# Channel Model Ad Hoc

Face to Face

C h a n n e l   M o d e l   A d   H o c
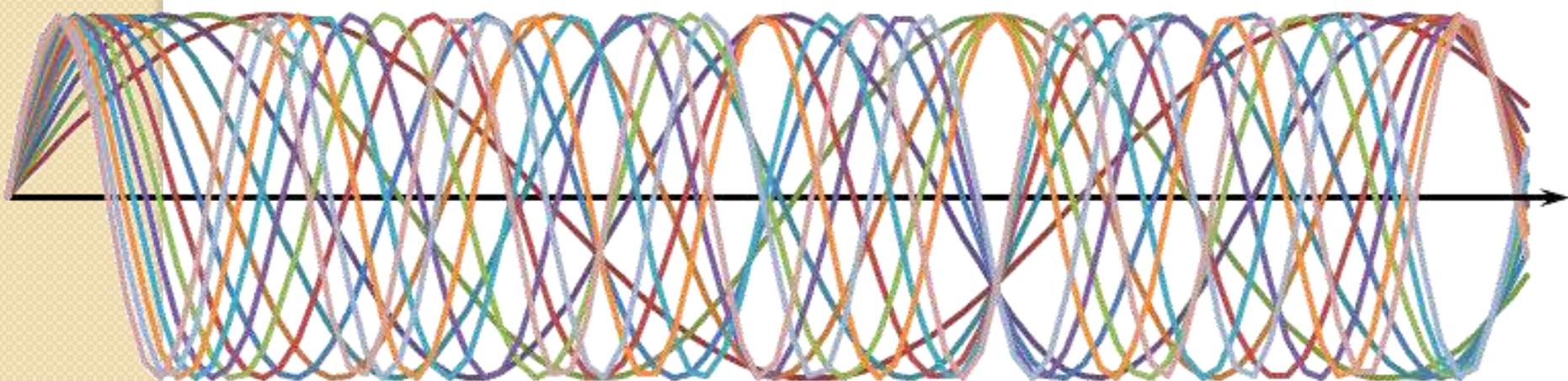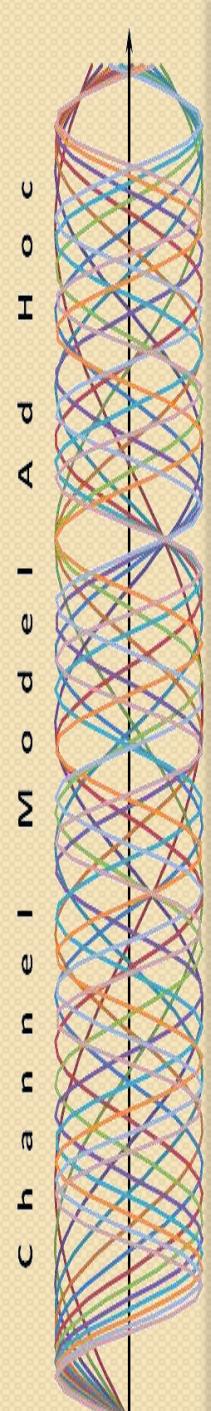
Agenda

- DS Channel model developed by an external group

- Channel model developed by the Ad Hoc

- Open Discussion / Straw Polls
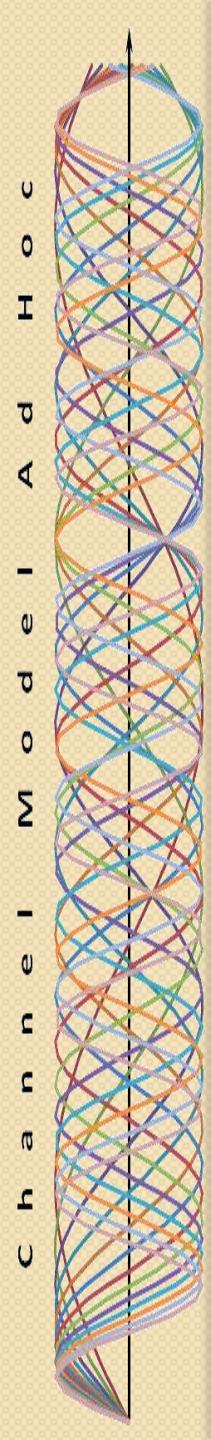
Parameter List (external group 1 of 7)

