



# Evolution der Zugangsnetze

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*Dietrich Boettle*

*Alcatel R&I Stuttgart*



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# Agenda

Current situation

Global trends

Technologies and trends

- DSL
- Fiber
- Cable
- Wireless
- (Niches:)
  - (Powerline)
  - (Satellite)

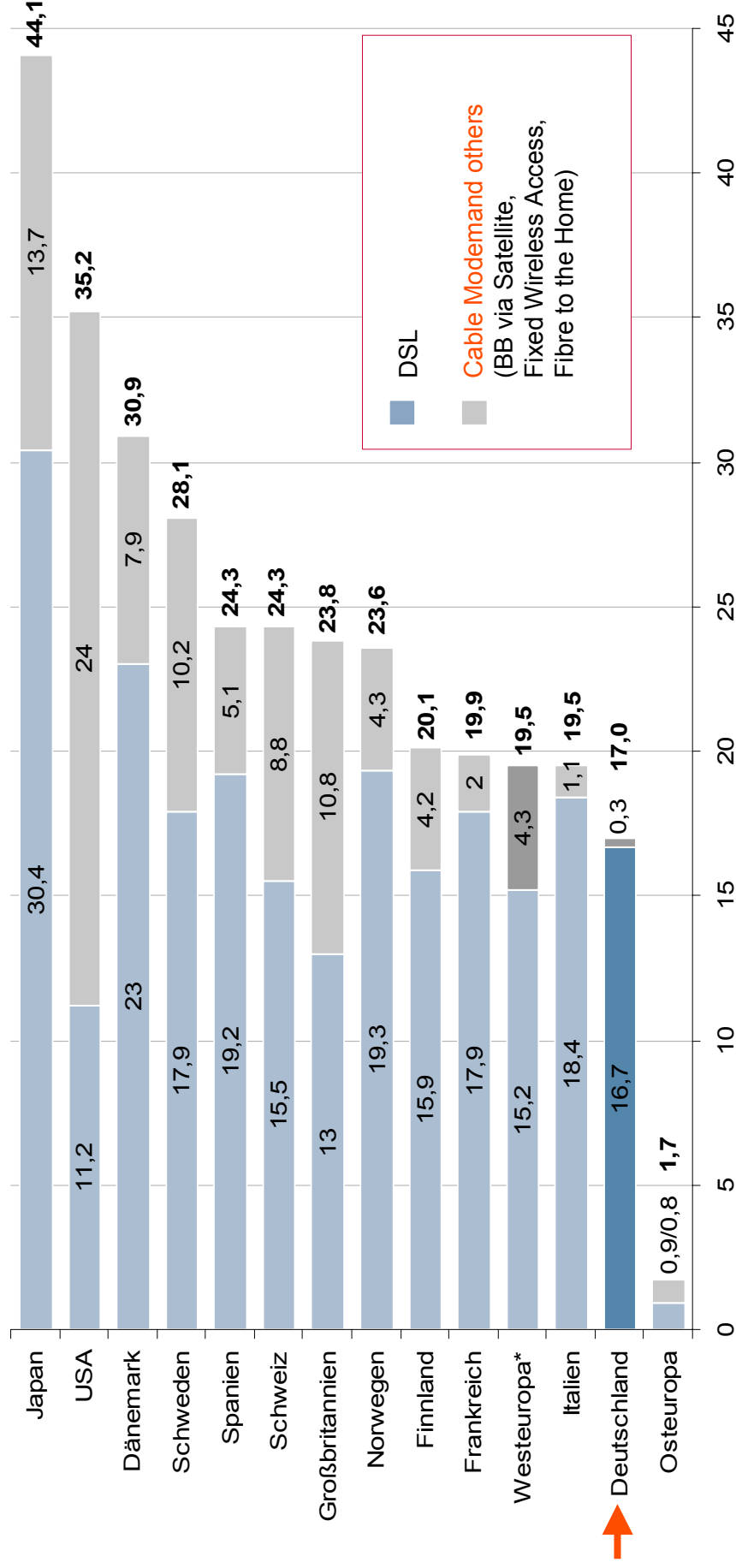
Summary

# Current Situation in Germany (key figures)

## Infra and number of users

- ~ 18 Mio. Buildings
- ~ **38.2 Mio.** Households (HH)  
= fixed network phone users
- ~ 72 Mio. mobile users (83.5 per 100 inhabitants)
- ~ 7.5 Mio. DSL users (16.7 per 100 HH in 2004)
- ~ **22.6 Mio. Cable** users  
(thereof 18.6 Mio. via NE3 and 4 Mio. via independant NE4)

