

# Single-pair cabling channel specifications

IEEE P802.3cg 10SPE Task Force

October 25, 2017

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# Overview

- JMTG organization and scope
- JMTG projects related to SPE
- Summary of current status of ISO/IEC TR 11801-9906
- Summary of preliminary investigation

# ISO/IEC JTC1 SC25 WG3 ad hoc: “JMTG”

- JMTG: Joint Modeling Task Group
- Official designation: ISO/IEC JTC1 SC25 JPT1
- Group constituents, experts from:
  - ISO/IEC SC25 WG3, LAN cabling systems
  - IEC SC46C, balanced cable
  - IEC SC48B, electrical connectors
- Scope: copper cabling channels and cable assembly modeling
- Members, common to ISO/IEC JMTG and IEEE 802.3:
  - Alan Flatman
  - Dave Hess
  - Bernd Horrmeyer
  - Bob Lounsbury
  - Dieter Schicketanz
  - Masood Shariff

# JMTG projects

## **Recently published:**

- TR 11801-9902 ed1, Alternative channel definition, with end connectors included
  - “End-to-end link configurations”
- TR 11801-9903 ed1, Balanced cabling channel model, differential mode only
  - Matrix modelling of channels and links,
- **Current projects:**
- TR 11801-9903 ed2, Balanced cabling channel model, differential and common mode
  - Matrix modelling of channels and links,
- TR 11801-9906 ed1, One pair channels up to 600 MHz
  - Single-pair channels specifications

# SC25 WG3, TR projects, in support of specific applications (TR projects not under JMTG)

## **Published:**

- TR 11801-9901 ed1, Specific application guidelines for 40GBASE-T
  - “Guidance for balanced cabling in support of at least 40 Gbit/s data transmission”
- TR 11801-9904 ed1, Specific application guidelines for 2,5GBASE-T and 5GBASE-T
  - “Assessment and mitigation of installed balanced cabling channels to support 2,5GBASE-T and 5GBASE-T”
- TR 11801-9905 ed1, Specific application guidelines for 25GBASE-T (PUB pending)
  - “Guidelines for the use of installed cabling to support 25GBASE-T application”

## **Current projects:**

- TR 11801-9907(tbd) ed1, Alternative application guidelines for 25GBASE-T
  - “Guidelines for the use of installed cabling to support 25GBASE-T for extended reach”

# Other JMTG coordinated projects

- IEC SC46C, Cables
  - IEC TR 61156-1-3/AMD1 ED1
    - Multicore and symmetrical pair/quad cables for digital communications - Part 1-3: Electrical transmission parameters for modelling cable assemblies using symmetrical pair/quad cables
- IEC SC48B, Connectors
  - IEC 60512-28-100 ED2
    - Connectors for electronic equipment - Tests and measurements - Part 28-100: Signal integrity tests up to 2 000 MHz ...

# ISO/IEC TR 11801-9906

## One pair channels up to 600 MHz

Draft scope (SC25 confirmed, September 15, 2017):

- Channel characteristics, for channels constructed from single-pair cabling, to be used primarily for general purpose industrial process control applications and Industrial IoT applications.
- For supporting IEEE 802.3 single-pair Ethernet (SPE) applications:
  - 802.3 bp, 1000BASE-T1;
  - 802.3 bw, 100BASE-T1;
  - 802.3 cg, 10BASE-T1.
  - 802.3 bu, 1-pair PoDL
- Functional space ranges:
  - Rate: 10 Mb/s to 1000 Mb/s
  - Reach: 10 m to 1000 m
  - BW range: 1 MHz to 1000 MHz
  - Cable size: including AWG 24, 22, 20, 18; others TBD
- Environmental specifications, particularly EMC related, are referenced from the ISO/IEC MICE classification scheme based on the severity of the environment interfering with the signal integrity.
- The channel descriptions include guidelines for IL, RL, TCL, aC, parameters specifications, comparisons to the 4-twisted-pair cabling specifications, and respective estimates of channel capacity.

