Presentation at the Joint ITU-T SG15/Q6 × IEEE 802.3dj Workshop, Montreal, Canada, July 2026

How to move from 800G to B1T?

ITU-T SG15/Q6 perspectives on technologies and standardization

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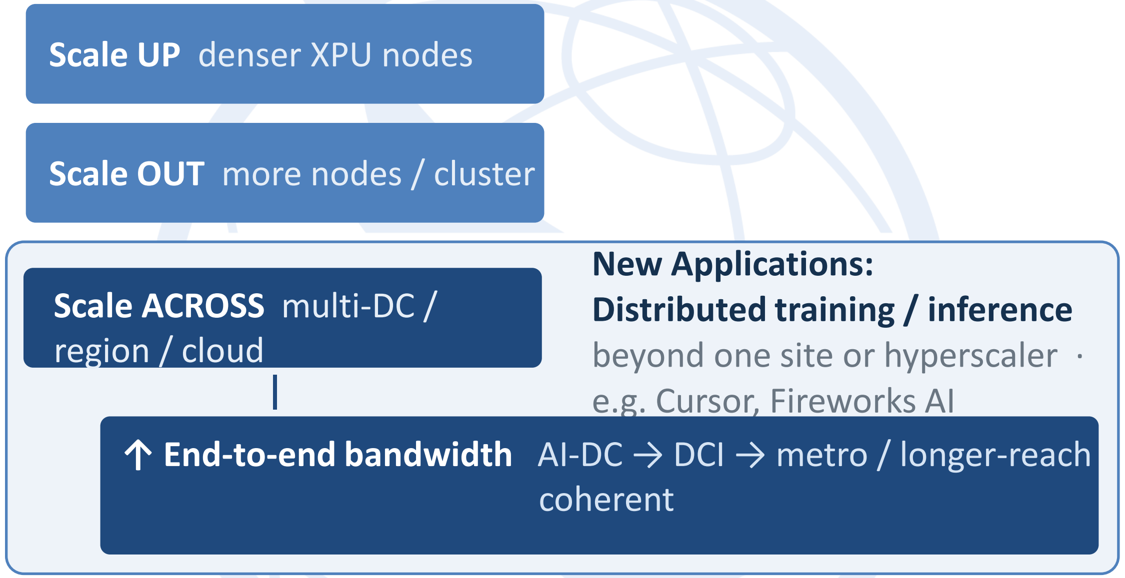
Why now: AI data centers are scaling out and across

AI is why 800G is moving to B1T — and the new pressure is bandwidth between sites.



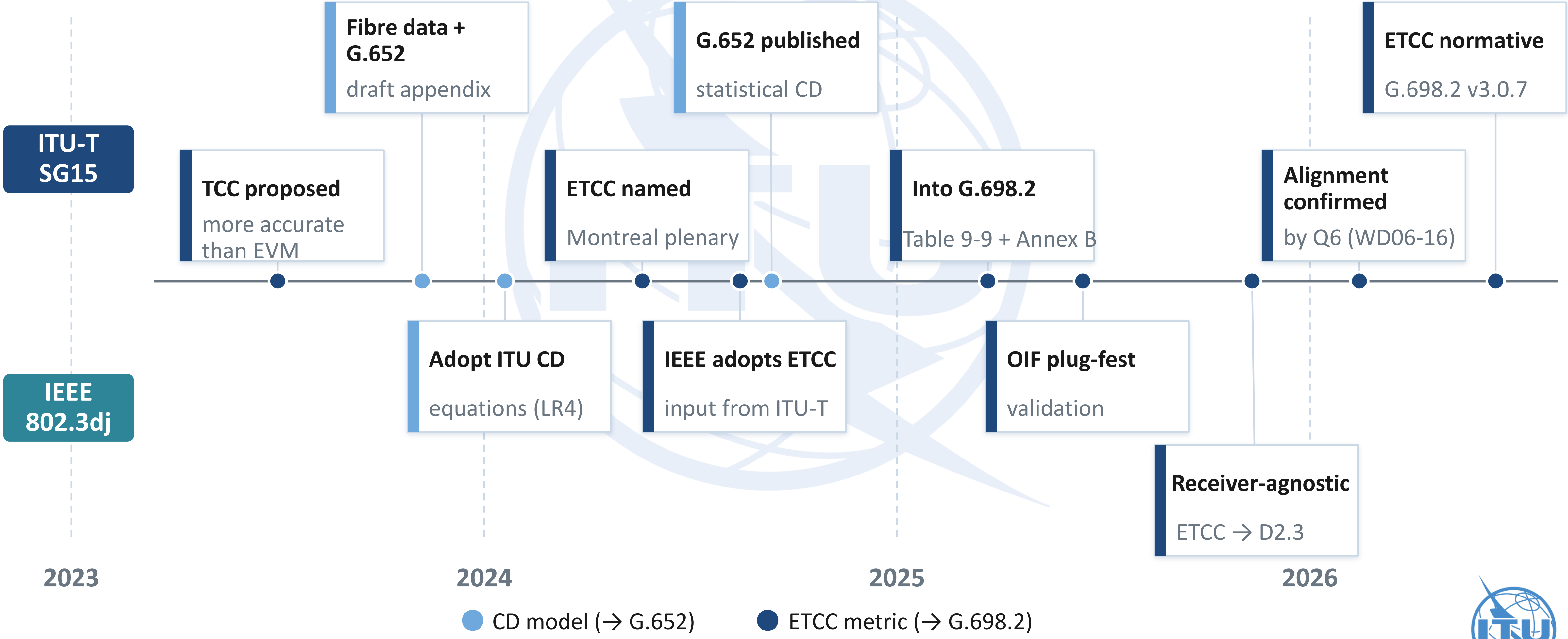
Framing after the ITU Workshop "Evolution of Optical Networks for AI" (Montreal, 29 Jun 2026):

