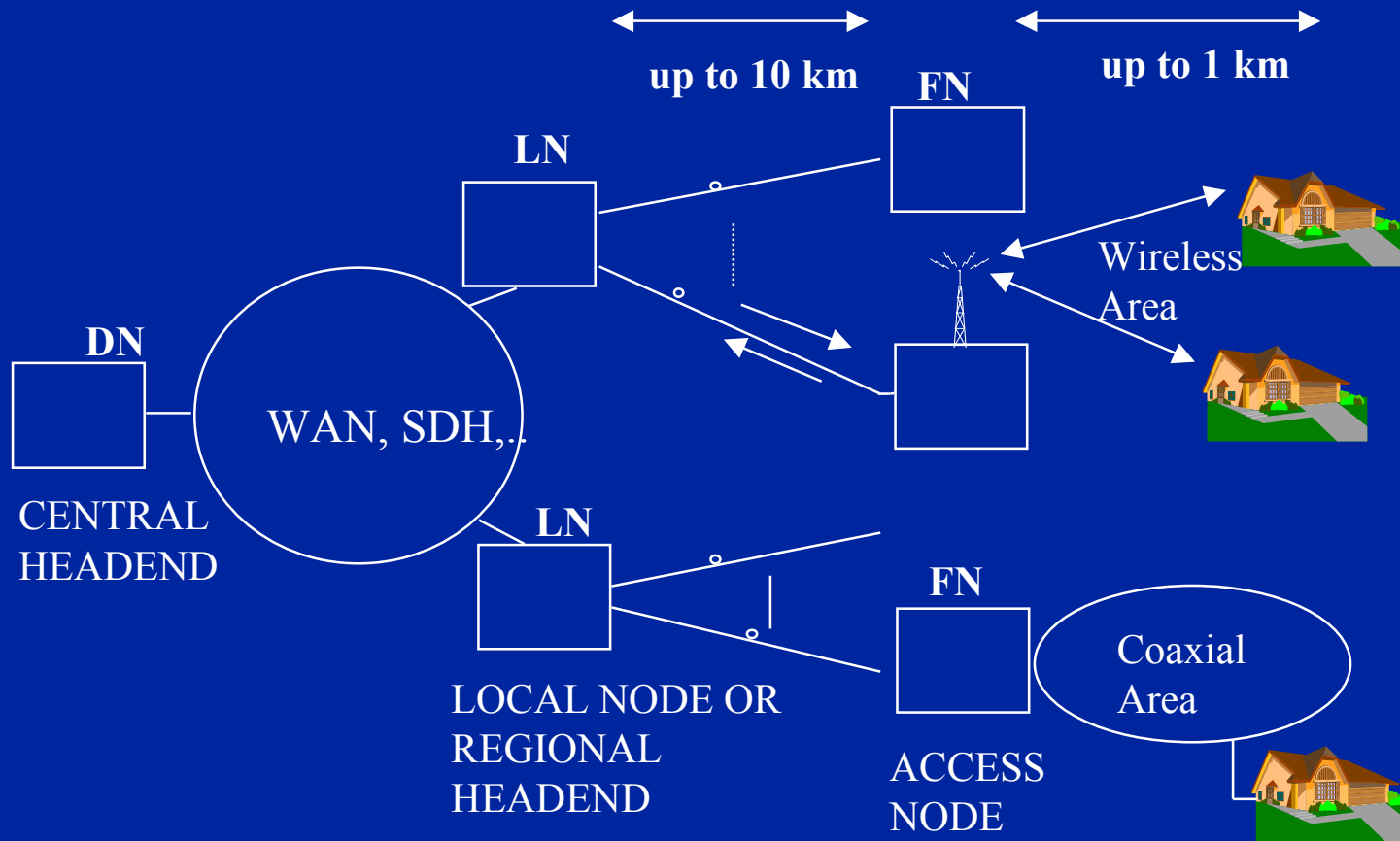


Spectrum allocation downstream/ upstream (example)