# ISO/IEC TR 11801-9906

## Component references, to date

- Cables
  - Current reference cables
    - IEC 61156-11: 1-pair cables for 1 Gbps over 40m application, CDV pending.
  - New reference cables
    - IEC 61156-12: 1-pair (flexible) cables related to IEC 61156-11, Preliminary work item (PWI)
    - IEC 61156-13: 1-pair cables for 10Mb/s over 1km application, PWI
    - IEC 61156-14: 1-pair (flexible) cables related to IEC 61156-13, PWI
- Connectors
  - Current reference connectors
    - IEC 61076-3-125: 1-pair, shielded and unshielded, free and fixed connectors for data transmission up to 600MHz, CD open
  - New reference connectors
    - IEC 6XXXXX: Connector, copper LC style, for 1-pair balanced twisted pair cabling, NW open
    - IEC 6XXXXX: Connectors for 1-pair balanced twisted pair cabling, PWI



# ISO/IEC TR 11801-9906 investigations underway, conclusions pending

- Channel capacity calculations for variable AWG size:
  - 24 AWG
  - 22 AWG
  - 20 AWG
  - 18 AWG
- Considering three-way, EMC conformance verification by coupling attenuation, unbalance attenuation, or enhanced alien crosstalk loss, according to component requirements.
- Considering component return loss summation model for links having multiple connectors, with variable spacing.