# BB Access per 100 Households (2004)



Germany on position 13

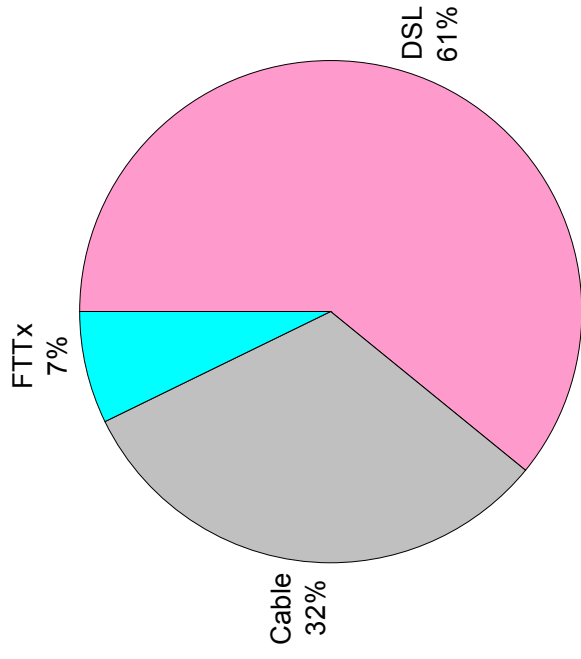
\* einschließlich Türkei

Quelle: BITKOM; Basis: EITO

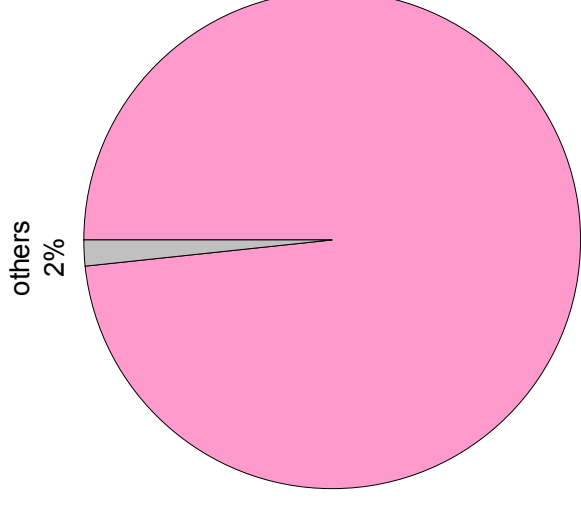


# Broadband Deployment Worldwide vs. Germany

## worldwide



## Germany

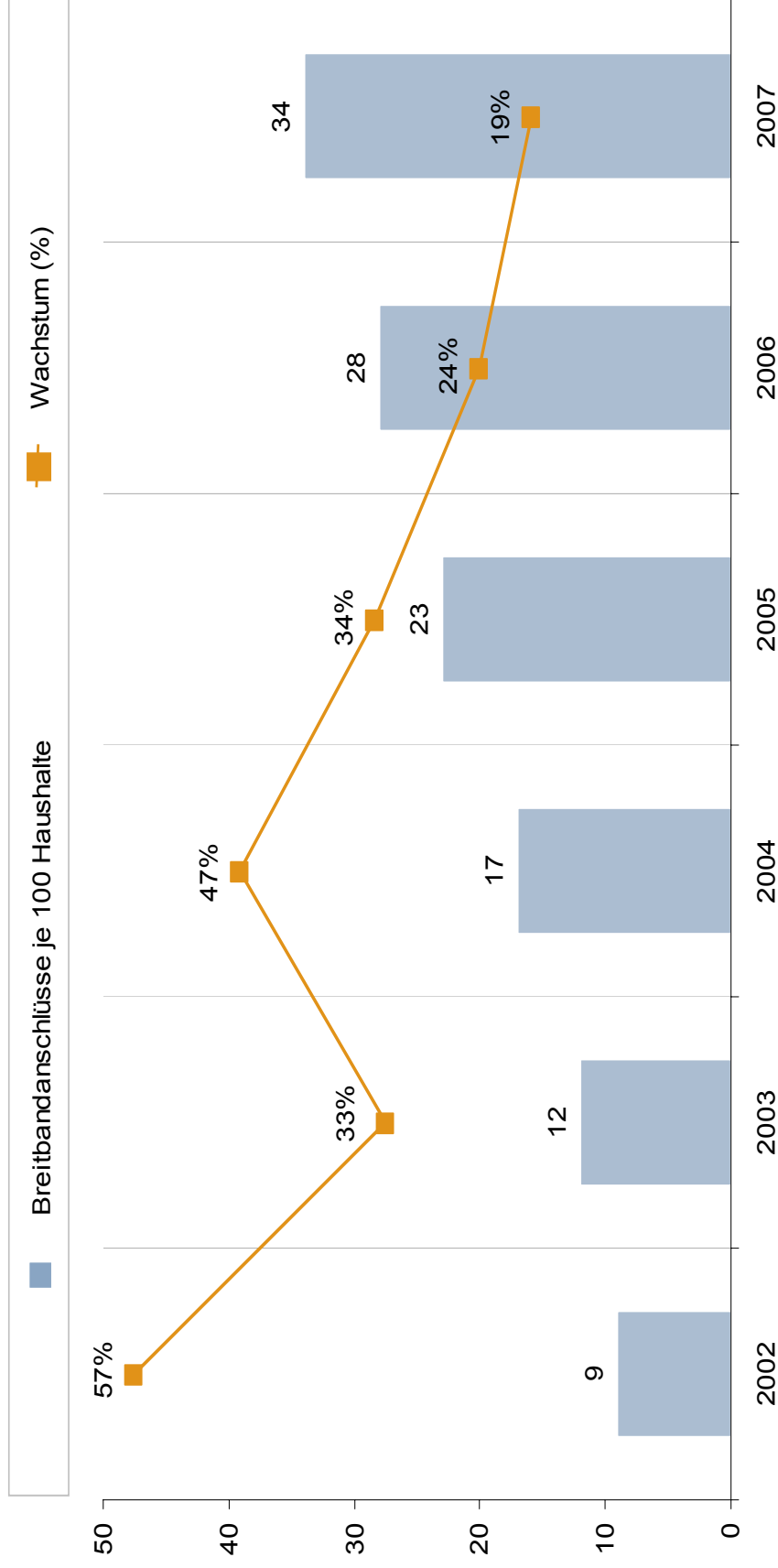


Worldwide: 123 Mio (June 04)      Germany: ~7,5 Mio (2004)

Sources: point topic      Bitkom/EITO

**DSL ,monoculture' in Germany**

# Evolution of BB Access Lines in Germany



decreasing growth

Quelle: BITKOM; Basis: EITO



# Global Trends

## User aspects

- **more mobility** (nomadicity, portability, simple mobility, full mobility) „access everywhere“
- **higher bitrates**, better service performance“any service everywhere“
- community services, personalized service packages
- seamless independance from network technology (IMS)
- single service provider (triple play)