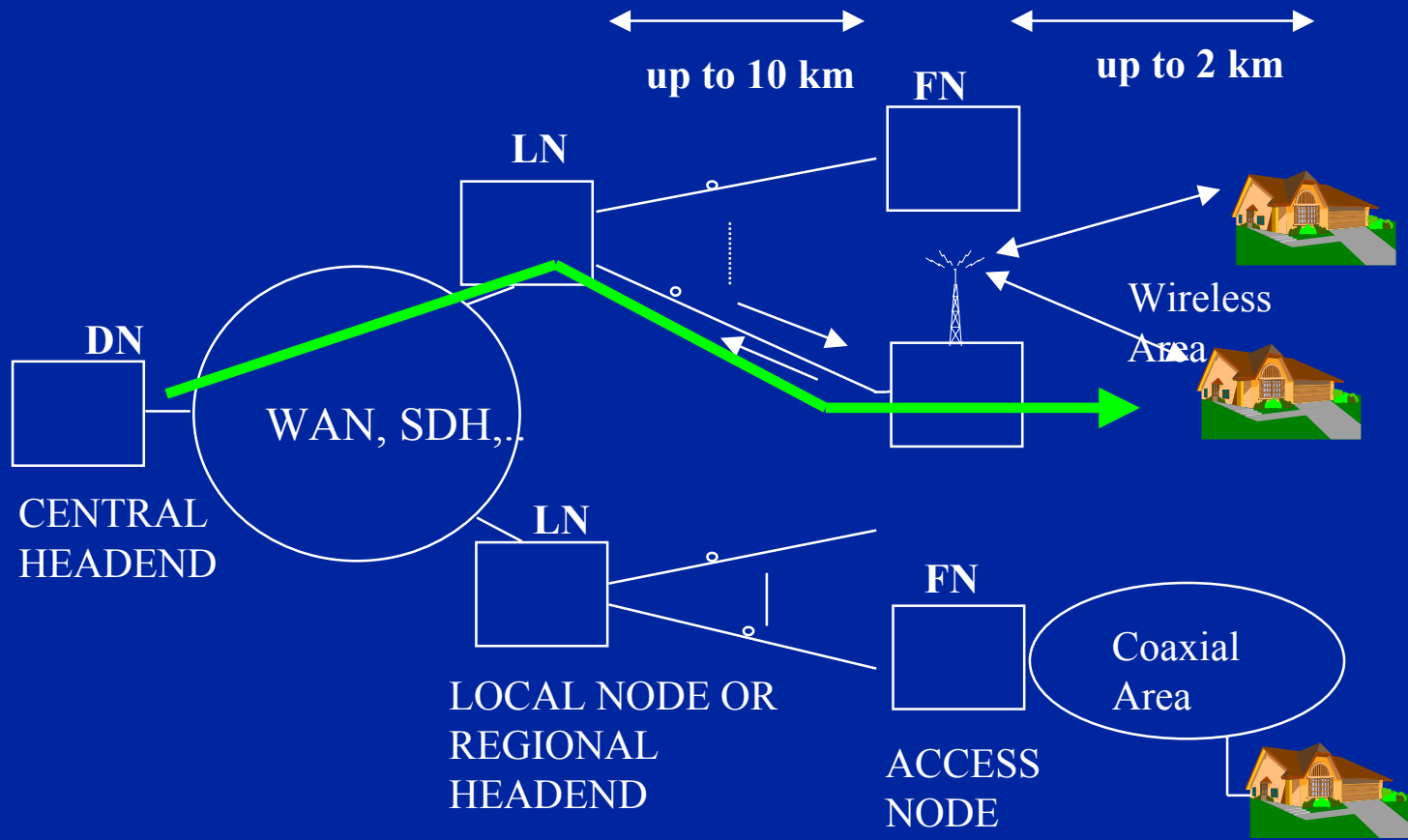


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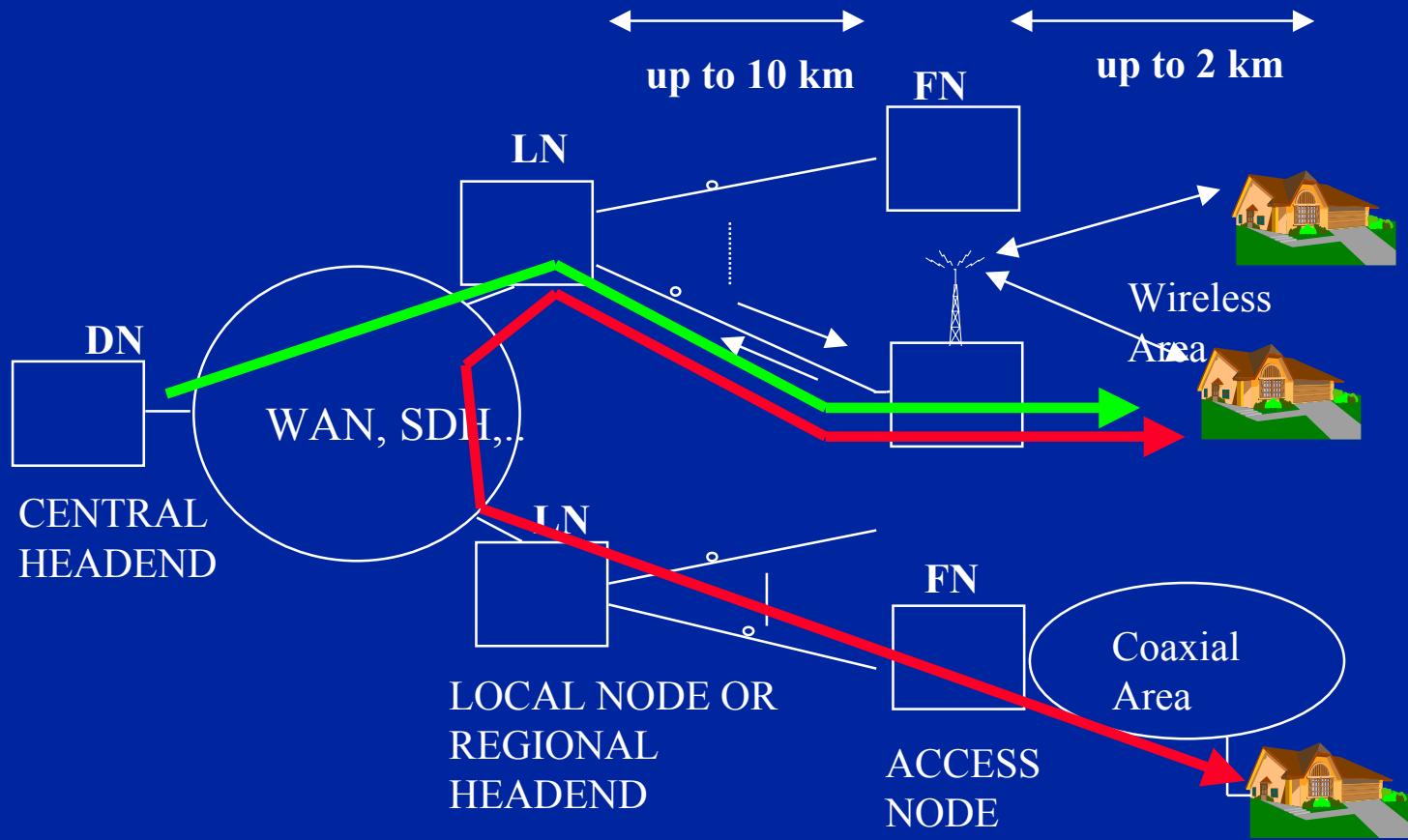
HFW system overview



