

# **Category-6 / Class-E Cabling**

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# How were the ISO Cat-6 Targets set?

- ≡ Sept '97: TIA input to US TAG of SC25 WG3
- ≡ Sept '97: ISO sets many channel parameters
- ≡ Jan '98: ISO sets remaining channel parameters
- ≡ May '98: ISO reaffirms channel model

**TIA and CENELEC drafts are compatible with ISO draft**



# TIA input to US TAG for ISO on objectives for Cat-6 (Sept '97)

- ≡ At least **twice the usable bandwidth** of Category 5 channels (similar ACR at 200 MHz as Cat-5 at 100 MHz)
  
- ≡ Strict super-set of category 5
  - **Modular jack interface shall be maintained** at the work area
  - **Category 6 components must be mechanically and electrically backwards compatible.** If the components (i.e., plugs and outlets) are able to be mixed, the mated combination will at least meet the transmission requirements of the lower performing component.



# TIA Input to US TAG for ISO on Objectives for Cat-6 (Sept '97)

- ⌘ Next generation cabling shall be a system specification including procedures for laboratory and field testing, installation practices, and other practical considerations.
- ⌘ Next generation cabling shall meet the horizontal cabling topology (100 m) as specified in TIA-568A and TIA-569-A.
- ⌘ TIA will develop detailed technical requirements for connecting hardware transmission for next generation cabling, based on an applied statistical model, combined with known constraints on channel and cable requirements