## Operator aspects

- **more added value** (from transport to service offering)
- **triple play** offering
  - **incumbents**: introduction of **video offering** (increase of bitrates via DSL)
  - **cable operators**: introduction of **HSI and voice** (VoIP)
  - new operators: HSI and VoIP (+ Video) e.g. via radio

mobility, higher bitrates, triple play

# DSL: Triple Play Scenario (example)

## Service portfolio example

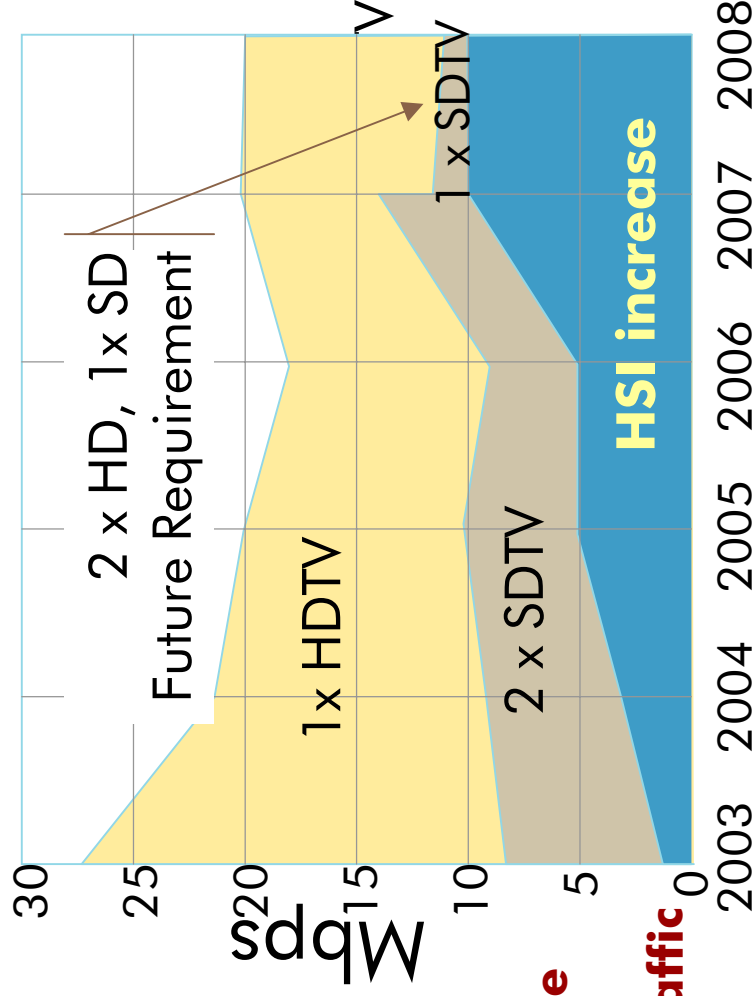
	Downstream	Upstream
1 HDTV, 2 SDTV simultaneously among 200+ channels	16 Mb/s	50 Kb/s
1 Gaming channel	256 Kb/s	256 Kb/s
2 Voice calls & Visio	220 Kb/s	220 Kb/s
High Speed Internet	3 Mb/s	512 Kb/s
<b>Total</b>	<b>20 Mb/s</b>	<b>1 Mb/s</b>

## Increasing service offering over time

- SDTV → HDTV
- Personal content → upstream traffic
- Added services (Remote meter reading, home security, distance learning ...)