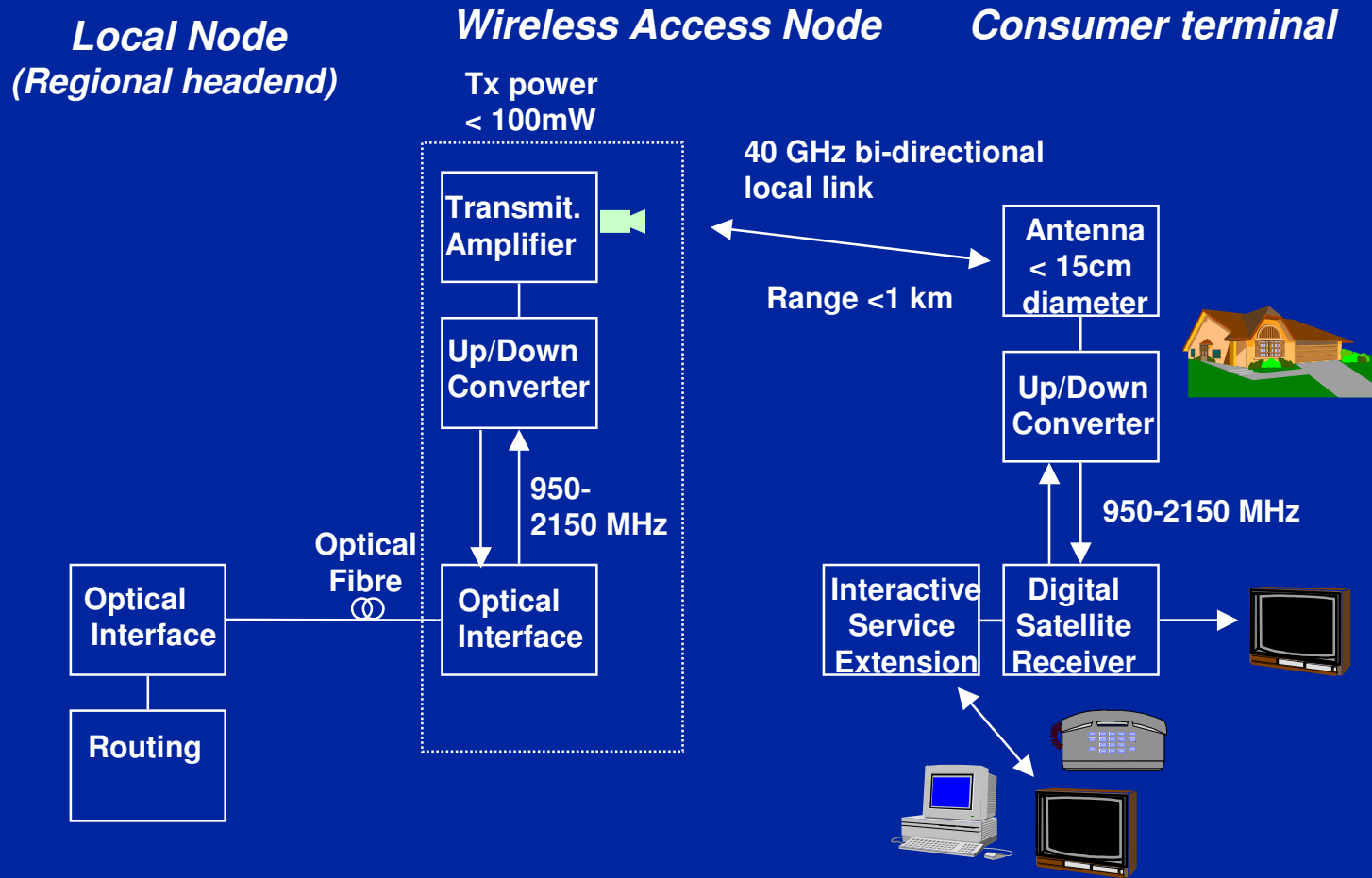
HFW system overview : Broadcast service path



