

ITU Regional Workshop on IMT

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Microwave Spectrum Strategy for IMT 2000

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Content

- The Challenge of Mobile Backhaul
- The Microwave Solution in High Frequency Bands
- Adaptive Modulation
- Success Stories in N and P Rain Areas
- Conclusions and Future

Evolution in Mobile Technology

GSM/GPRS → 3G/HSxPA → LTE

Voice/SMS
~9.6kbps



Mobile narrow
band Internet
14.4 ~ 64kbps



Low-QoS MMS
64 ~ 144kbps



Support fewer
data users



2G

2.5G/
2.75G

3G

3G
HSxPA

LTE



Smartphones
Tablets
Netbooks



Digital life
M-health
M-banking

Voice → Voice + Data

9~240kbps

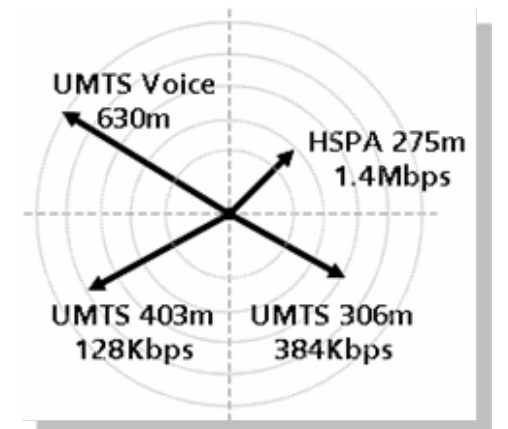
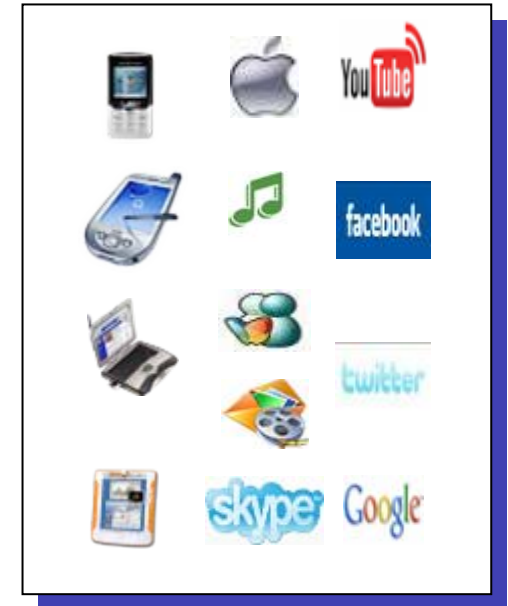
128~384kbps

1.8~14.4Mbps

+100Mbps

Multiplication Effect on Backhaul

- Higher data rates to the End User (Smartphones, Tablets and Netbooks)
 - ➔ Backhaul capacity 10x increase
- Shorter Cell Radius to support those data rates
 - ➔ Number of sites to backhaul 2x..4x



Realities and Challenges in Vietnam

- Frequency spectrum is non-renewable
- Seamless coverage of GSM in major cities, BTS of many operators to share frequency bands in same region (mainly 7GHz / 15GHz)
- Very limited spectrum resource for 3G NodeB in Urban Area

Solution

- A. Allocating new frequency band license**
- B. Simplifying application process for MW links**



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The Microwave Toolbox

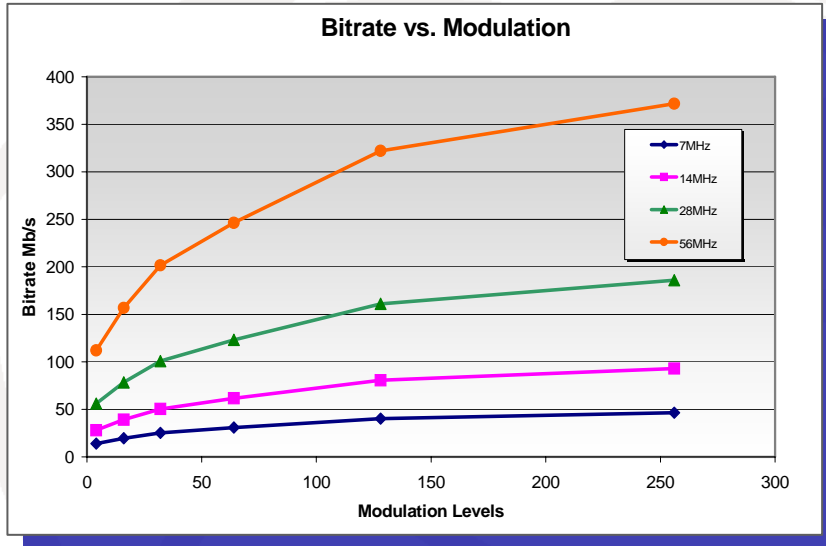
- Higher modulation schemes
 - ➔ Currently 256 QAM is state of the art
- Differentiate services by value
 - ➔ Use Adaptive Modulation to reach top speed at affordable price
- Use higher frequency bands
 - ➔ More spectrum and more channels per band

