



Tower Technology Summit

MICROWAVE BACKHAUL GAINING MOMENTUM



Sponsored By:



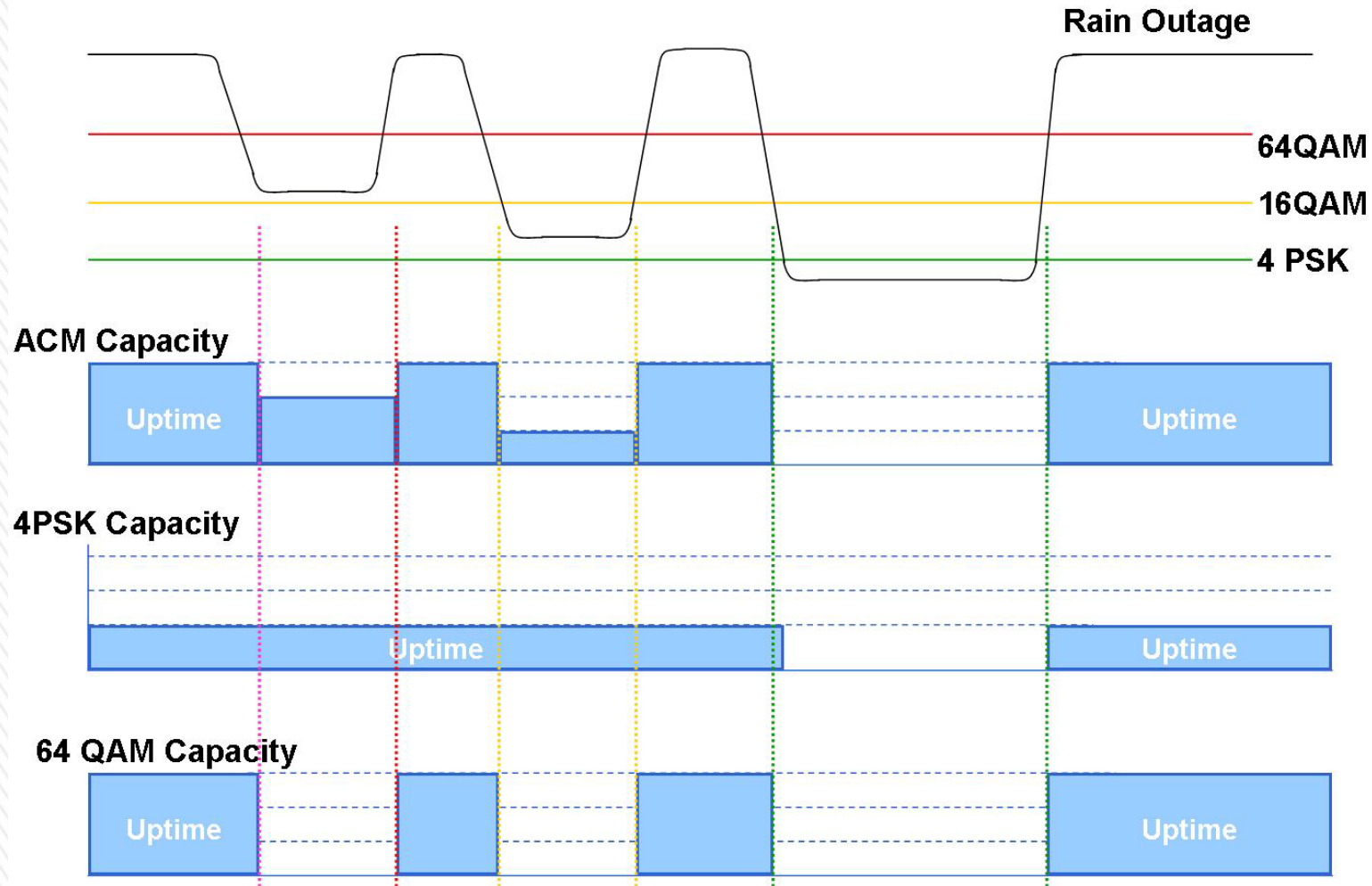
» Adaptive Modulation – remove bandwidth restrictions for temporary operation

- > Today: Must meet minimum bits/Hz in 101.141 for 6, 10, 11GHz
 - + 10MHz channel: 44.7Mbps
 - + 20MHz channel: 89.4Mbps
 - + 30MHz channel: 11GHz = 89.4 Mbps, 6GHz = 134.1Mbps
 - + 40MHz channel: 134.1Mbps
 - + 1bits/s/hertz for all other bands