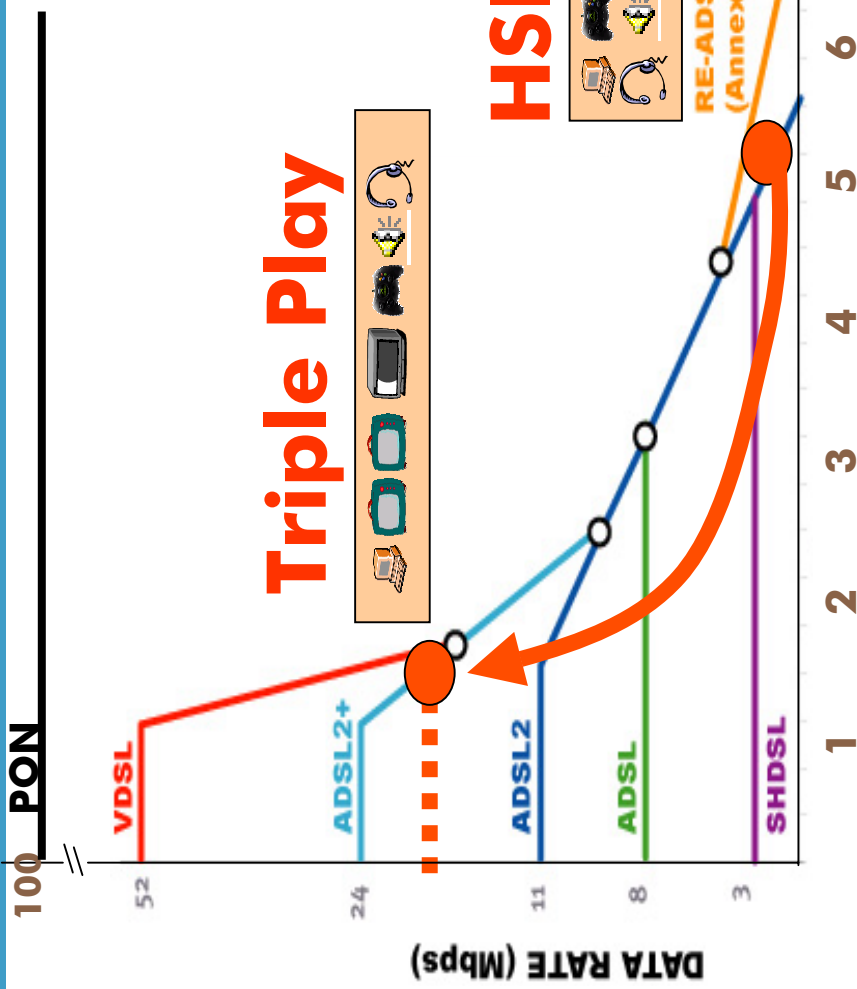
target 2007: 20 Mbit/s

## Simulation for access bandwidth evolution





# Loop lengths & new services impose Deep Fiber



Current deployment is optimized for HSI

- up to 1.5 Mbps; > 5 km
- ADSL or SHDSL

Triple Play impacts network architecture

- Bandwidth ~15-25 Mbps
- Requires VDSL, ADSL2+ bonded or FTTH

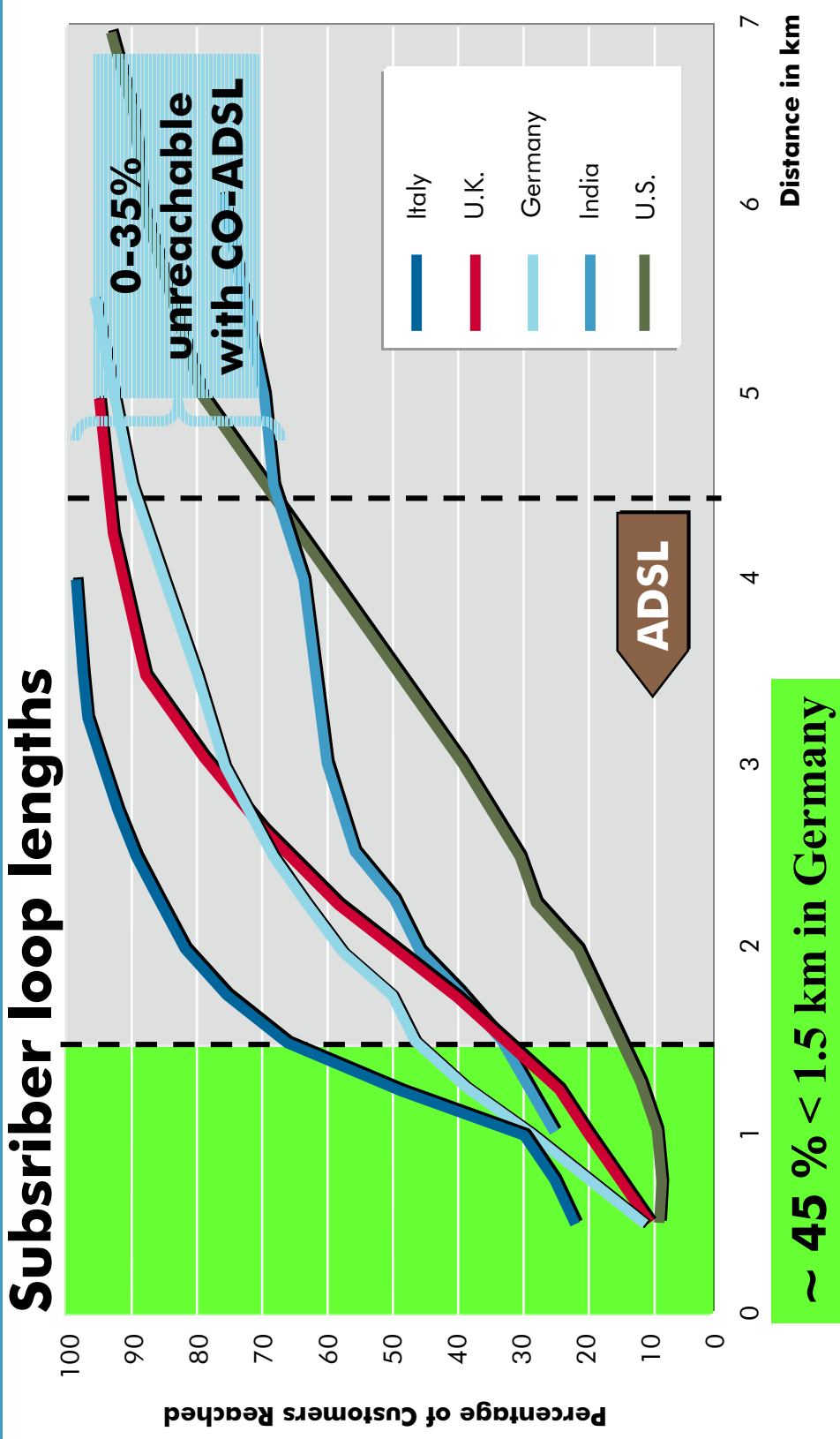
**fiber needed in the network for full coverage**

**% subs from CO**  
**- West. Europe 18%**

**LOOP LENGTH (km)**  
**56%    78%    74%**



# DSL: Subscriber Loop Lengths in various Countries



# Fiber in the Loop: current situation

FTTH has been proposed and discussed since the late 80ies, but until recently has never been deployed on a larger scale

Presently **general conditions are changing**:

- **increasing bandwidth** required (new applications, **bidirectional video**)
- increasing competition : DSL vs. TV-cable (USA)/ DSL vs. DSL (Japan)
  - US: 68% cable, 31% DSL
- regulation (and policies)
- aggressive cost reduction of optical components

Activities about FTTH are increasingly observed worldwide

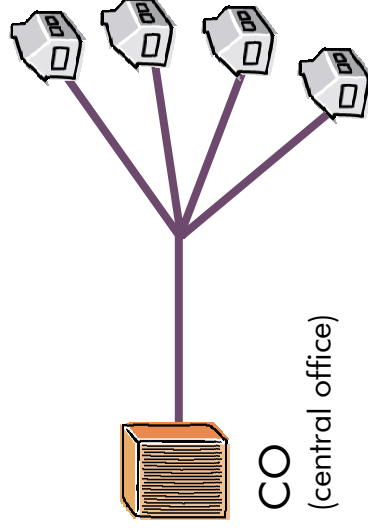
# FTTH solutions

FTTH = FTTU = FTTP = .... (Fibre-to-the-home / -user / -premises ...)