- **X. Liu (Huawei)** — *International Optical Networks towards 2030 (ION-2030)*;*
- **S. Gareau (Ciena)** — *AI interconnects · scale up / out / across.*

*ITU-T's ION-2030 vision already frames this (**GSTR-ION-2030**); the SG15 AI-DC report **GSTR.ION-aiDC** is in draft. Inputs: **C-1165** (LLM training), **CD12-07** (inter-DC at 800G and beyond).

Two joint track records — one timeline (800G era)

Before B1T, ITU-T and IEEE 802.3 already solved two hard problems together — by passing the work back and forth.



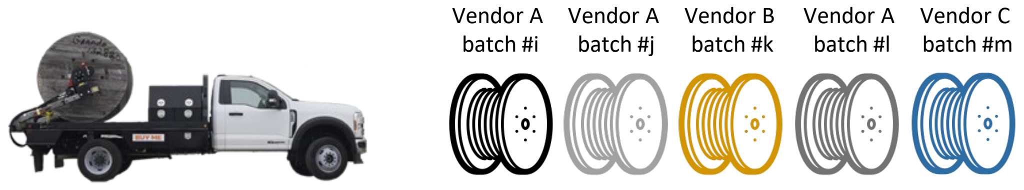
CD model: an engineered-link toolbox

Even in the O-band, chromatic dispersion is large and wavelength-dependent — it smears the pulse and makes the IM/DD eye (TDECQ) hard to meet at 100+ GBd.

Good PAM-4 eyes at 0 CD	bad PAM-4 eyes at worst CD

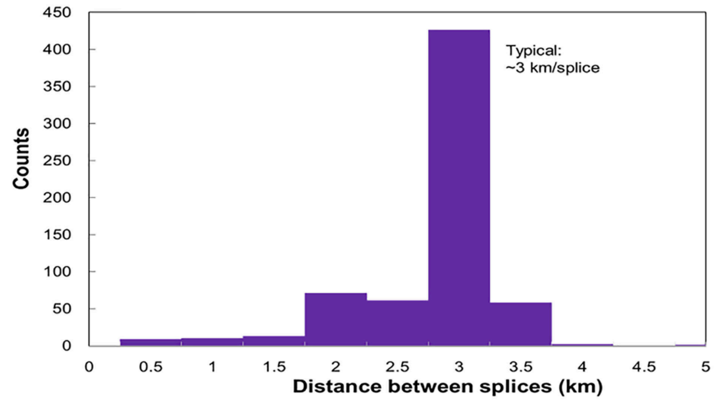
The impact of CD on current TDECQ measurements (fan_3dj_01a_2407)

But real-world cable ships in ~2 km reels. A 10 km link is a chain of segments — their dispersions partly cancel.

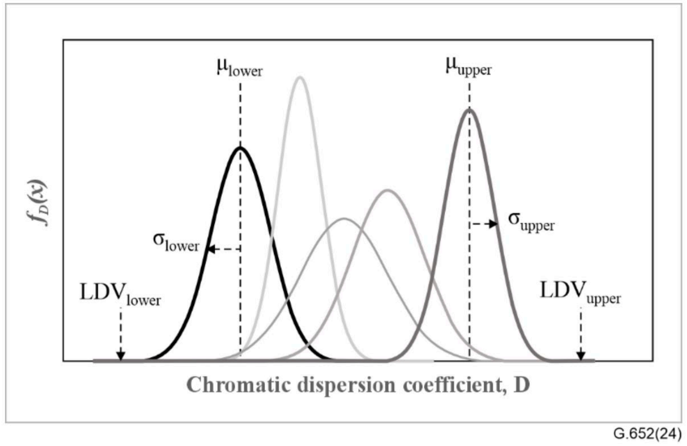


≤ ~2 km per reel

10 km link = chain of ~5 segments



Distribution of the measured distances between fusion splices within each installed fiber span (Zhang, Liu et al., Journal of Lightwave Tech. 2022).