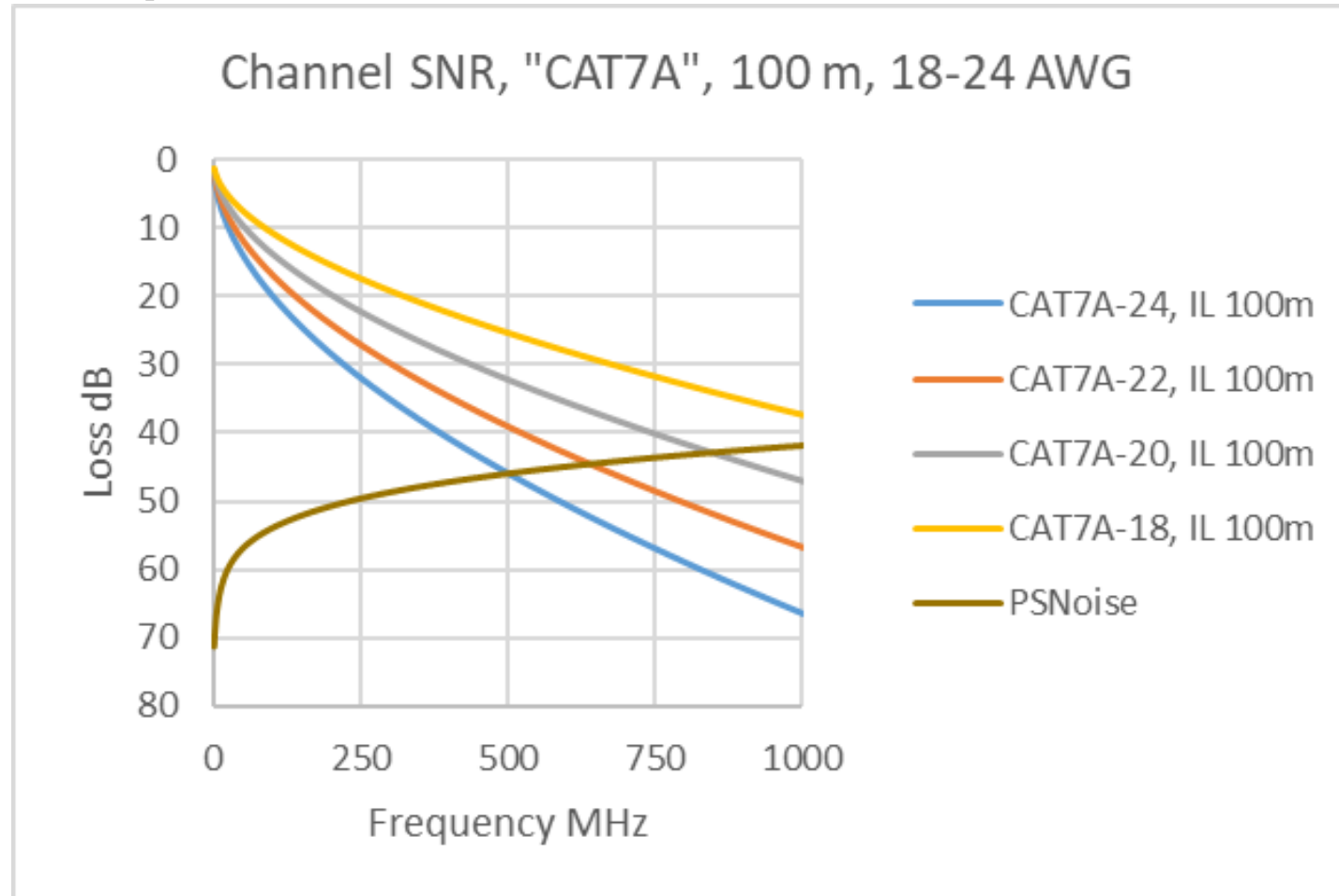
# Channel capacity estimates

- Based on 802.3bz “ALSNR” equivalent calculation.
  - Using CAT7A (Class-FA) 4-connector channel parameters.
  - Cable sizes: vary attenuation according to AWG diameter.
    - 24 AWG
    - 22 AWG
    - 20 AWG
    - 18 AWG
- Using -135 dBm/Hz noise figure
  - Equates to  $75 - 10\log(f)$  dB coupling attenuation
- Using 375 MHz signal frequency for 1000 Mb/s
- Notation:
  - CAT7A-24 = Category 7A channel equivalent using 24AWG

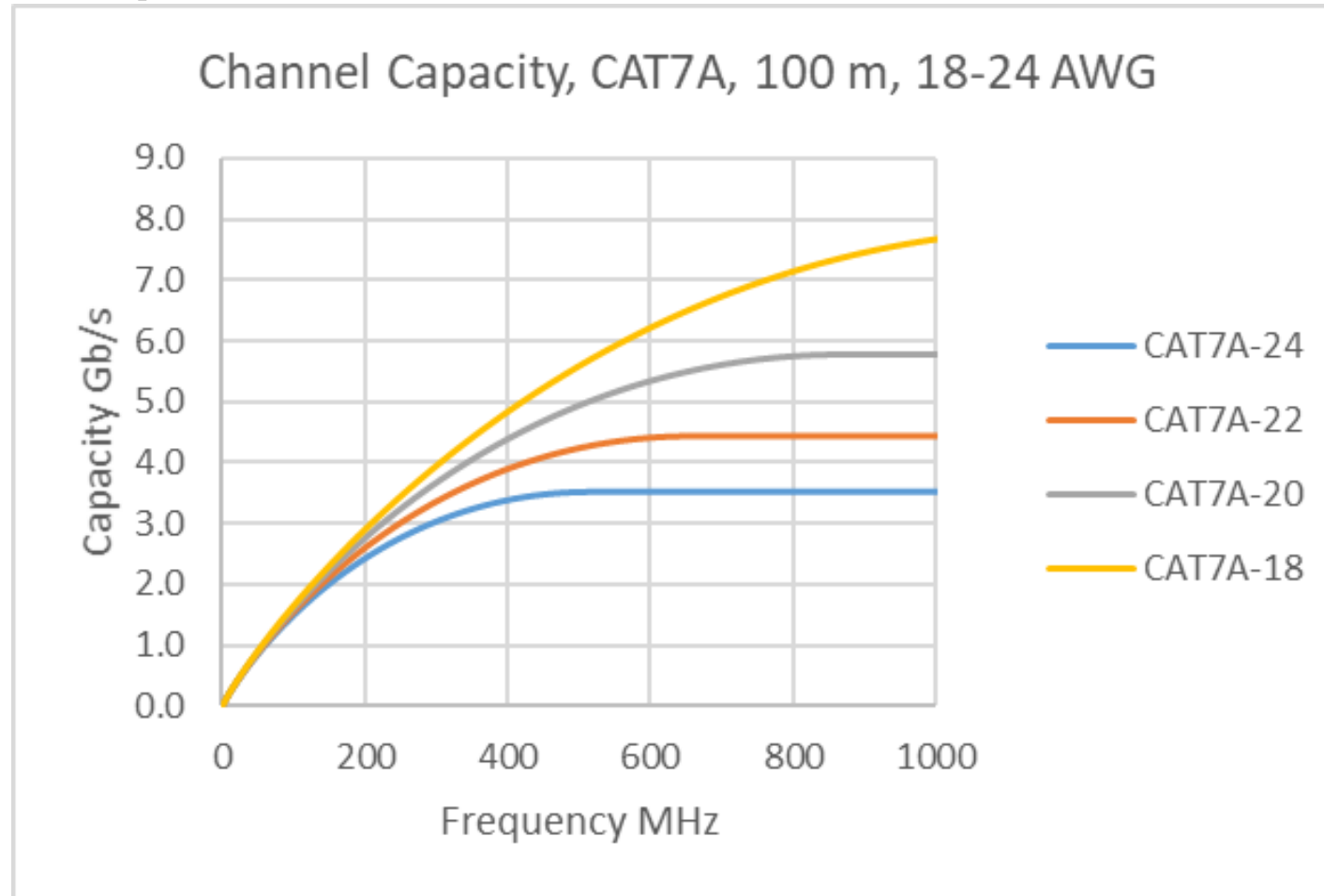
# Results

- Channel capacity calculations for variable AWG size
  - 24 AWG
  - 22 AWG
  - 20 AWG
  - 18 AWG
- 1000BASE-T1 is supported by CAT6A channel IL/RL for 24 AWG
- 18 AWG supports 0.5X IL as 24 AWG, may support 2X reach