FTTH networks must provide „triple play“ services (data / voice / video)

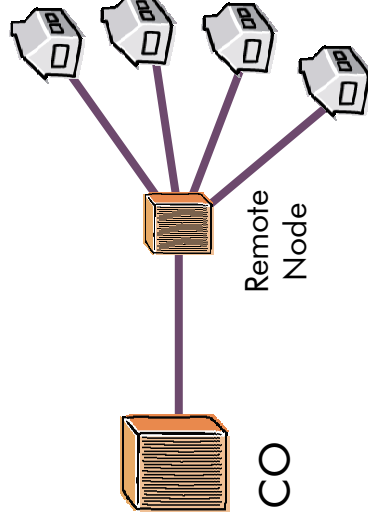
## PON

passive star



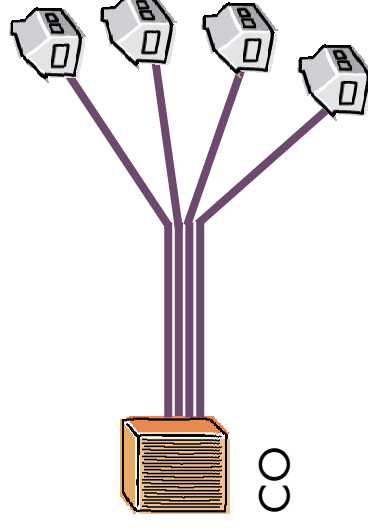
## ,Optical' Ethernet

active star



## ,Optical' Ethernet

point-to-point



**fiber aggregation needed**

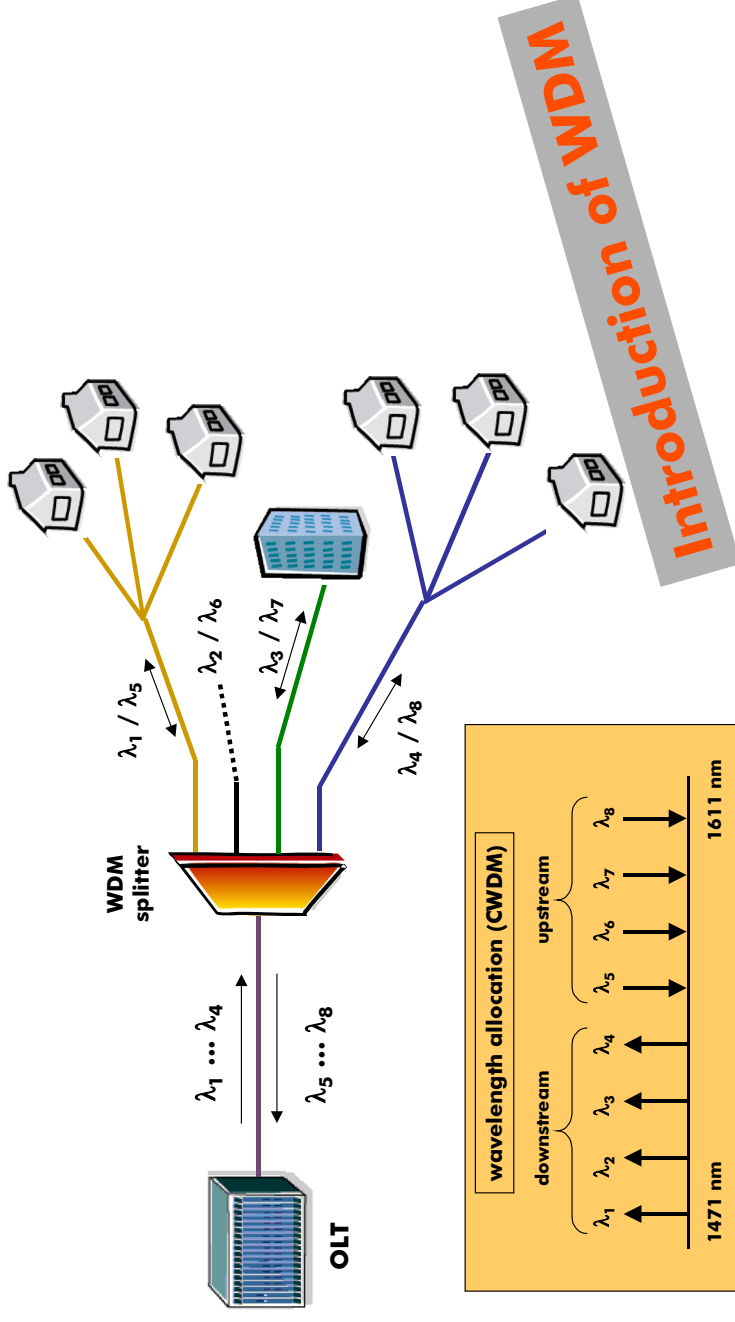
(average 10.000 subscr. per CO)