HFW system overview : interactive service path



HFW System Detail



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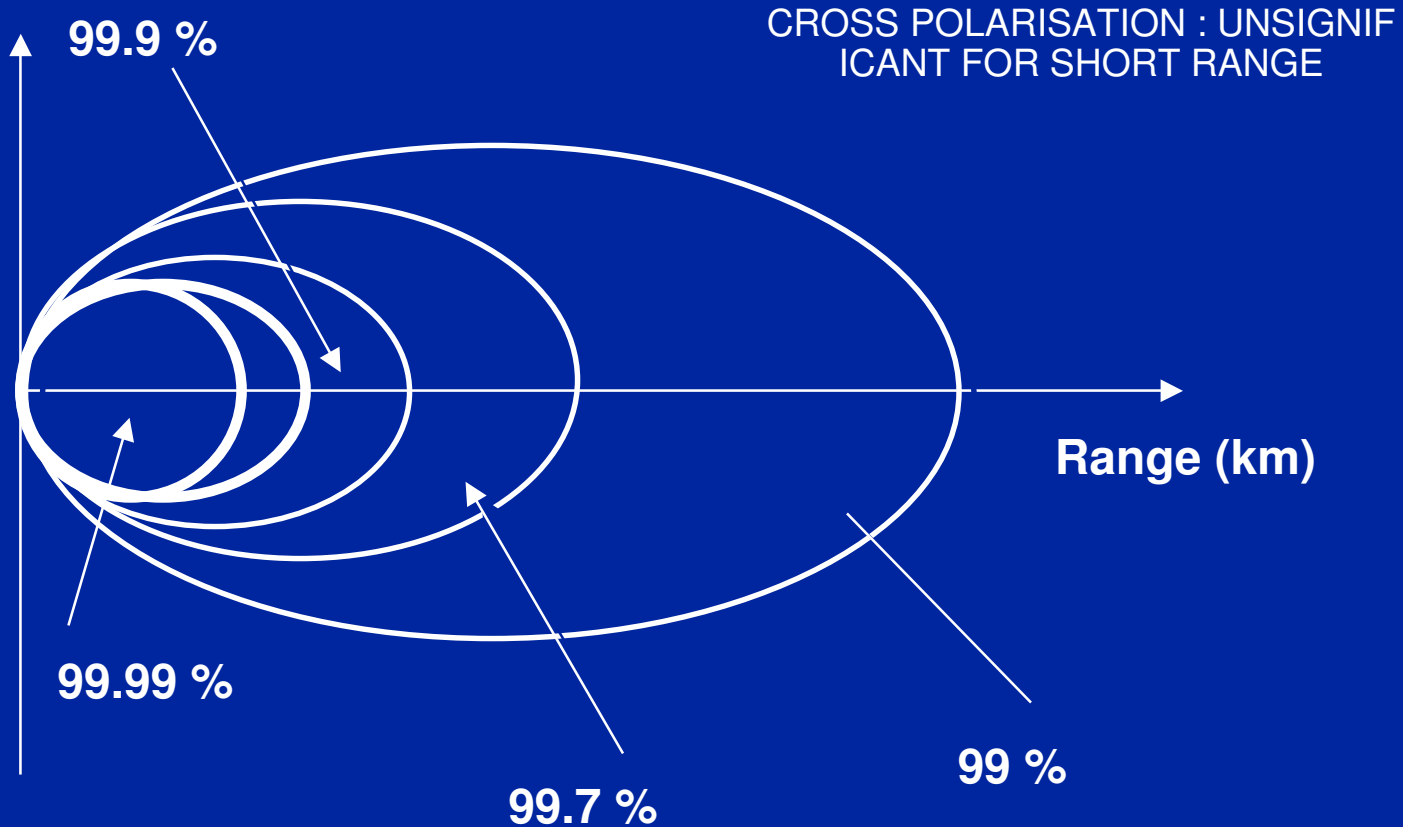
Parameters affecting propagation

- Gaseous absorption : 0.14 dB/km
- Rainfall attenuation : most significant
- multipath : not significant
- Vegetation

Rainfall attenuation

- due to attenuation and scattering of signal by rain
- acts as an attenuator on signal

Rainfall attenuation effect :Service area vs availability (64 ° horn antenna)



Vegetation : some data

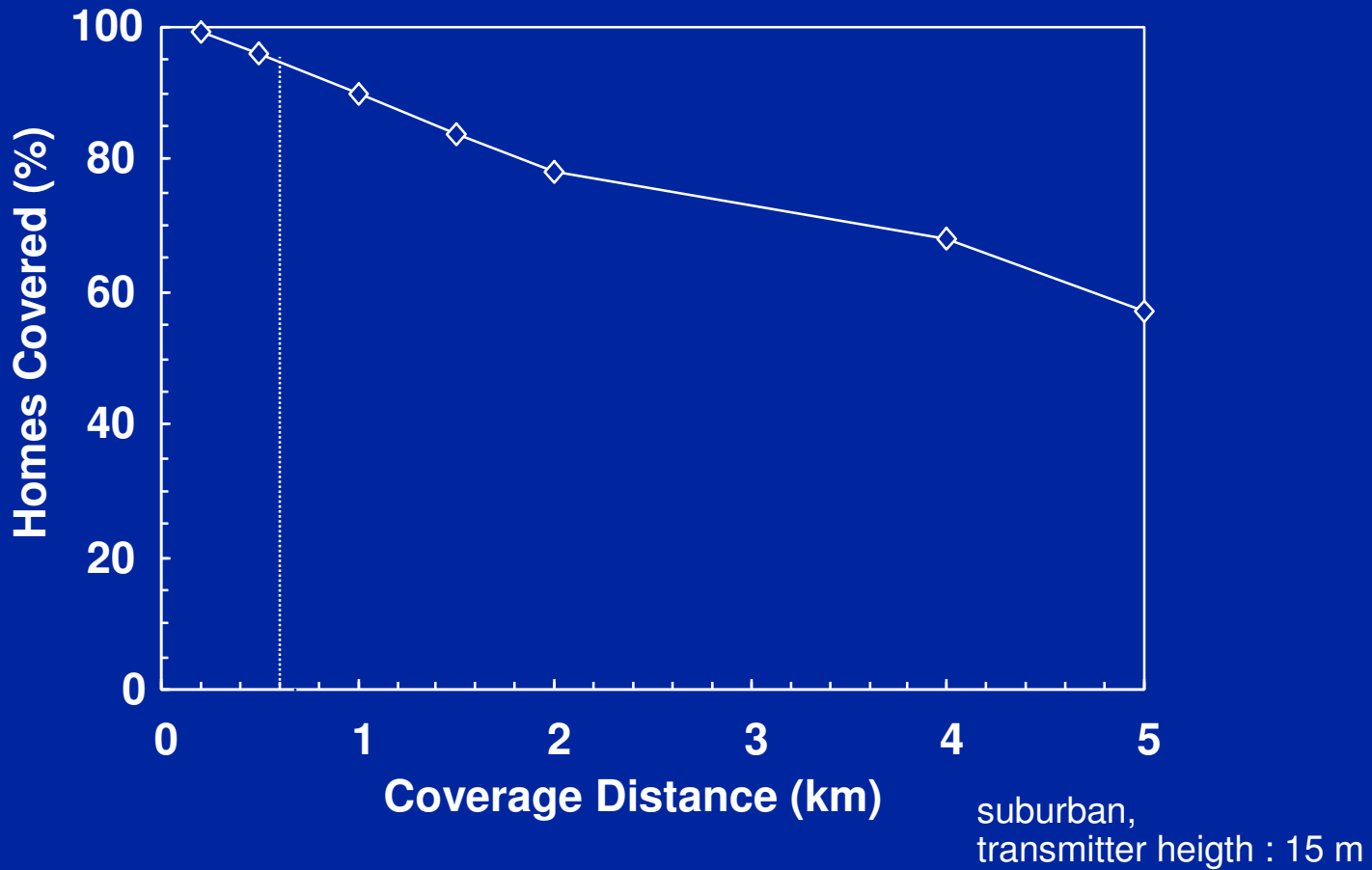
att. per metre	in leaf	in leaf wet	leafless
Ash tree	0.96/0.18	2.41/0.3	0.17/0.02
Oak tree	1.67/0.33	5.1	0.83/0.17
Silver birch	0.93/0.19		