Assumed composite distribution with two partial limiting distributions which set the LDV limits (Rec. ITU-T G.652 (08/2024)).

With a simple FFE receiver, 800G-LR4 operates close to its CD tolerance limit.

CD tolerance — Rx-sensitivity penalty vs CD (Fan et al., IEEE 802.3dj, fan_3dj_01a_2405).

ETCC: grades a coherent transmitter for interop

EVM is only a proxy for BER.

Modern scopes capture millions of symbols and FEC thresholds sit near 1e-2 — error counting is no longer the problem EVM was invented to dodge.

Test it at the operating point.

Don't trust a number measured far from where the transmitter actually runs. Noise-load it instead: add noise until the signal just reaches the target error rate, and read how much it took. As Chris Cole quipped, no chef serves a dish without tasting it — ***"taste, taste, taste."*** That's the **required-OSNR penalty** the link budget needs.

Borrow the practice from IM/DD: noise loading.

Exactly the TDECQ idea from the CD work — IEEE's coherent reference receiver even reuses TDECQ's dark-level noise calibration.

A naming lineage

TDECQ

Transmitter & Dispersion Eye Closure Quaternary — the IM/DD yardstick

TCC

Transmitter Constellation Closure — ITU-T Q6's coherent version, named to honour TDECQ

↓

ETCC

Extended TCC — adds a receiver eye-closure penalty to isolate the transmitter (named at the Jul 2024 Q6/15 meeting)

ETCC : coherent rOSNR penalty :: TDECQ : IM/DD power penalty

TDECQ's noise-loading idea, ported from IM/DD to coherent.

Sources: fan_3dj_02a_2407 (TCC/ETCC naming & method; reuses TDECQ calibration); C. Cole "taste, taste, taste" — cole_3dj_01d_2507 (IEEE 802.3dj, Jul 2025).

Co-developed by ITU-T & IEEE, verified on OIF data — now in G.698.2

EVM ITU-T

The inheritance

ITU-T Q6 built the EVM algorithm (shared to IEEE & OIF). The cross-SDO habit started here.

ITU-T · pre-2023

TCC ITU-T

Initiated by ITU-T SG15

Huawei (in Q6) proposes Transmitter Constellation Closure (TCC) — more accurate than EVM.

ITU-T · Jul 2023

ETCC ITU-T

The down-select

Q6 picks the required-OSNR-penalty form (by Ciena) and names it Extended TCC at the Montreal plenary.

ITU-T · Jul 2024

ETCC IEEE

IEEE adopts it

"Based on input from the ITU-T", 802.3dj adopts ETCC as normative — into Annex 185A.

IEEE · Sep 2024

ETCC IEEE

Refined & affirmed

IEEE finalizes a receiver-agnostic ETCC; ITU confirms it matches Q6's own analysis.

IEEE → ITU-T · 2025–26

OIF's plug-fest data verified it: its multi-vendor 400ZR / 800ZR interop measurements (OFC 2024–2025) gave both ITU-T and IEEE the real-world data to validate ETCC.

Where it stands in draft G.698.2 (v3.0.7):

Defined · cl. 8.2.22	Test method ⇄ IEEE 185A	Table 9-9 value: TBD	IEEE reference: pending

Structure locked & cross-SDO-aligned; only the final number and the published IEEE reference remain — both gated on IEEE 802.3dj publication.

The arc: 800G today, B1T next

The coherent engine and the metric carry over. The PHY, the link and the testing are new work.

800G today

OIF 800ZR · IEEE 800GBASE-LR1/ER1 (802.3dj draft), 698.2

- One carrier, plain DP-16QAM, ~118, 124 GBd (OTN)
- No shaping, no subcarriers
- FEC differs: LR1 = KP4+BCH; ER1 / 800ZR = oFEC
- Mature & interoperable — the common case today

B1T next

OIF 1600ZR+ · ITU-T FlexO-16o (G.709.6, at consent)

- A different coherent engine: digital subcarriers + oFEC + shaping (PCS)
- EEPN impacts the implementation (laser frequency noise + CD matters)

The genuinely new work: the link model and interoperability testing — which is what the rest of this talk is about.