PON : Passive Optical Network

# PON Performance

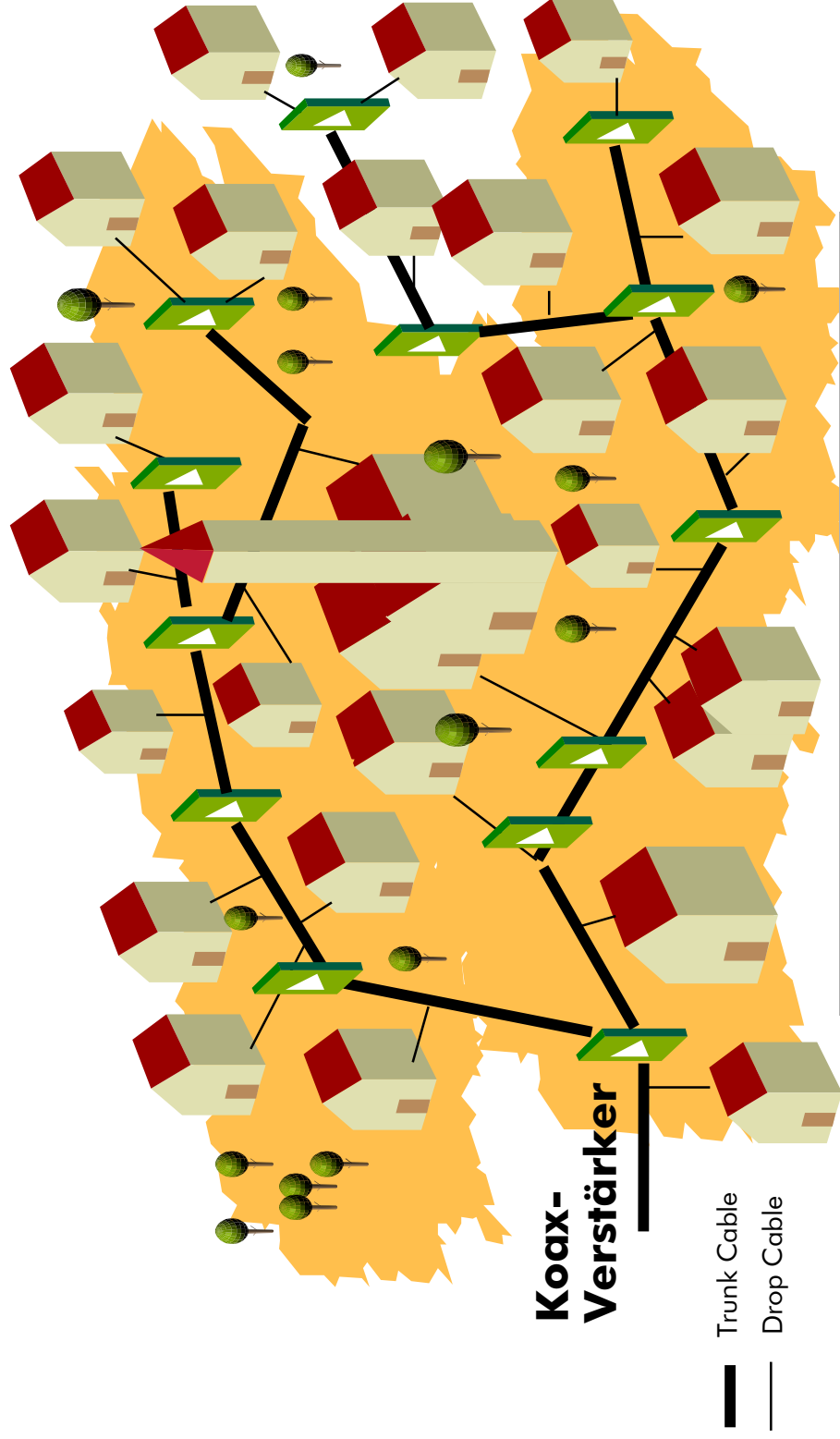
	ITU-T BPON	ITU-T GPON	IEEE EPON
<b>Data rate (Mbit/s)</b>	down: 1244, 622, 155 up: 622, 155	down: 2488, 1244 up: 2488, 1244, 622, 155	down: 1250 up: 1250
<b>Line coding</b>	NRZ (+ scrambling)	NRZ (+ scrambling)	8b/10b
<b>Minimum split (on TC layer)</b>	32	64	16
<b>Maximum split (on TC layer)</b>	64	128	not specified
<b>Maximum logical reach supported by TC layer</b>	20 km	60 km (with 20 km differential between ONTs)	10 km, 20 km
<b>Layer 2 protocols</b>	ATM	Ethernet, TDM over GEM (GPON Encapsulation Mode), ATM	Ethernet
<b>Standards documents</b>	ITU-T G.983 series	ITU-T G.984 series	IEEE 802.3ah
<b>TDM support</b>	TDM over ATM	native TDM, TDM over ATM, TDM over Packet	TDM over Packet
<b>Typical downstream capacity (for IP data throughput)</b>	520 Mbit/s (for 622 Mbit/s line rate)	1170 Mbit/s (for 1.244 Gbit/s symmetrical)	910 Mbit/s
<b>Typical upstream capacity (for IP data throughput)</b>	500 Mbit/s (for 622 Mbit/s symmetrical)	1160 Mbit/s (for 1.244 Gbit/s symmetrical)	760-860 Mbit/s
<b>OAM</b>	PLOAM + OMCI	PLOAM + OMCI	Ethernet OAM (+ optional SNMP)
<b>Downstream security</b>	“Churning” or AES	AES (counter mode)	not defined

# PON Evolution towards WDM



- High speed PONs: 10 Gbit/s per wavelength. DL and UL
- Capacity enhancement through WDM
- Service specific wavelengths/overlays, service ,decoupling', unbundling