Risk of signal fading due to wind

Conclusion :

- attenuation can be predicted, but line of sight is preferable
- for small cells : cell overlap should be planned for increased penetration

Percentage Number of Homes Covered in a Typical Urban Environment



Network planning (bis)

A	B	B	A	A	B	B							
B	A	A	B	B	A								
b	a	a	b	b	a	a							
a	b	b	a	a	b	b							
A	B	B	A	A									

A, B : HORIZONTAL POLARISATION
a, b VERTICAL POLARISATION

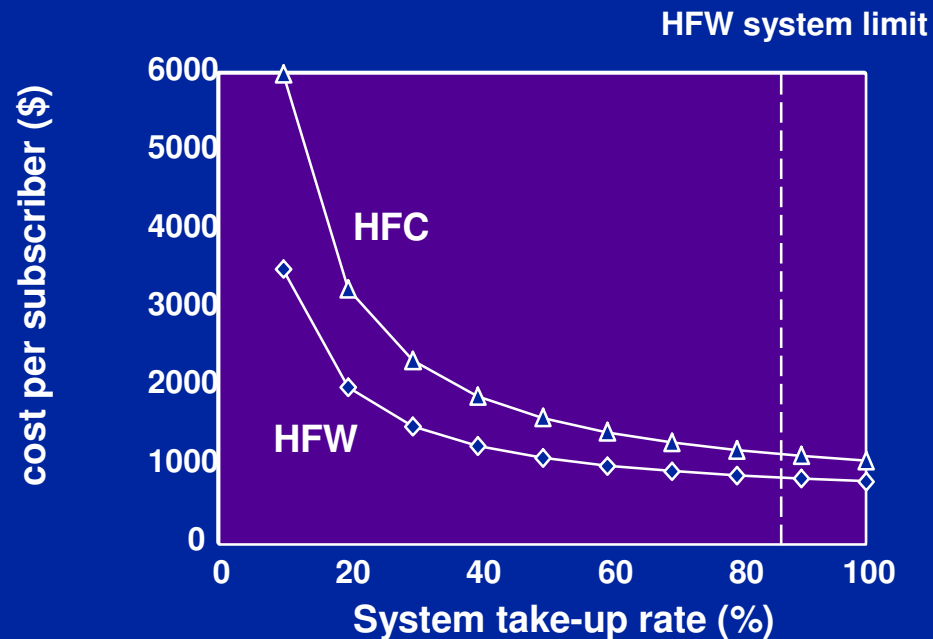
network planning : conclusion

- line of sight must be considered
- rainfall attenuation brings significant attenuation for 99.99 % availability
- 1 km cell size ensures good penetration (>90-95%)
- cell overlap should be considered to avoid shadow areas (vegetation, buildings..)



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Hybrid Fibre Coax (HFC) / LMDS Cost Comparison



- ❑ 1000 subscribers per node
- ❑ System range less than 1km
- ❑ Optical, coaxial and wireless network system costs included

Reaching 100 % penetration

- 10 % more subscriber to reach, spreaded in the network
- cost per subscriber : can be 100 % higher than LMDS
- ADSL to reach shadow areas (limited number of subscribers)
- HFC or LMDS repeater to reach larger shadow areas

Cost : Local Telco view

- ❑ **PON : provides broadband access, but :**
 - very expensive at low take up
- ❑ **ADSL : low cost at low take up, but :**
 - 100 % / 2 TV programs per subscriber difficult to achieve
 - operation cost
- ❑ **Conclusion : HFW (combined with other techniques in shadow areas) competitive**