Scenarios

- HFC D/S Spectrum
  - *Example* 1.0 GHz
- Cascade Depth
  - *Example* N+3
- Channel Loading
  - *Example* 79 Analog + 53 Digital Optical
- Architecture
  - *Example* Linear Optics 1310 nm, nominal link length
- Home Architecture
  - *Example* Max Drop Length & 4-way Splitter

Parameter List (external group 2 of 7)

	Parameters	Notes
Spectrum	OFDM Bandwidth	
	Frequency range	
RF Level	OFDM Power at CPE Input (dBmv/MHz) (X +/- dB)	Tap Port Range + Drop Range + Home Architecture
Composite Carrier-to-Noise	CCN Ratio	AWGN + Aggregated Digital Distortion
	Variation Freq, 24 MHz BW	
	Variation Freq, 48 MHz BW	
	Variation Freq, 96 MHz BW	
	Variation Freq, 192 MHz BW	
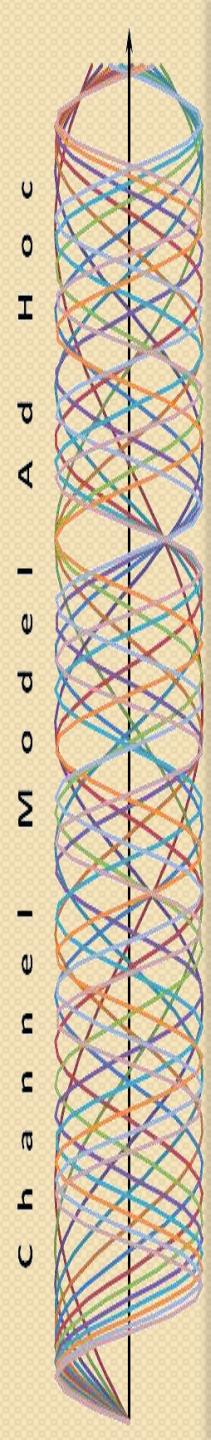
Parameter List (external group 3 of 7)

|	Parameters	Notes
Interference		
"Narrowband"	CTB Interference (Analog Ref + live video correction)	20 kHz BW, note that reference is typically to analog level
	CSO Interference (Analog Ref + live video correction)	20 kHz BW
	Additive Spurious interference (other) dBc/10 kHz, dBc/100 kHz, dBc/1 MHz, dBc/24 MHz (LTE case contained within)	
	Adjacent Channel (dBc, Overlap BW)	
Wideband	Burst noise (spectrum, duration, duty, dBc)	16 usec (32x4) protection observed
	Impulse noise (white, duration, duty, dBc)	Ref: SCTE-40, CL RFI, ReDesign, Meas
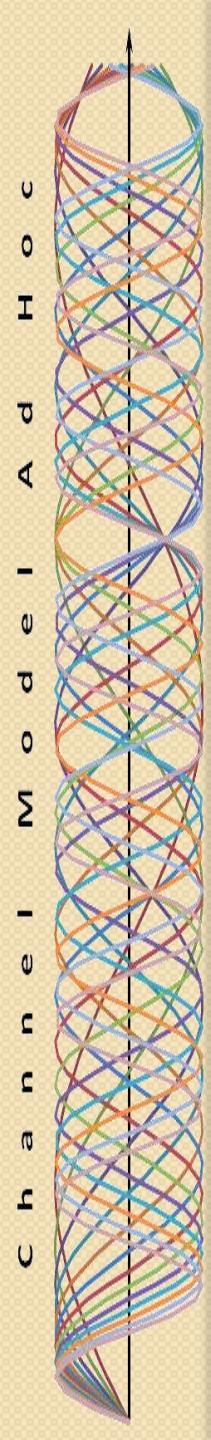
Parameter List (external group 4 of 7)