# CoTV Access Area (conventional: broadcast only)



**unidirectional, shared medium**

# Upgrade of Cable TV Networks

Improved usage of CaTV networks through upgrades

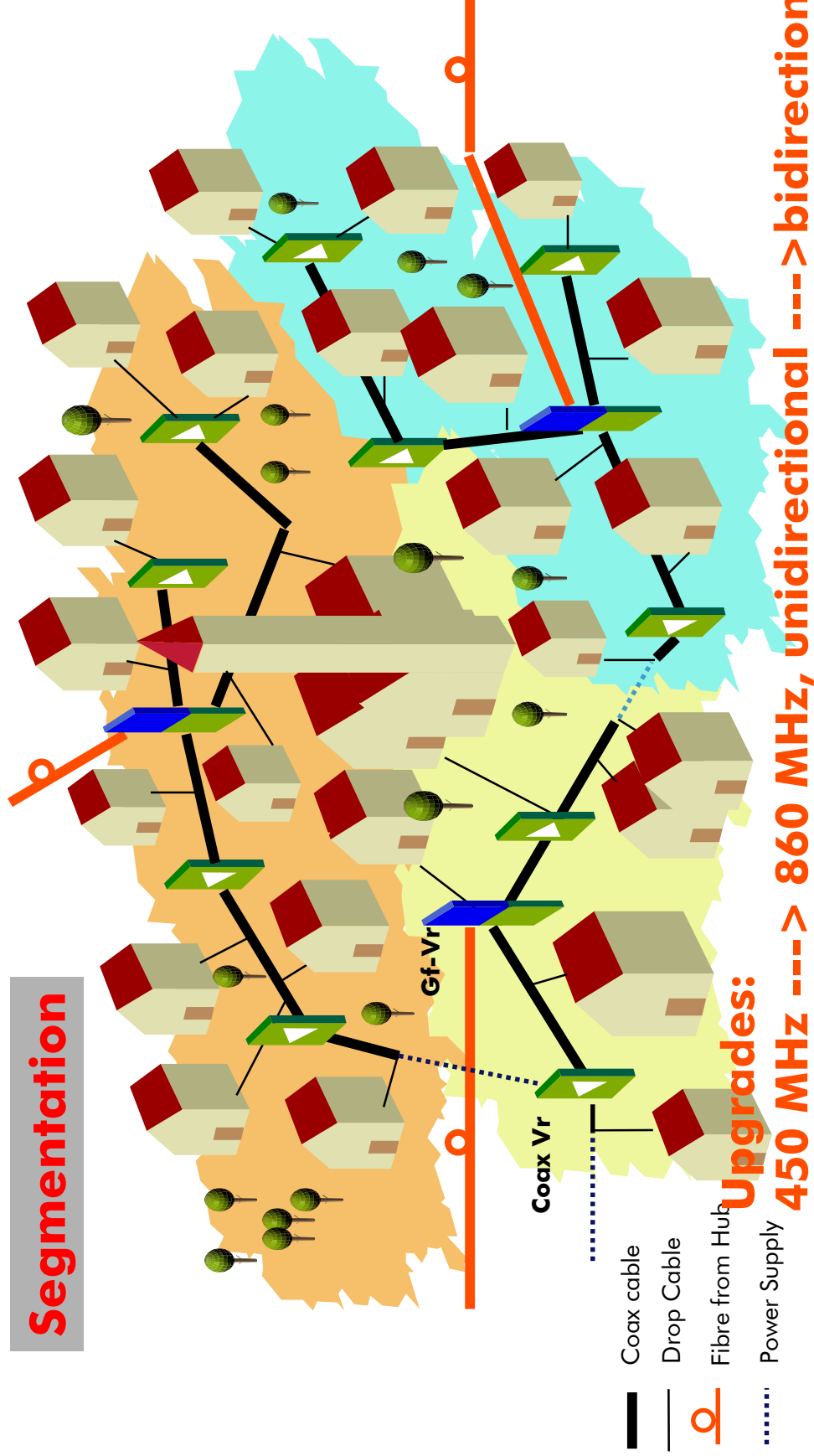
- Completion of **digitization**: ~ **factor 10** channel increase
- From unidirectional to **bidirectional**: additional interactive services
  - high speed **Internet access**
  - **VoIP**
  - **interactive** video
- Upgrade to HFC (Hybrid Fiber Coax) and segmentation: bitrate, bidirectional

**high investments needed**

- **Key issue in Germany**
  - separate ownership of NE3 and NE4
  - solutions
    - partnership between NE3 and NE4 owners
    - wireless (WiMAX) bypass of NE4
    - NE4 operators partnering with ...



# Access Area **after** Network Upgrade



# Wireless Access: WiMAX Promotion

Previous fixed wireless solutions failed commercially in the past

## Why believing in WiMAX

- Non Line of Sight (**NLOS**) capability (2-11 GHz)
- Standardized solution (**IEEE802.16e**)
- Standardized WiMAX Certified™ solutions will result in **mass volume CPE** deployment **bringing cost down** with strong component supplier back-up
- **Intel**: WiMAX interface in **Centrino** ( $\geq 2007$ )
- evolution from fixed access towards nomadicity, **portability**, mobility