High Frequency Bands

	23GHz	26/28GHz	32GHz	38GHz	
Standards	ITU-R F.637	ITU-R F.748	ITU-R F.1250	ITU-R F.749	
Frequency Range (MHz)	21.2-23.6	26,450 ~ 26,500	31,800 ~ 33,100	36,000 ~ 40,500	
Tx/Rx Spacing (MHz)	1008/1200/1232	800 / 1008	812	700 / 1260	
Available Channel Bandwidth (MHz)	3.5, 7, 14, 28, 56	3.5, 7, 14, 28, 56	3.5, 7, 14, 28, 56	3.5, 7, 14, 28, 56	
	3.5MHz Channels	168	256	216	320
	7MHz Channels	83	128	108	160
	14MHz Channels	41	64	54	80
	28MHz Channels	20	32	27	40
	56MHz channels	9	16	12	20
Typical Transmission Distance	within 3~5 km	within 3~5 km	within 2~3 km	within 1~2 km	
Typical Application	BTS / Node B backhaul	BTS / NodeB Backhaul, Aggregation Link	BTS / NodeB Backhaul for Short Distance	BTS / NodeB Backhaul link in sight	
Resistance to Rain	Relatively Weak	Relatively Weak	Weak	Very Weak	

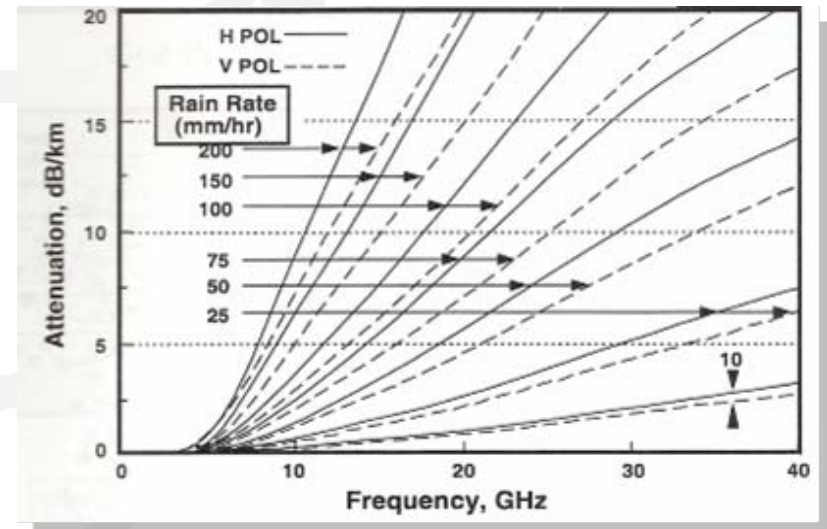
The frequency bands above 23GHz have
more available channels

Things to Keep in Mind



- There is a limit to what can be gained with higher modulations
- More spectrum is still necessary