Industry momentum, black link fit — and beyond

OIF 1600ZR+ adopted 2-DSC (two digital subcarriers) — a considered compromise, now with industry momentum to meet the near-term market window in time. Within ITU-T SG15, a number of members support adopting the 1600ZR+ ecosystem, seeing a reuse opportunity for certain metro applications.

1-DSC	2-DSC · OIF's choice	4-DSC
Single carrier — simplest framing, but the weakest EEPN tolerance.	A balanced compromise — more EEPN-tolerant than 1-DSC, simpler to frame than 4-DSC.	Best EEPN tolerance — at higher framing & implementation cost.

OIF: oif2024.596.01 · oif2024.608.00 · oif2025.444.04

Q6 supports that direction — and did its homework on how each subcarrier count fits the ≤ 450 km black link:
Recent Q6 correspondence reports outcomes of initial studies comparing single-carrier and multi-subcarrier options — to understand how each suits different link assumptions.

Sources: Q6 B1T correspondence report TD-GEN-0290; CD06-10, CD06-06R1.

G.698.2 — the multi-vendor black link

Metro DWDM up to ~400–450 km, through 3–4 OADMs (not precluding 6–7).

Multi-vendor interop over a black link — where an existing interoperable ecosystem offers a reuse opportunity for certain metro applications.

WD06-05, this plenary

G.696.1 — intra-domain, beyond

Engineered intra-domain lines reaching beyond 450 km.

Different constraints — EEPN and filtering scale with reach — so the optimum implementation may differ.

WD06-04, this plenary

Th1B

OFC 2026

Clock Recovery and EEPN Mitigation

Presider: Timo Pfau

EEPN compensation is an active effort across industry and academia — e.g., a dedicated OFC 2026 session (Th1B, 'Clock Recovery and EEPN Mitigation') Intriguing topic to study at Q6.

How to move from 800G to B1T — ongoing works

*Three open workstreams for Q6/15 — and for coherent, **EEPN is what CD was for IM/DD.***

Link models for different applications	Nail the ETCC reference receiver	An EEPN evaluation model
Define link models for different B1T application scenarios, to take into consideration system reach, OSNR requirement, and the number of OADMs and the resulting passband spectral shape etc	Carry over the hard-won IEEE / TDECQ lessons and the OIF plug-fest validation. Better metric-to-reality correlation ultimately needs a better-defined reference receiver.	In coherent, DSP handles CD — so EEPN becomes a limiting impairment, the role CD played for IM/DD. It needs its own careful evaluation model.

Open questions to resolve

- Should laser phase / spectral noise count toward Tx quality — especially when Tx and Rx share one laser?
- How to specify laser frequency noise masks to ensure both acceptable EEPN penalty and sufficient support from laser vendors?
- What clock recovery should the reference receiver define?
- …and more, as the B1T work matures.

Make ETCC the metric — keep params as guard-rails

At OIF, the ZR/ZR+ Implementation Agreements grade the transmitter by a list of individual parameters — ETCC was proposed there as a single TQM from 2024 (oif2024.062 "EVM vs TCC", oif2024.594) and validated on 800ZR plug-fest data (oif2026.280).

Individual parameters

Mostly informative · for debugging

- I/Q skew, imbalance, phase error, offset … each impairment, on its own
- Great for finding WHY a transmitter underperforms
- But a worst-case stack can underestimate the real penalty
- Not all need to be normative

ETCC = the TQM

normative · transmitter quality metric

- One number — easy to use, compare and understand
- Predicts the real transmitter-induced OSNR penalty
- A single, vendor-neutral pass/fail conformance test
- Co-owned by two SDOs; validated on plug-fest data

The guard-rail rule: make normative only the few parameters that can game the metric — a "TQM hack" like TDECQ's precursor tricks; the rest stay informative.

Accuracy tracks the receiver, not the method: how well ETCC matches measured rOSNR depends on the reference-receiver quality — which we can still improve. TDECQ took years to mature; ETCC is young — be patient.

Conclusion: carry the cooperation into B1T

The 800G era proved the joint model. The CD engineered-link toolbox (G.652) and ETCC (G.698.2 ⇄ IEEE P802.3dj) were built together — and verified on OIF plug-fest data.

B1T opens the next round of shared problems. The coherent link model, the ETCC reference receiver, the EEPN evaluation model — and the subcarrier-count fit to each design point.

No single body owns these answers. The fastest path is the one we have already proven together.

Our proposal: continue the joint ITU-T SG15/Q6 × IEEE 802.3dj studies into B1T — especially the continued evolution of ITU-T G.698.2 and G.696.1 — with OIF interop data keeping the work grounded.