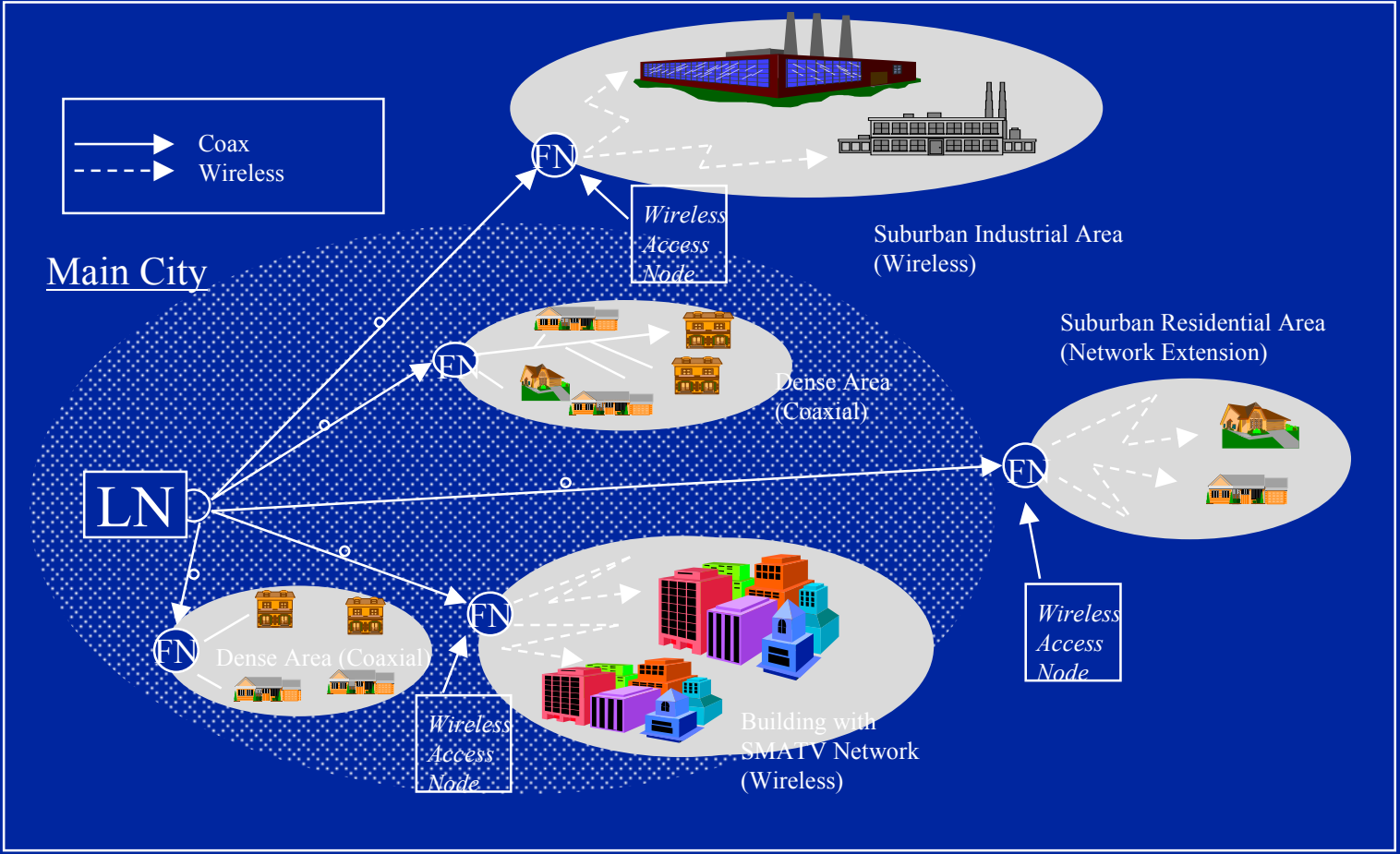
Conclusions

- **High frequency digital LMDS (40 GHz)**
 - ▶ **Low cost interactive broadband network/home connection**
 - ▶ **Introduces both broadband residential/professional applications**
 - ▶ **Fast installation**
 - ▶ **Low cost 40 Ghz equipment now becoming available**
- **Introduction scenarii**
 - ▶ **cable operators : network extension/upgrade to interactive (HFC / LMDS SPEC COMPATIBILITY IMPORTANT)**
 - ▶ **local telco's : fast introduction of broadband offer**
 - ▶ **2nd entry operators : fast introduction/low initial cost**