» Remove Antenna Size Restrictions

- > Today:
 - + 6 GHz, 6ft
 - + 10 GHz, 2ft
 - + 18 GHz, 2ft
 - + 38 GHz, 1ft
 - + 80 GHz, 1ft
- + 7/8 GHz, 4ft federal band
- + 11 GHz, 2ft
- + 23 GHz, 1ft
- + 60 GHz, ISM Band (no restriction)

Adaptive Coding and Modulation (ACM) Overview

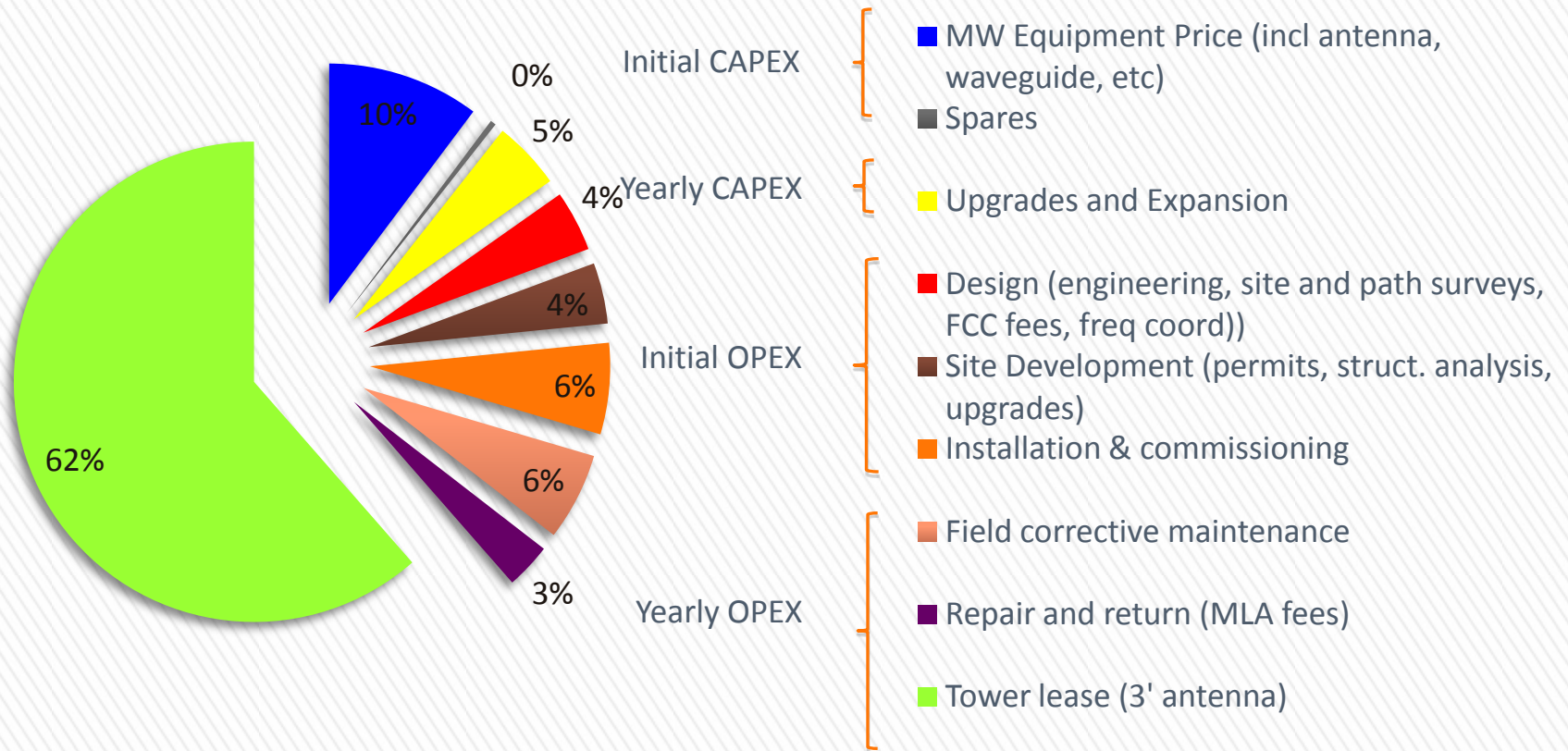


ACM Benefits

Parameter	Existing Link with Traffic Prioritization	Existing Link without Traffic Prioritization	New Link with Traffic Prioritization	New Link without Traffic Prioritization
Capacity	Increased	Same	Increased	Same
Reliability/Uptime	Increased	Increased	Increased	Increased
Distance	FIXED	FIXED	FIXED	FIXED
Antenna Size	FIXED	FIXED	Smaller*	Same
Frequency	FIXED	FIXED	Higher*	Same
* In many cases				
Benefit	Higher Capacity More Uptime	More Uptime	Higher Capacity More Uptime Lower Cost	More Uptime