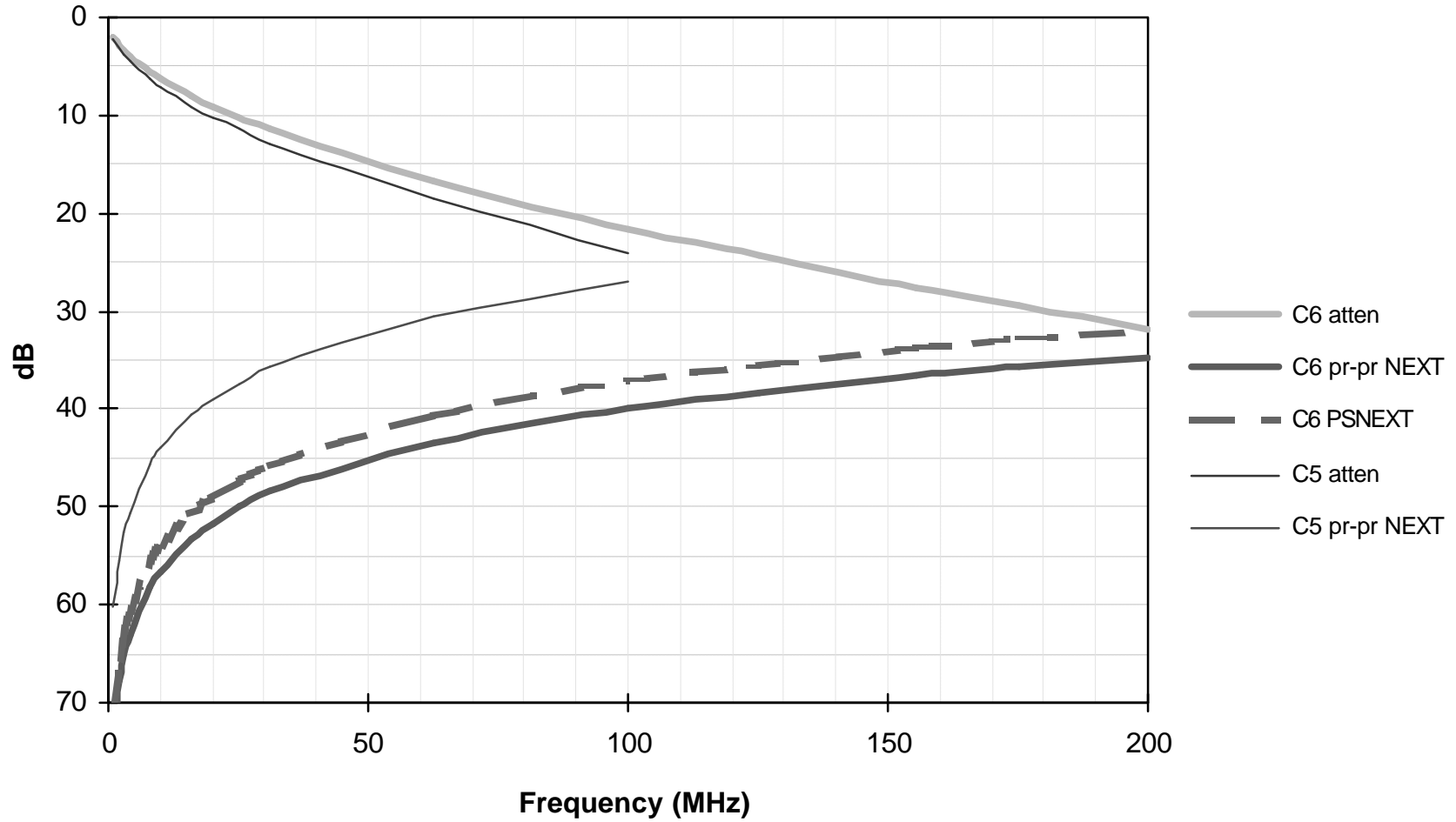


# Sept '97 Munich ISO Meeting: Sets Direction for Cat-6

- ⌘ Channel specs for attenuation, NEXT, PSNEXT set up to 200 MHz assuring double the channel bandwidth of Cat-5
- ⌘ Channel specs based on proposed component specs
- ⌘ Backward compatibility with Category-5 components required
- ⌘ Liaison letters on proposed channel specs sent to ATM Forum, IEEE, and IEC
- ⌘ Oktoberfest celebration starts the following week



### Draft Category-6 / Class-E Channel performance (Sept '97)



# Jan '98 ISO Meeting: Addresses Additional Parameters & Tweaks

- ⌘ Proposed component specs for attenuation altered slightly (lower loss cable & higher loss cords) to accommodate shielded cords while maintaining comparable channel attenuation.
- ⌘ Additional specs for ELFEXT, PSELFEXT, return loss, delay, and delay skew proposed (200 MHz similar to 100 MHz Cat-5)



# May '98 ISO meeting: Reaffirms Channel Model & Tweaks

- ≡ 100 meter four connector channel model reaffirmed (transition point now electrically accounted for)
- ≡ Component specs for attenuation altered slightly further (lower loss cable) to accommodate additional connectors while maintaining comparable channel attenuation
- ≡ Existing channel equations extended to 250 MHz after considerable debate **to accommodate IEEE request**





# Current ISO Cat-6 Channel Specifications

freq (MHz)	atten (dB)	pr-pr NEXT (dB)	PS NEXT (dB)	pr-pr ELFEXT (dB)	PS ELFEXT (dB)	return loss (dB)	phase delay (ns)	delay skew (ns)
1	2.2	72.7	70.3	63.2	60.2	19.0	580.0	50.0
4	4.2	63.0	60.5	51.2	48.2	19.0	563.0	50.0
10	6.5	56.6	54.0	43.2	40.2	19.0	556.8	50.0
16	8.3	53.2	50.6	39.1	36.1	19.0	554.5	50.0
20	9.3	51.6	49.0	37.2	34.2	19.0	553.6	50.0
31.25	11.7	48.4	45.7	33.3	30.3	17.1	552.1	50.0
62.5	16.9	43.4	40.6	27.3	24.3	14.1	550.3	50.0
100	21.7	39.9	37.1	23.2	20.2	12.0	549.4	50.0
125	24.5	38.3	35.4	21.3	18.3	11.0	549.0	50.0
155.52	27.6	36.7	33.8	19.4	16.4	10.1	548.7	50.0
175	29.5	35.8	32.9	18.4	15.4	9.6	548.6	50.0
200	31.7	34.8	31.9	18.4	15.4	9.0	548.4	50.0
250	36.0	33.1	30.2	17.2	14.2	8.0	548.2	50.0

Note: Table entries are for reference only. Actual specifications are based on equations



# Current ISO Cat-6 Governing Channel Equations

All parameters must comply with the following equations over the entire 1-250 MHz frequency range on a swept basis:

$$\text{Attenuation (dB)} = 1.991*\sqrt{f} + 0.01785*f + 0.21/\sqrt{f}$$

$$\text{pr-pr NEXT (dB)} = -20\log( 10^{(-0.05(74.3-15\log(f)))} + 2*10^{(-0.05(94.0-20\log(f)))} )$$

$$\text{PSNEXT (dB)} = -20\log( 10^{(-0.05(72.3-15\log(f)))} + 2*10^{(-0.05(90.0-20\log(f)))} )$$

$$\text{pr-pr FEXT (dB)} = -20\log( 10^{(-0.05(67.8-20\log(f)))} + 4*10^{(-0.05(83.1-20\log(f)))} )$$

$$\text{PSFEXT (dB)} = -20\log( 10^{(-0.05(72.3-20\log(f)))} + 4*10^{(-0.05(90.0-20\log(f)))} )$$

$$\text{Return loss (dB)} = 19 \text{ at } 1\text{-}20 \text{ MHz; } 19-10*\log(f/20) \text{ at } 20\text{-}250 \text{ MHz}$$