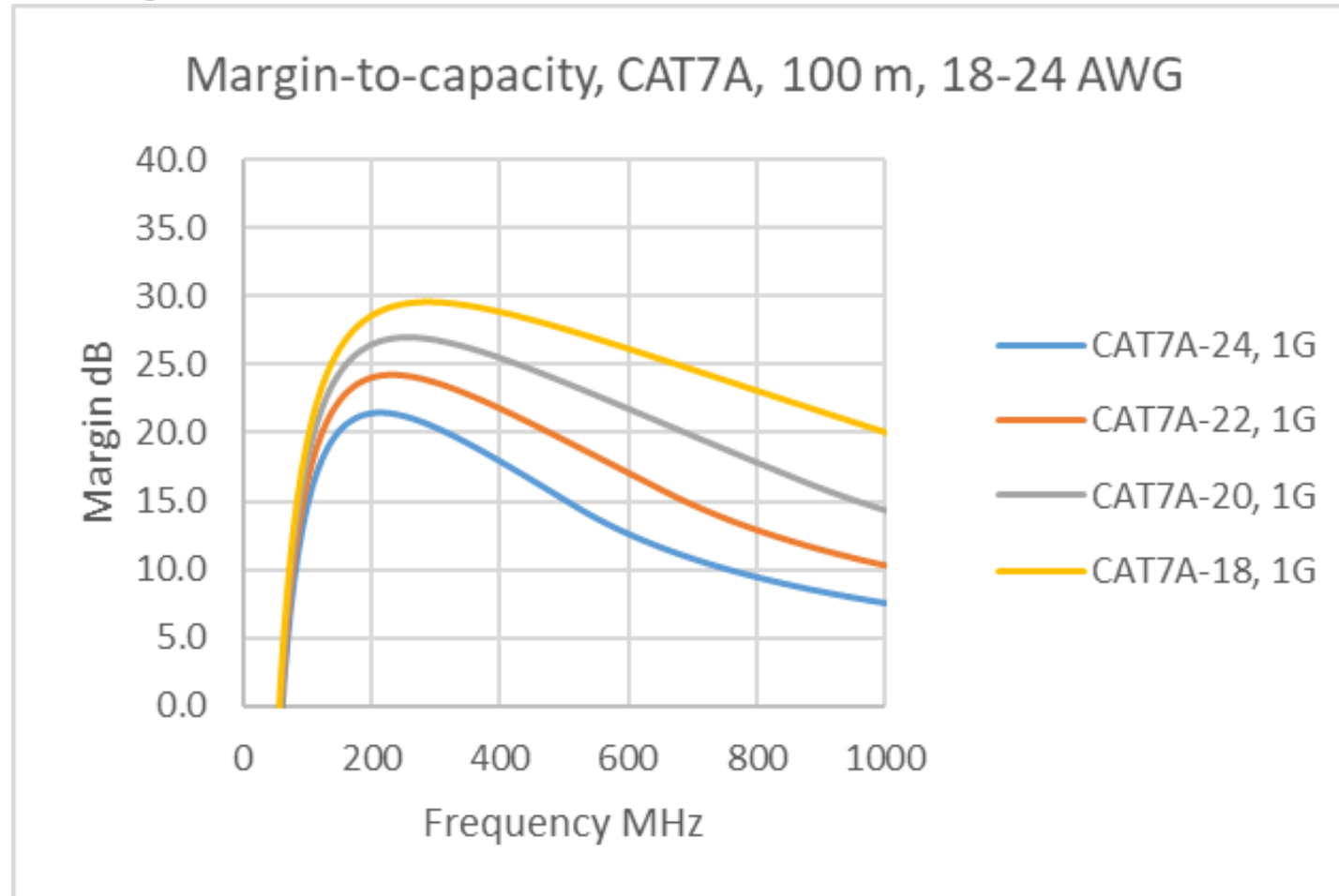
# 1-pair CAT7A/Class FA Types, 100 m channel SNR, per conductor size variation: 24 (standard), 22, 20, & 18 AWG.