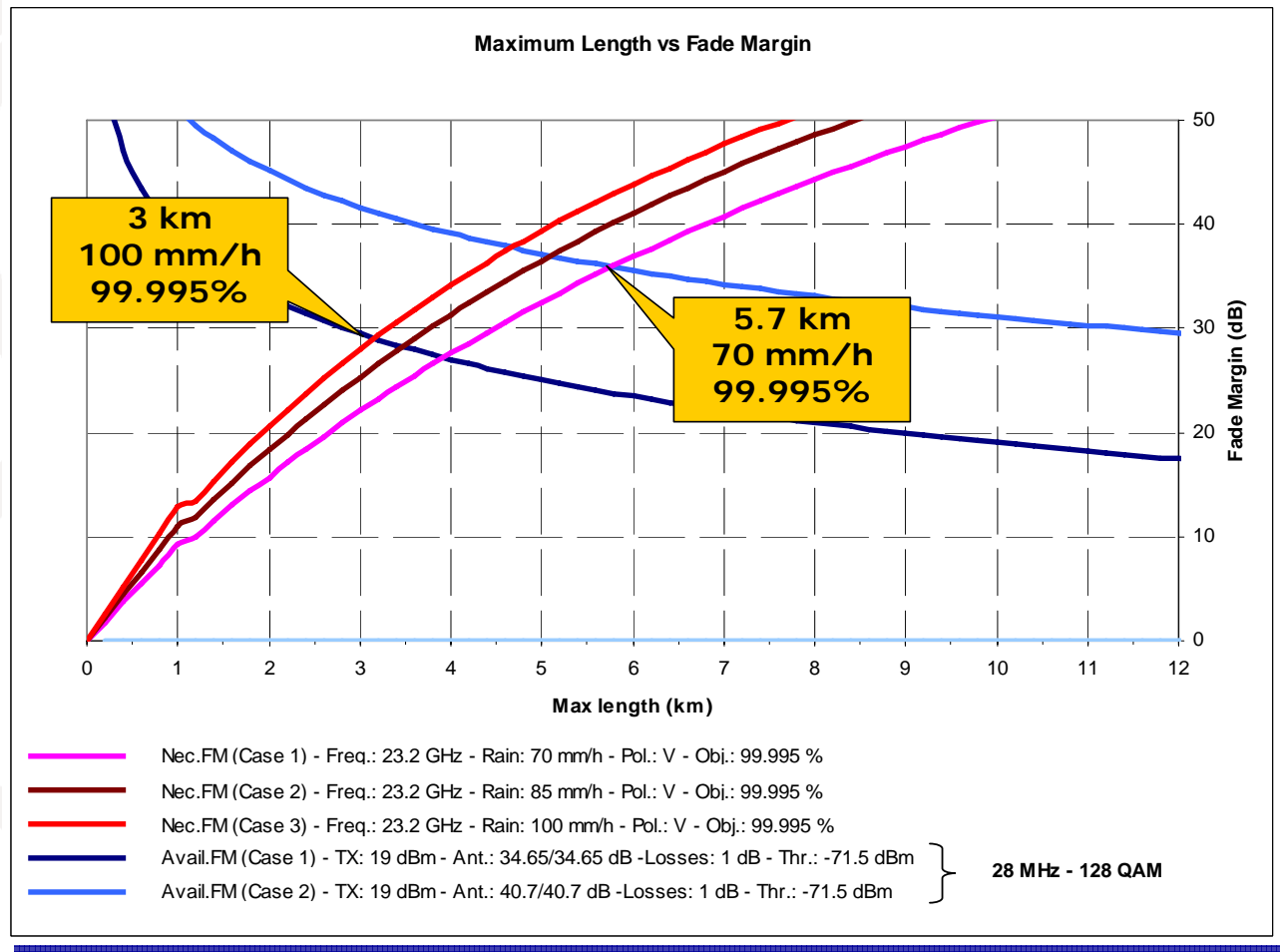
- At higher frequencies, rain attenuation limits the feasible link length
- Adaptive modulation allows parsimonious engineering