$$\text{Phase Delay (ns)} = 546 + 34/\sqrt{f}$$

$$\text{Delay skew (ns)} = 50$$

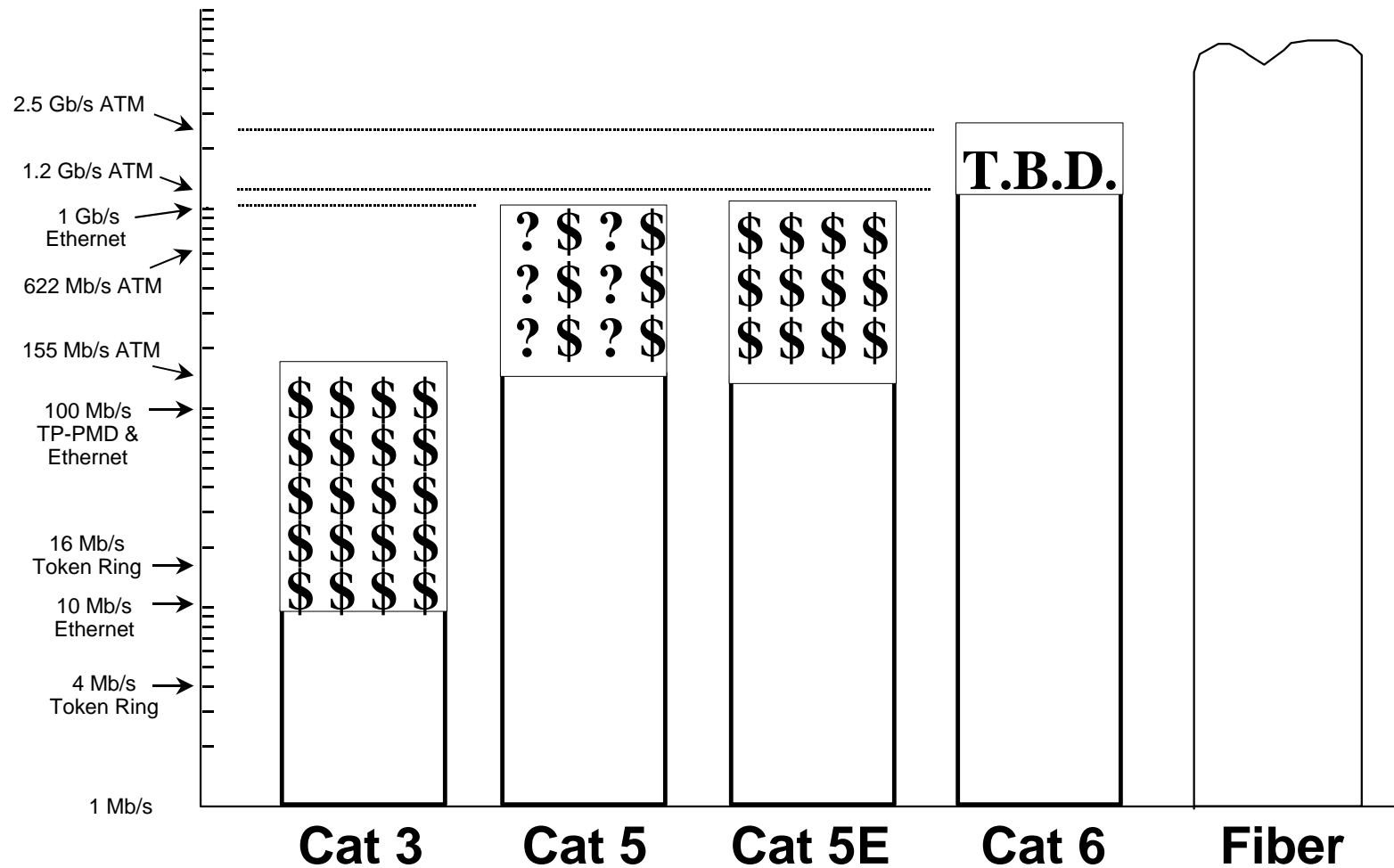


# Category 6 Open Issues

- ⇒ Establishing agreement on laboratory & field testing methods
- ⇒ Refined specifications on plugs & jacks to ensure interoperability and backward compatibility
- ⇒ Specifying balance (modal decomposition methodology)
- ⇒ Obtain consensus on permanent link definition & requirements
- ⇒ Accommodating channel insertion loss deviation
- ⇒ Maintaining harmony between ISO, TIA, CENELEC, national
- ⇒ Need wide deployment of Level III-type testers to distinguish the good from the bad and the ugly



# Applications Coverage by Media



# Lucent Prediction

**Lucent Technologies**  
Bell Labs Innovations



Cat 5 is nearly dead

***30-40% conversion to cat-6 in 1998***

***50-70% conversion to Cat-6 in 1999***

***>90% conversion to cat-6 in 2000***