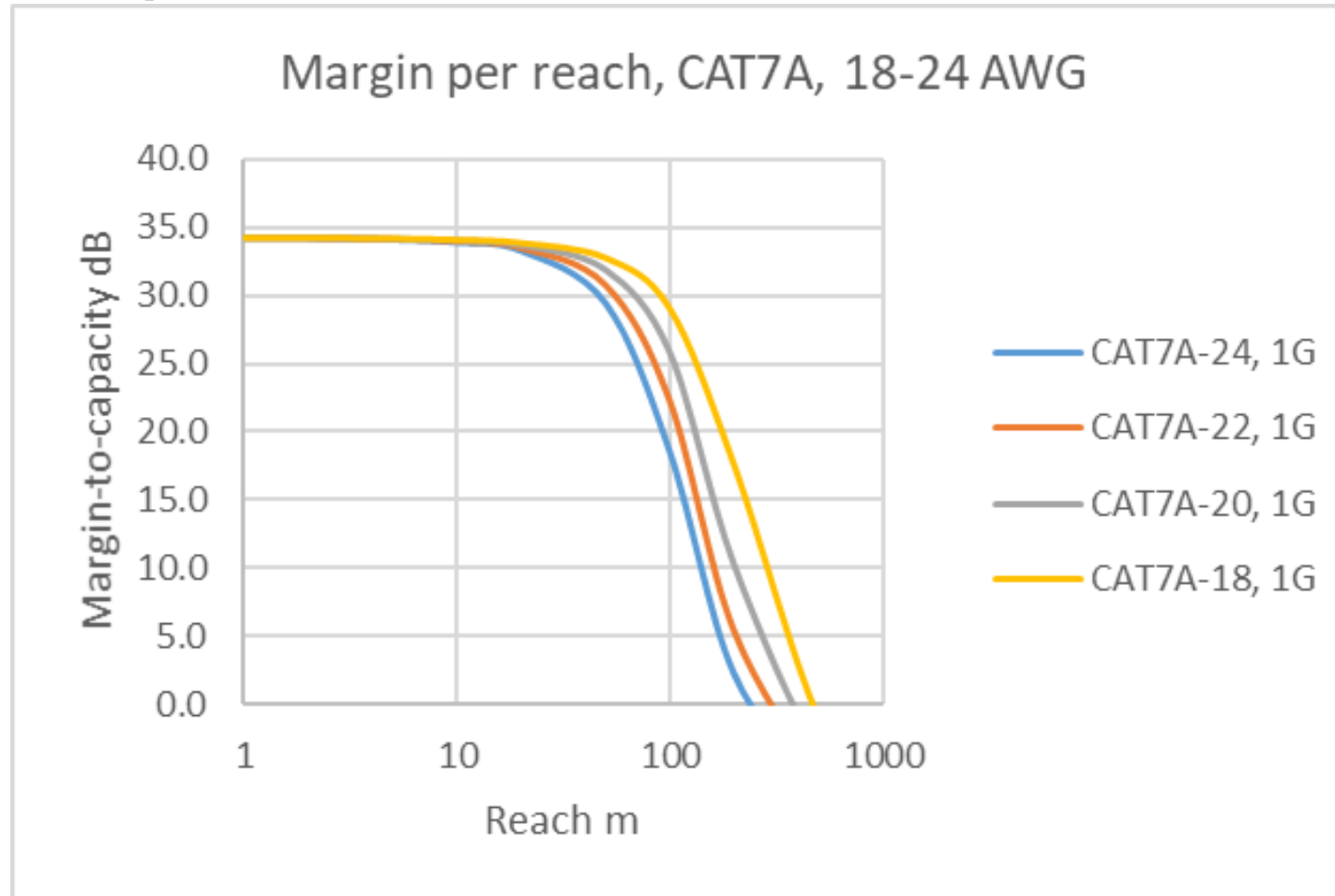
# 1-pair CAT7A/Class FA Types, 100 m, Channel Capacity, per conductor size variation: 24 (standard), 22, 20, & 18 AWG sizes.



# 1-pair CAT7A/Class FA Types, 100 m, Channel Margin-to-capacity, per conductor size variation: 24 (standard), 22, 20, & 18 AWG sizes.



# 1-pair CAT7A/Class FA Types, 1000 Mb/s, Channel Margin per reach, per conductor size variation: 24 (standard), 22, 20, & 18 AWG sizes.



# Preliminary conclusions

- CAT6A performance level components (U/UTP) appear to support 1000BASE-T1 operation in an E1 environment.
- CAT7A performance level components (F/UTP) appear to support 1000BASE-T1 operation in an E3 environment.
- Regarding AWG size, larger cable has a greater effect on supporting Power delivery, than its effect on supporting Data capacity.