	Parameters	Notes
Freq Response		
	Amplitude Variation (dB pk-pk/4 MHz)	Include 2nd order component
	(dB pk-pk/24 MHz)	
Amplitude	(dB pk-pk/192 MHz)	
	(dB pk-pk/Total DS BW)	
	Amplitude Slope (dB/MHz, dB/kHz) in-channel peak slope	Brooks - max steepness/narrow BW
	Group Delay Variation (ns/MHz over 4 MHz)	Include 2nd order component
Phase	(ns/MHz over 24 MHz)	
	(ns/MHz over 192 MHz)	
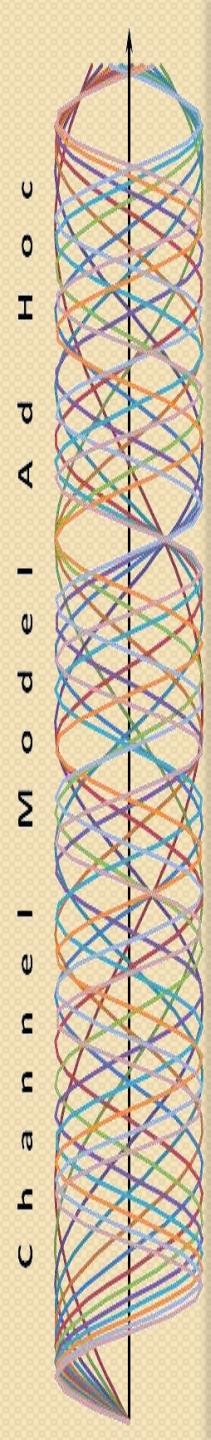
Parameter List (external group 5 of 7)

	Parameters	Notes
Echo	Echo Profile, Delay Spread (µs)	ampitude ripple implied
	10 dB	
	15 dB	
	20 dB	
	30 dB	
	35 dB	
	40 dB	
Sprectral Purity	Phase Noise Mask	Not "Channel" impairment
		To be defined in "DRFI" equivalent
		Reference Only

Parameter List (external group 6 of 7)

	Parameters	Notes
Other	Discrete SPM, dBc / 10 kHz,100 kHz, 1 MHz	
	AM/Carrier hum modulation	Add freq content of nx60Hz
	Implementation Loss	
	≤ 256-QAM	
	≤ 1024-QAM	
	≤ 4096-QAM	
	> 4096-QAM	
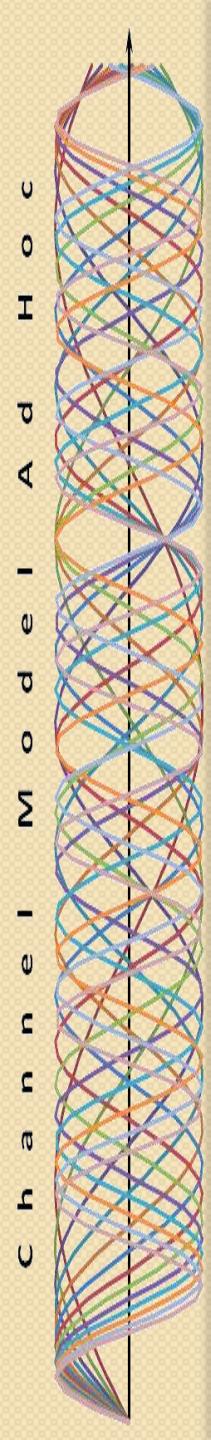
Parameter List (external group 7 of 7)

	Parameters	Notes
Unused	MER	Perhaps identify a Tx Fidelity reference value (i.e. 43 dB of DRFI)
	Transit delay to most distant customer	Not needed for PHY model. Don't want to lose visibility MAC team/MSO determine new assumption
	AM/PM (deg/dB for > 10 kHz AM)	TBD if needed
	Total Analog Power at CPE Input	Product Design - FE Overload
	Total RF Power at CPE Input	Product Design - FE Overload
	Maximum number of analog carriers	
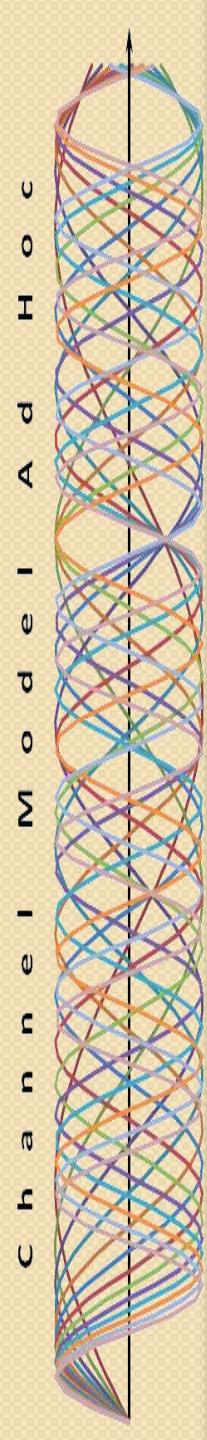
Parameter List (Ad Hoc developed)

| Channel Param	US	DS	Units	Notes
Noise Power Ratio				Parameters affected: QAM Level and dB/dB dynamic range
CCN				
Microreflections				Parameters affected: Cyclic Prefix duration, Subcarrier Bandwidth
≤ 0.5 μsec			dBc	sub-parameter limits tbd, 4 sub-parameters OK
<= 1.0 μsec			dBc	
<= 1.5 μsec			dBc	
> 1.5 μsec			dBc	
Group Delay Ripple				Parameters affected: Cyclic Prefix duration, Subcarrier Bandwidth Should be frequency dependent, 2-3 frequency ranges, relative to channel size
@ lower channel			ns/MHz	
@ center Channel			ns/MHz	
@ high Channel			ns/MHz	