The New ITU Rain Map

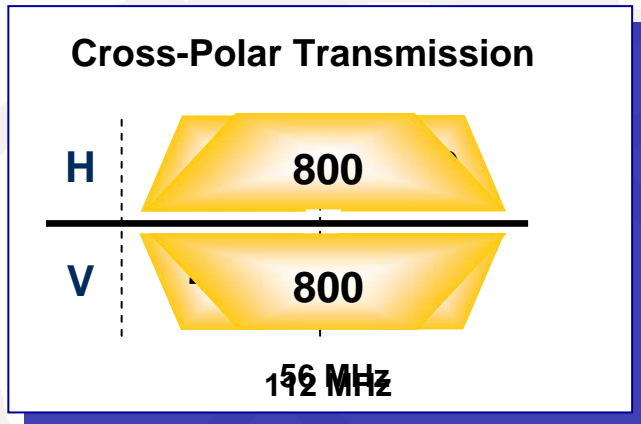


Operating Range at 23 GHz



The high frequency bands meet the requirements of
urban applications

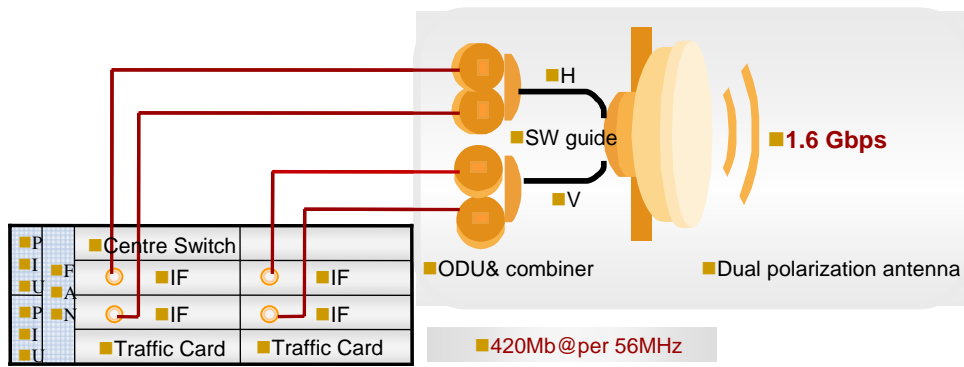
High Modulation + Channel Bundling



Parallel Links for added Capacity:

- High throughput of up to **800 Mbit/s on a single carrier** with XPIC and **1.6 Gbit/s on two carriers on one antenna**
- Radio LAG for load balancing of data services
- Satisfies Regulators' request for spectral efficiency

Beyond the Gbit/s Barrier in Traditional Bands



■ **Combine AM and frequency re-use with XPIC**

■ **Go for 112 MHz (i.e. 42 GHz)**

Note: 112 MHz not standardized yet

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3G Data: Differentiated Value

3GPP Traffic Type	PHB	DSCP	Queue No.	802.1p Priority	RNC	Node B	
Common Channels, SRB	EF	B'101110	0	5	PQ scheduling	PQ scheduling	
Telephony	EF						
R99 Conversational	AF4	B'100110	1	4			
R99 Streaming	AF3	B'011110	2	3	WRR scheduling		PQ scheduling
R99 Interactive	AF2	B'010010	3	2			
R99 Background	AF1	B'001010	4	1			
HSPA Streaming	AF3	B'011110	2	3			
HSPA Interactive, HSPA Background	BE	B'000000	5	0			

Note: The mapping is configurable by operators.

Adaptive Modulation Gain

Channel Bandwidth	Modulation Level	Km	Availability	Unavailability min / year	Mbit/s	Time Spent in this mode / year	Equivalent Capacity
7MHz	QPSK	4,7	99,995%	24	11	28	43,995
	16 QAM		99,990%	53	21	19	
	32 QAM		99,986%	72	25	31	
	64 QAM		99,980%	103	32	28	
	128 QAM		99,975%	131	38	86	
	256 QAM		99,959%	217	44	525359	
14MHz	QPSK	4,7	99,995%	29	21	38	89,99
	16 QAM		99,987%	67	42	25	
	32 QAM		99,983%	91	51	39	
	64 QAM		99,975%	131	66	37	
	128 QAM		99,968%	168	78	118	
	256 QAM		99,946%	285	90	525286	
28MHz	QPSK	4,3	99,995%	28	42	39	182,97
	16 QAM		99,987%	67	84	27	
	32 QAM		99,982%	94	109	44	
	64 QAM		99,974%	138	133	42	
	128 QAM		99,966%	179	158	139	
	256 QAM		99,940%	318	183	525254	
56MHz	QPSK	4	99,995%	28	84	43	362,93
	16 QAM		99,986%	71	168	30	
	32 QAM		99,981%	101	209	50	
	64 QAM		99,971%	152	265	49	
	128 QAM		99,962%	201	343	174	
	256 QAM		99,929%	375	363	525196	

Link data: 23 GHz, 0.3 m Antenna, 100 mm/h Rain Intensity, H Pol.