MW TCO Summary

10 Year Microwave Total Customer Cost of Ownership



ACM Design Example

- Customer requirement:
 - 50Mbps, 99.999%, 10.15mi

ACM Benefits

- 213Mbps more throughput** for most of time
- Over **5x more** total data sent
- 29s** more uptime per year
- Smaller antenna = **\$4800 per year cost savings**

ACM Design, 18GHz, 2' Antenna

Link State	Uptime %	Uptime Secs	Capacity (Mbps)	Total Per Year (TB)
256QAM	99.5613%	523,294	263	1,032
64QAM	99.7784%	1,141	155	1.33
16QAM	99.9299%	796	100	0.60
QPSK	99.9995%	366	50	0.14
Out of Service		3	0	
Total		525,600		1,034

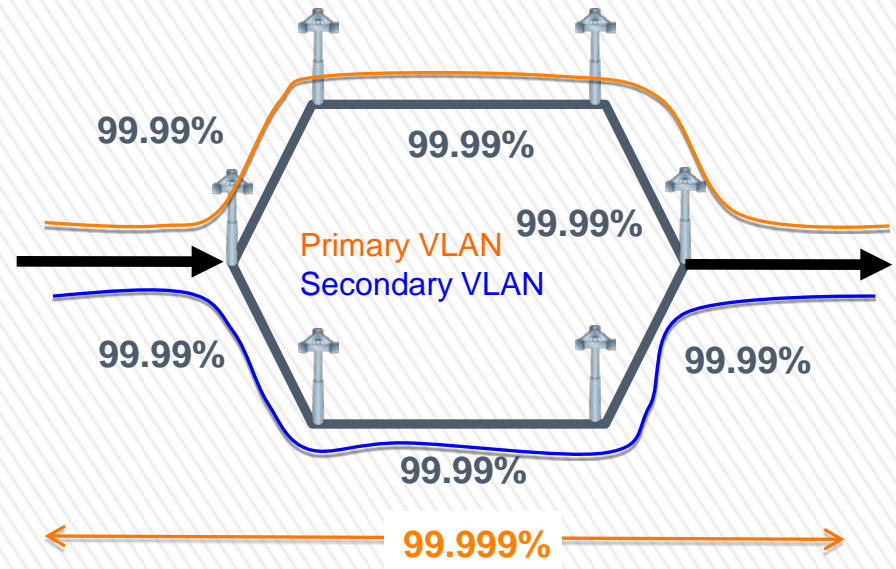
Fixed Modulation Design, 11GHz, 4' Antenna

Link State	Uptime %	Uptime Secs	Capacity (Mbps)	Total Per Year (TB)
64QAM	99.9994%	525,597	50	197
Out of Service		3	0	
Total		525,600		197

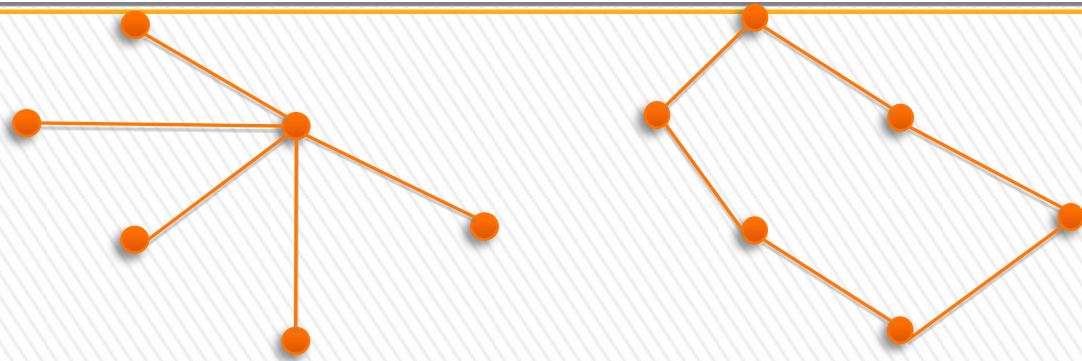
Diverse network topologies

Rings/mesh lower per hop availability requirements

- Smaller antennas
- Made possible with higher layer redundancy schemes



Network Design Example



	Hub – Spoke	Ring
Sites	6	6
Links	5 (1+1)	6
Antennas	10	12
Average Antenna Size	5.2	2.3
Reliability (per link)	99.999%	99.95% (average)
Capacity (per link)	50Mbps	200Mbps
CAPEX	\$176k	\$119k
Yearly Tower Lease	\$77k	\$48k
5 Year TCO	\$676k	\$478k