Parameter List (Ad Hoc developed

2 of 3

Channel Param	US	DS	Units	Notes
Impulse Noise				Wide band, intermittent in time
duration			ns	exact sub-parameters/units tbd
amplitude			dBc	
periodicity			kHz(?)	
Burst Noise				Narrow band noise, intermittent in time
duration			ns	exact sub-parameters/units tbd
amplitude			dBc	
periodicity			kHz(?)	
frequency band			MHz	such as LTE
Sub-Carrier to Discrete Interference				Needs more detail, i.e. #sub-carriers < XdB CIR?
0dBc < SIR < 5dBc			%	exact number of sub-parameters tbd
5dBc < SIR < 10dBc			%	"
10dBc < SIR < 15dBc			%	"
15dBc < SIR < 20dBc			%	"
20dBc < SIR < 25dBc			%	"

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Slide   11

Parameter List (Ad Hoc developed 3 of 3

Channel Param	US	DS	Units	Notes
Amplitude Ripple			dB/MHz	Should subcarriers have different QAM? This parameter is likely be expanded into 3-4 entries
Carrier Hum Modulation			dBc	Defines short term variations due to active elements in the channel (e.g., amplifiers)
Transit Delay			us	Both upstream and downstream
Channel Loading (outside EPoC channel)				Multiple tables may need to be generated based on the specific topology.

Notes

Phase Noise limits are included in the transmitter and receiver specifications.
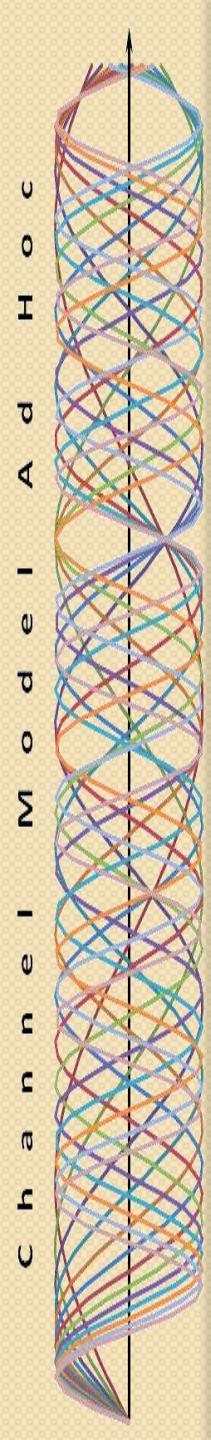
Straw Poll

The Channel model parameter list shown in slides 10-12 of remein_03_1112.pdf represent:

a fair starting point   __3__

a good starting point   __13__

a very good starting point   __3__

essentially complete   __0__
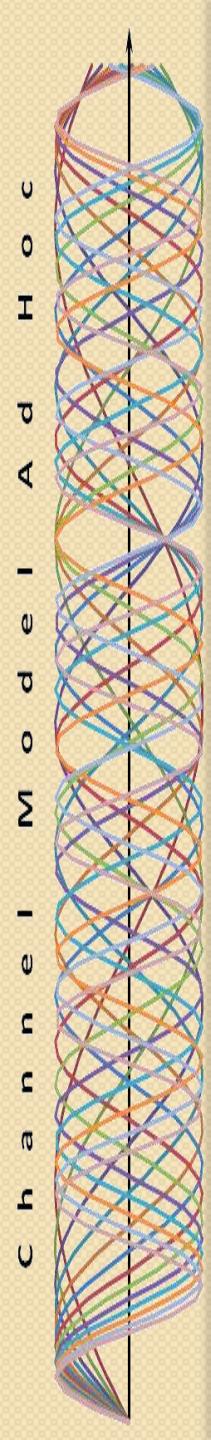
Plans

- Begin populating table

- Consolidate data from previous presentations
  - BHN,
  - QCN
  - COX
  - Hangzhou

- Consider several topologies (small set of <10)

THANK YOU

Channel Model Ad Hoc