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23GHz Links for 3G in Philippines

Background

- The second biggest operator in Philippines
- **23G** frequency bands are used in Luzon
- Philippines is in N rain area (Same as Vietnam)

Challenges

- Limited frequency resource
- Heavy rain, serious impact to microwave links
- Network planning and deployment

Huawei solution

- Careful link engineering
- Most of the antennas are **0.3m**;
- The capacity can be up to **75*E1**



23GHz Links for Oi Brasil

Background

- Oi is one of the largest mobile operator in Brazil
- High frequency band for microwave frequency panning
- **Brazil is in N and P rain area (planning according to P area)**

Huawei solution

- Supplied Microwave solutions at **23GHz**
- Most of the antennas were less than or equal to 0.6m
- The capacity was distributed from 4E1 to 63E1

Benefits for Oi Brasil

- Optimal cost/performance ratio of MW links
- Small antenna reduces site cost (also mast/tower cost)
- **99.999%** of annual availability guaranteed for all these links



The List Keeps Getting Longer



Indonesia

Frequency: 23GHz



Malaysia

Frequency: 23GHz, 26GHz



India

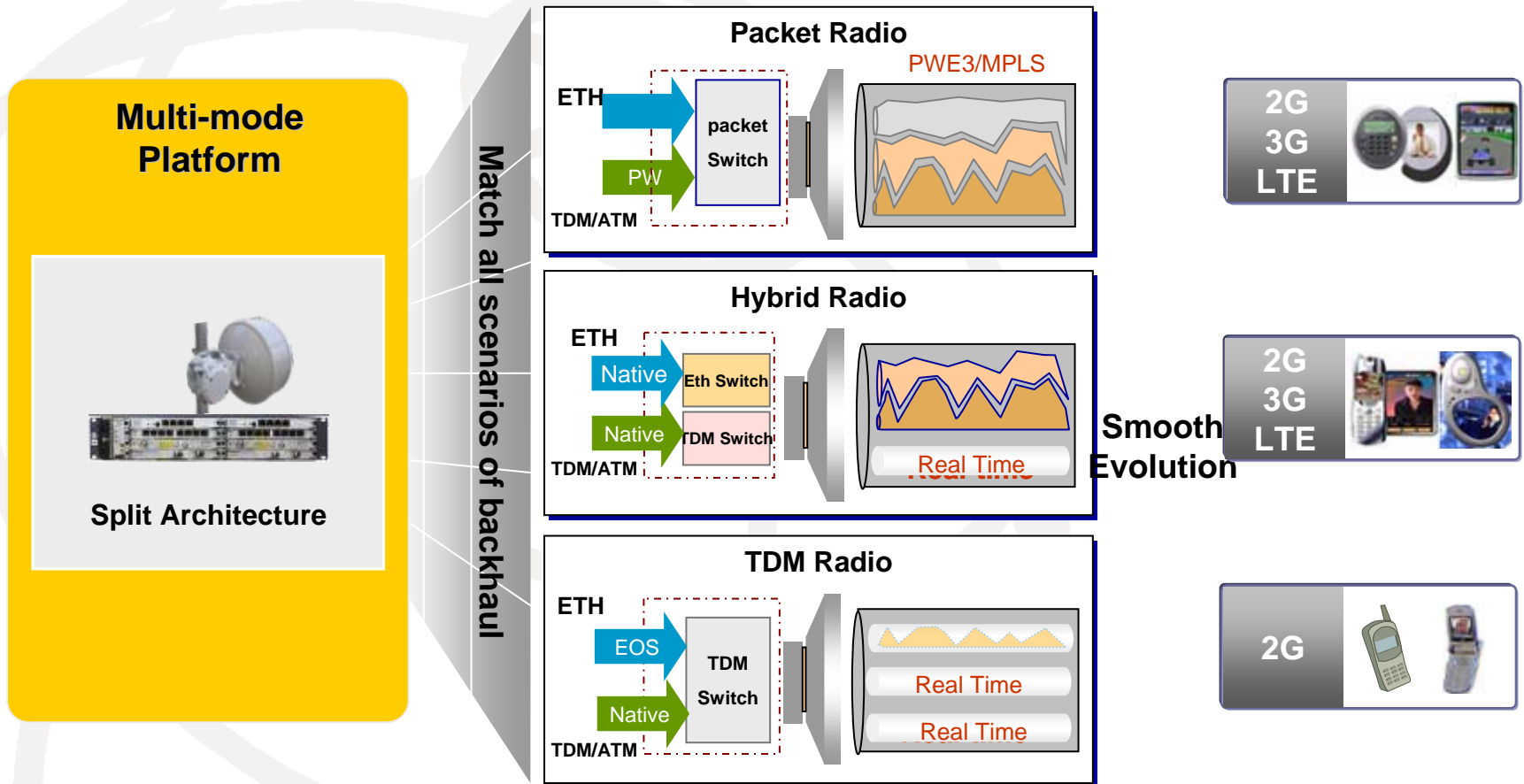
Frequency: 23GHz

- Huawei grew to Top 3 MW Vendors and #1 in IP Microwave
- Extensive experience and know how show that it is possible to reliably deploy High Frequency MW in N and P Rain Zones