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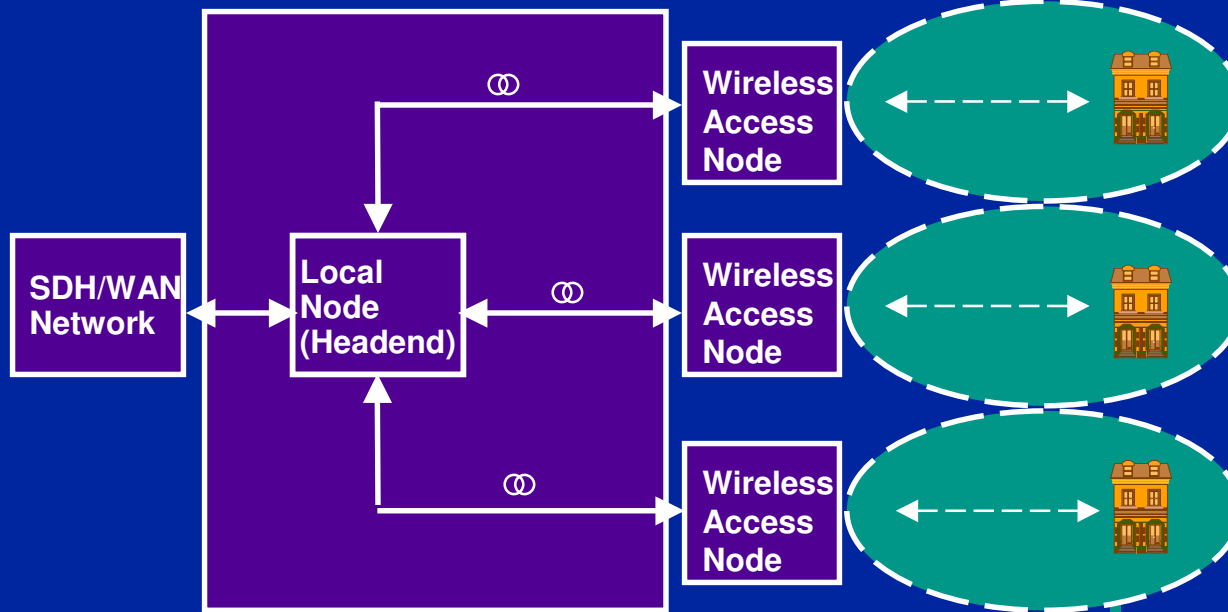
Full service network



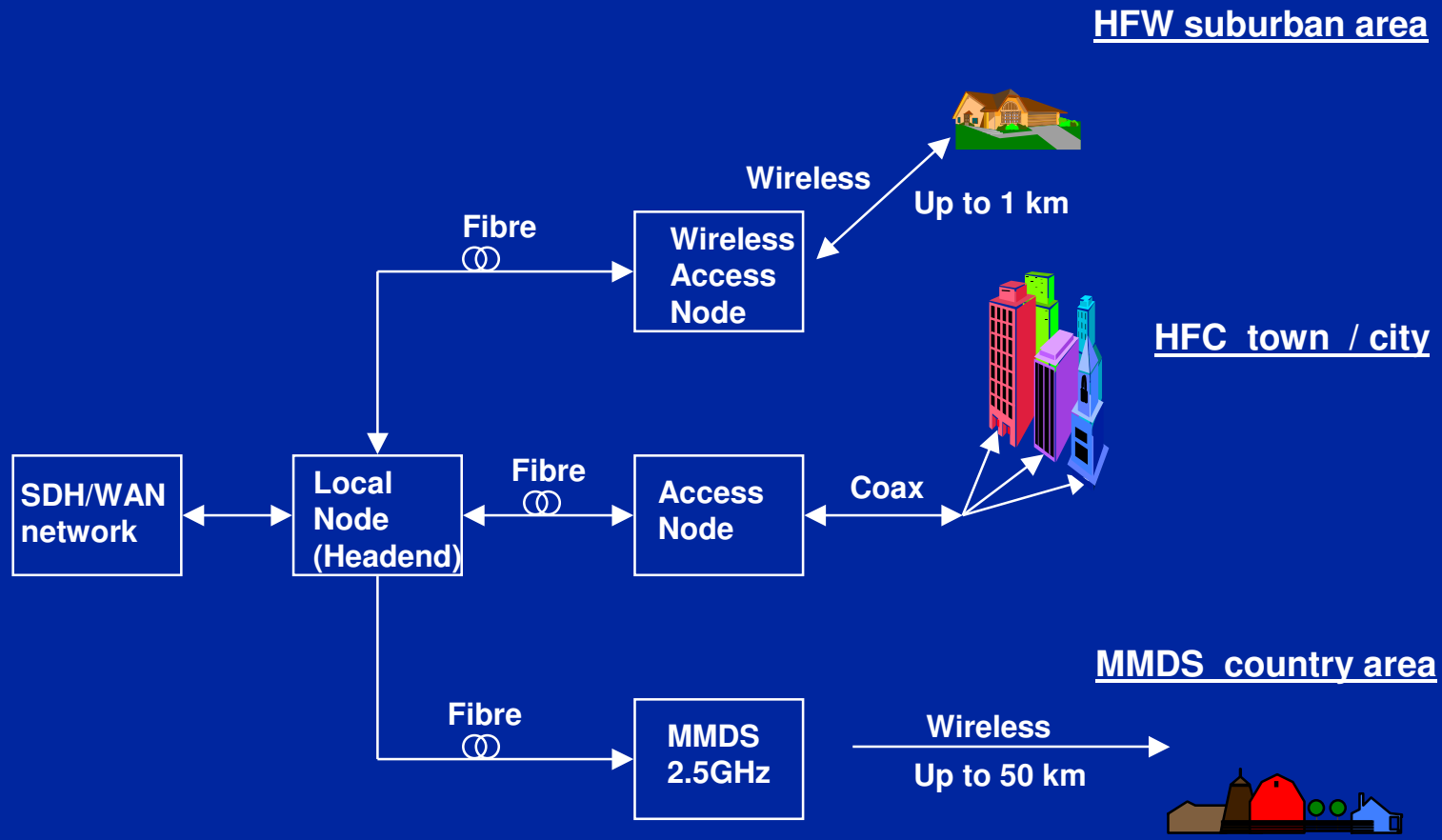
High Frequency MMDS Application to Hybrid Fibre Wireless (HFW)