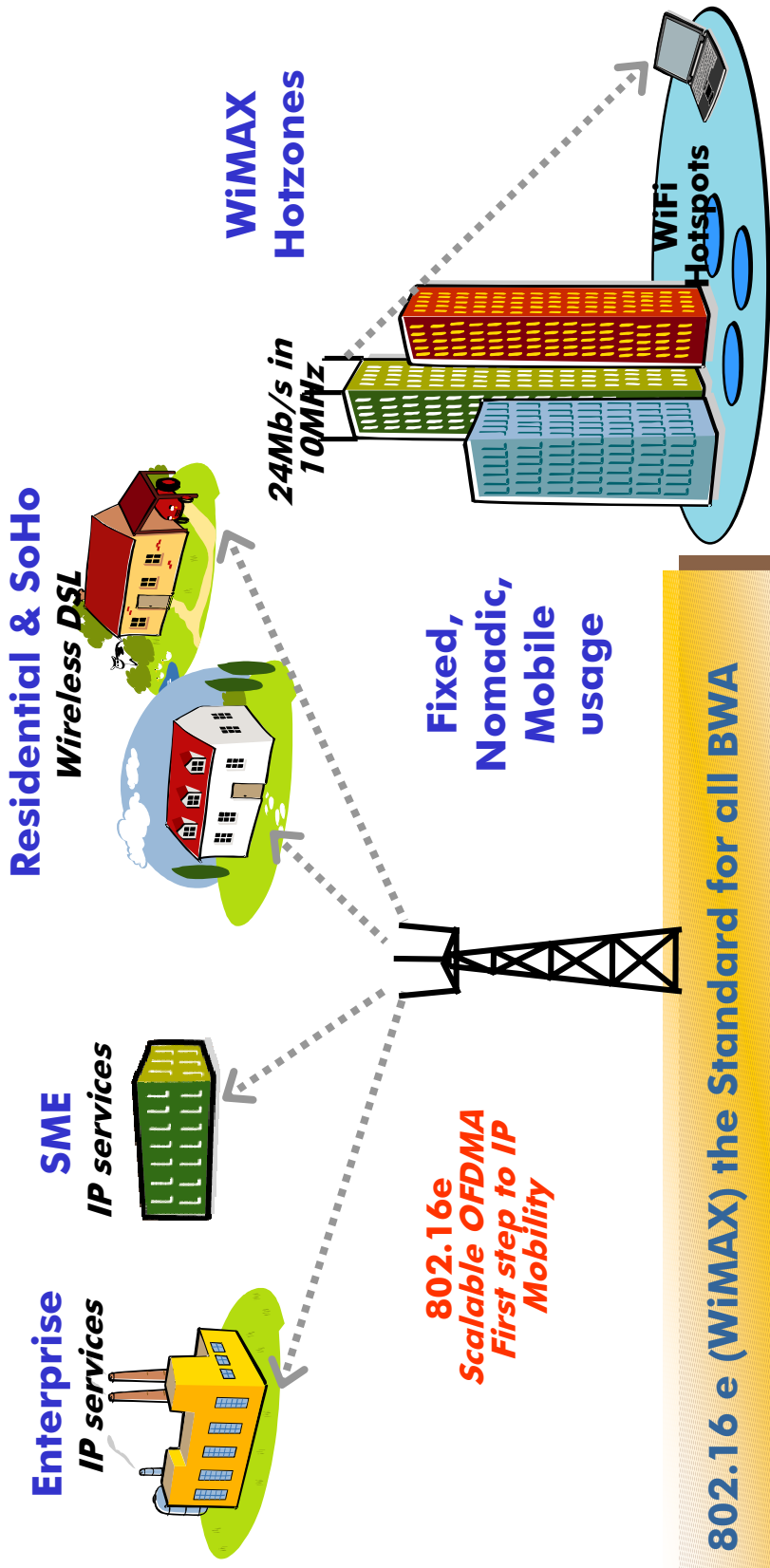
**WiMAX interface in each CPE !?**

# Where is WiMAX ?

## Complementary access solutions for different mobility and nomadic needs



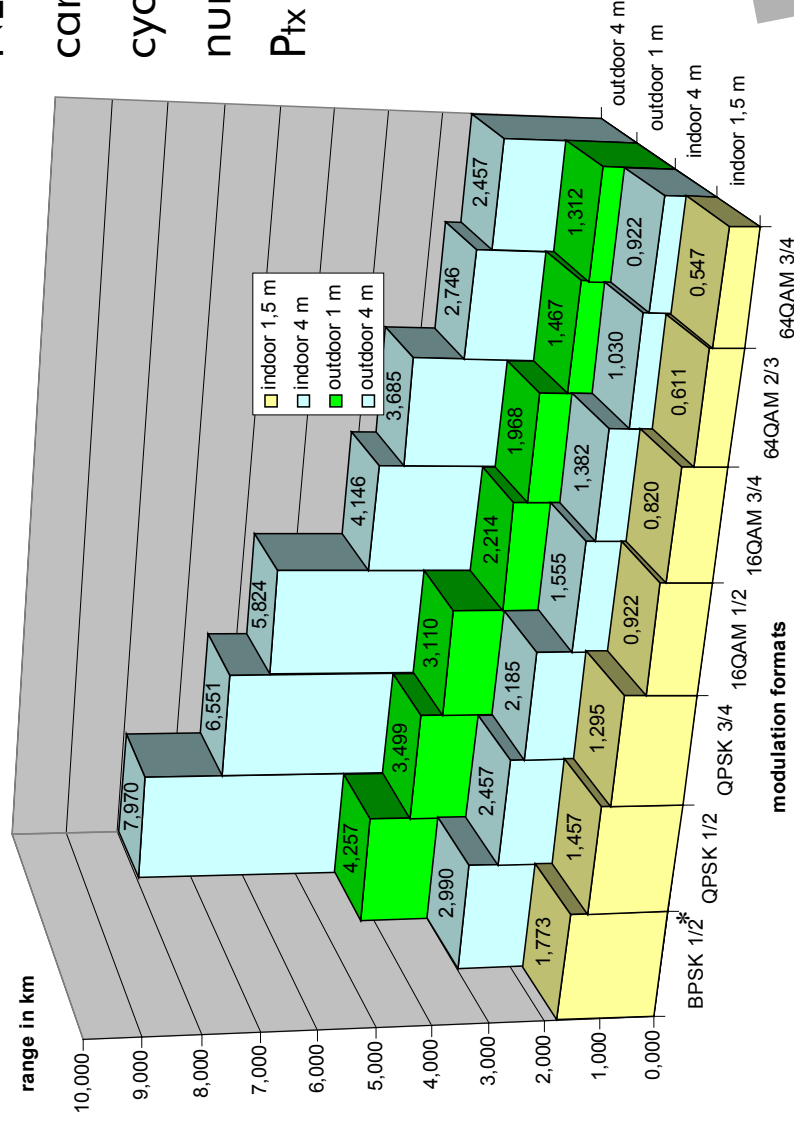
# WiMAX Applications



# WiMAX: Achievable Ranges

Example: rural scenario, AAS 4 elements, 3,5 MHz Bandwidth

Rural, 3,5 MHz Bandwidth



~11,5 Mbit/s  
TDD/DL+UL

**capacity and distance depending on ....**

NLOS environment  
 carrier frequency = 3,5 GHz  
 cyclic prefix = 1/4  
 number of subchannels in UL = 4  
 $P_{tx} = 35 \text{ dBm (BS)}$

\*for preambles/pilotes



# WiMAX: Addressable Customers/Market Segments

- **fixed operators:** white zones DSL, provision of nomadcity, portability
- **mobile operators:** 3G complement (low cost data@high speed in hot spots/zones)
- **CLECS:** low cost high speed data access incl. portability
- **VoIP in developing countries**
- **Cable operators:** multi access: cable + WiMAX, e.g. KDG in Germany

**WiMAX enabling new business**

# Summary

- BB access in ~17 % HH in Germany, thereof **98% DSL**
- **20 Mbit/s DSL** scenario:  
■ **Fibre** installation (FTTC) needed (for > 60% )
- ~ 60% HH (22,6 Mio) could get interactive BB via upgraded **CaTV** network
- CaTV issue in Germany: ownership of NE3/NE4 (WiMAX could solve it through bypassing NE4)
- **WiMAX** will be key enabler for
  - economic broadband access in rural areas (,digital divide‘)
  - increased bitrates in hotspots and hotzones (in mobile and fixed networks)
  - economic support of nomadicity, portability, mobility (user requirement)
  - business opportunity for fixed network operators (HO regulation issue )
  - growing competition through new operators and ,alternative access‘

B R O A D E N Y O U R L I F E

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