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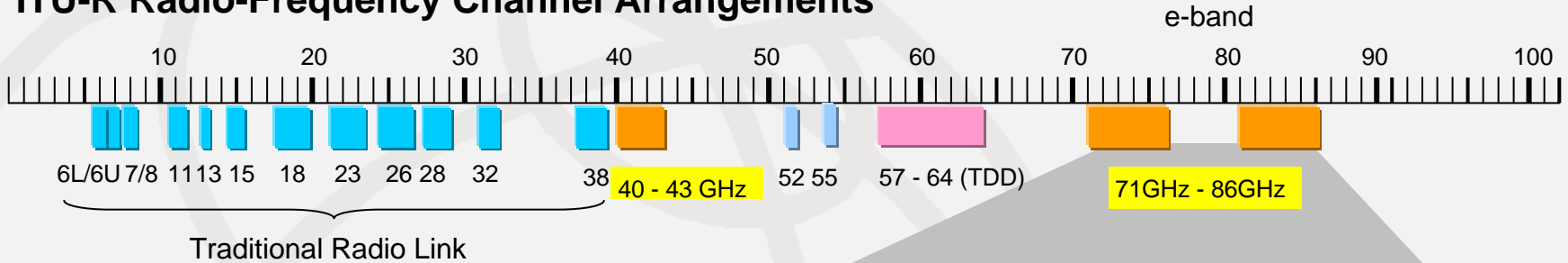
MW Platform Evolution to IP



- Universal solution for TDM, Hybrid and Pure Packet (PWE3/MPLS) in one box
- 256 QAM, Adaptive Modulation, XPIC, 1.6 Gbit/s in one box, scalable solution
- E-band and Fully Outdoor evolution foreseen when market is ready (LTE)

Beyond “Traditional” Bands...

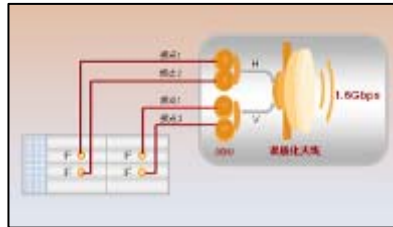
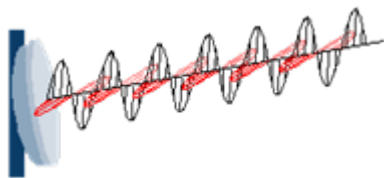
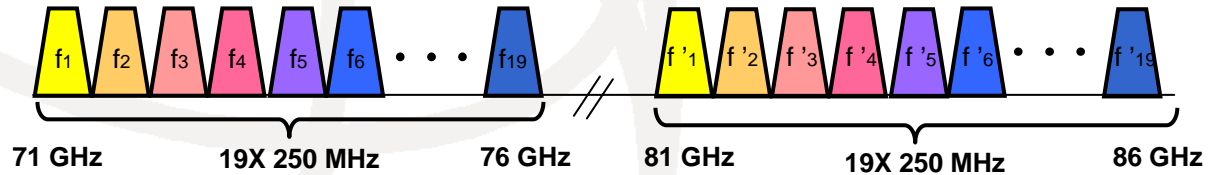
ITU-R Radio-Frequency Channel Arrangements



Very large spectrum available, 10 GHz in 19 channels 250 MHz wide

Channels can be bundled to provide more capacity

- 1x 250 MHz, 4QAM → approx. 400 Mbit/s
- 2x 250 MHz, 4QAM → approx. 800 Mbit/s
- 3x 250 MHz, 4QAM → approx. 1.2 Gbit/s



800M/1.6G capacity with 56MHz CS

Narrow beam width = less interference

Higher modulations are possible:

- 800 Mbit/s in 16 QAM per 250MHz channel
- 1200 Mbit/s in 64 QAM per 250MHz channel

3.2G capacity with 3 chs @ 64 QAM

Conclusions

- Mobile Backhaul requires huge capacity expansion
- High Frequency Bands are suitable to provide the required spectrum
- Modern Microwave can reliably and economically provide the solution

**Transforming ideas into
great potential.
Realize Your Potential**

Thank You!

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