Optical Fibre Backbone

Wireless Point to Multipoint Links

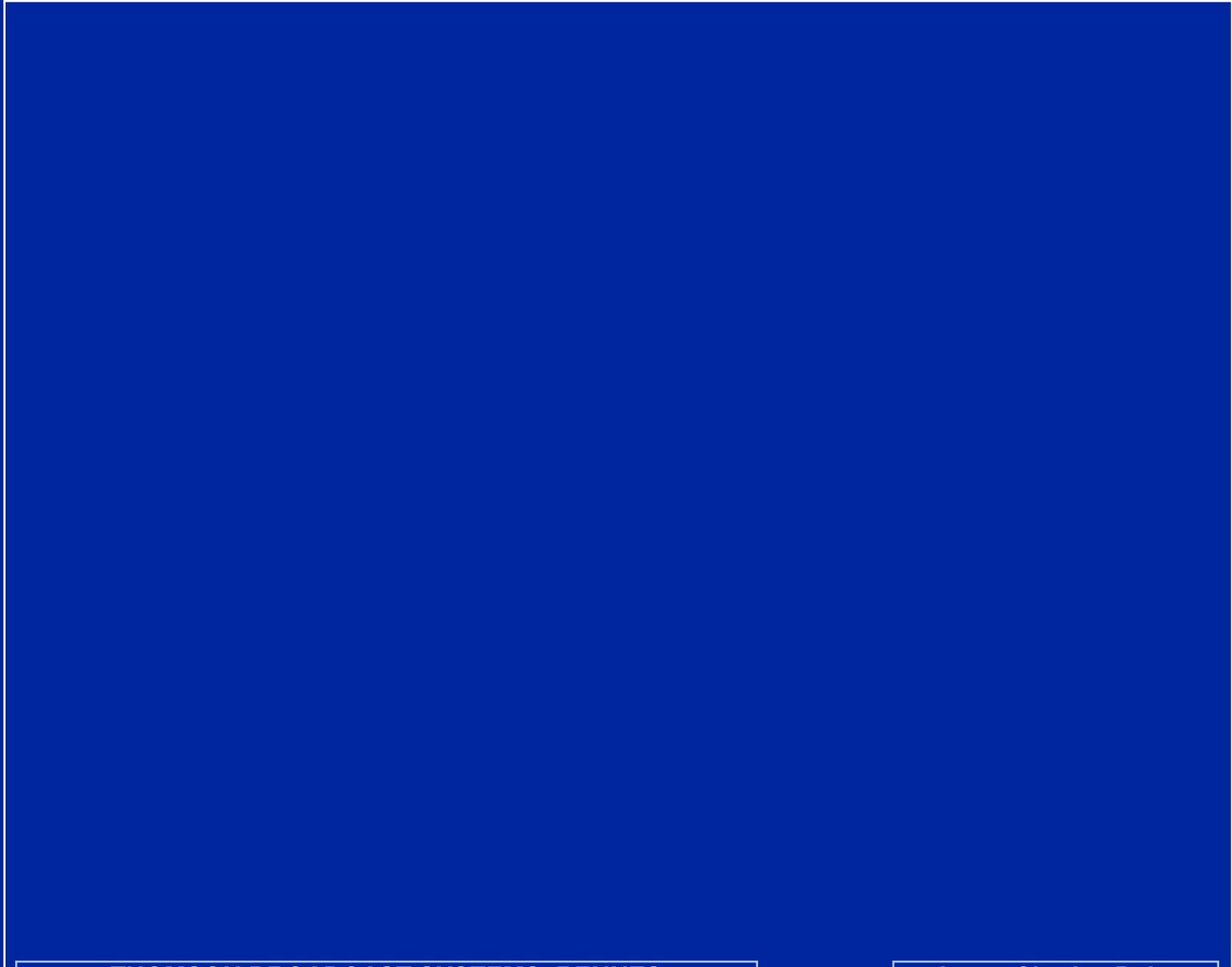


Digital MMDS Applications Overview



HFW introduction scenarii

- HFW complementary to HFC : network extensions/plant upgrade for cable operators
- 2nd entry telecom operator
- green fields

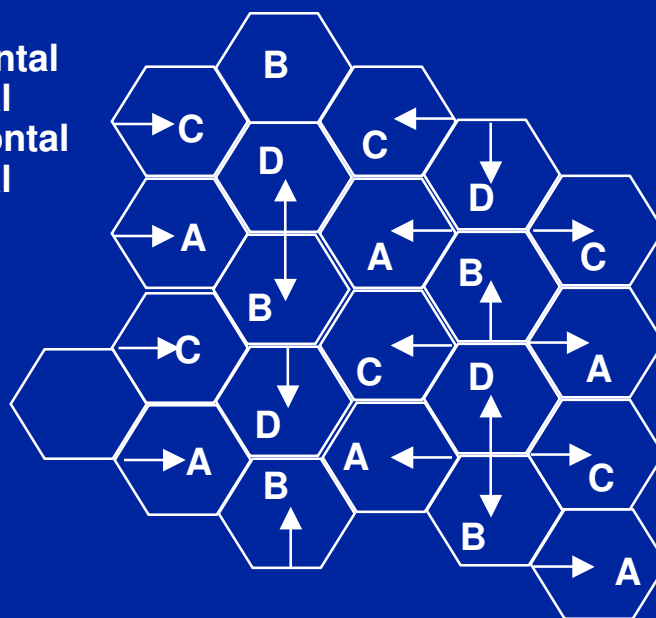




2 nd entry operator :
LMDS , 90 % coverage

Network planning

A : band 1, horizontal
B : band 1, vertical
C : band 2, horizontal
D : band 2, vertical



HFC/W network

