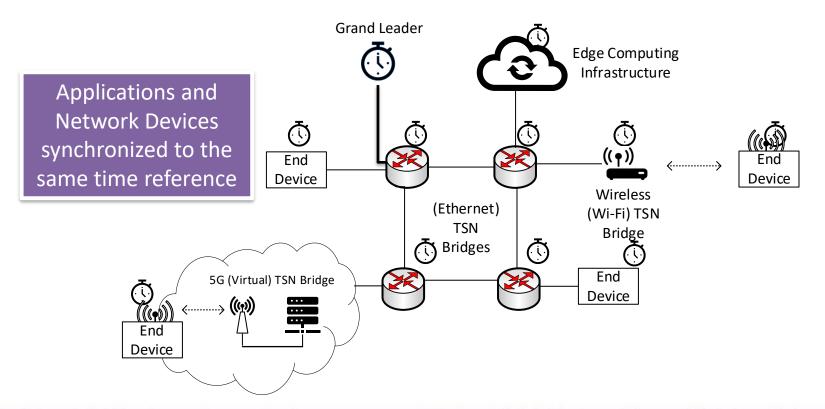# Enabling Converged Networks: TSN and Avnu Testing & Certification

Dave Cavalcanti, PhD, Intel Corp. & Avnu Alliance President
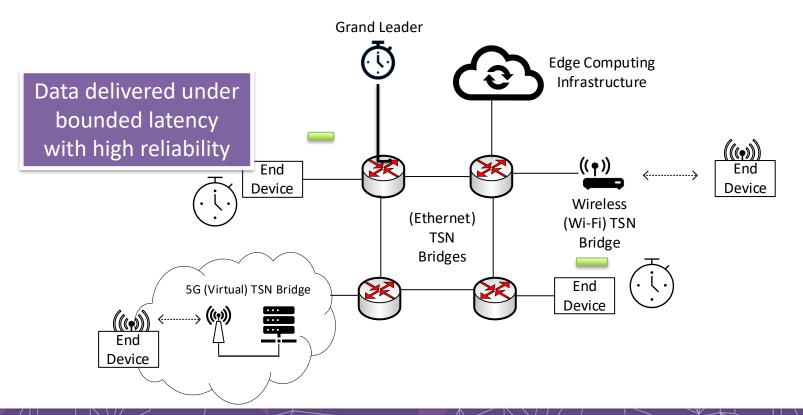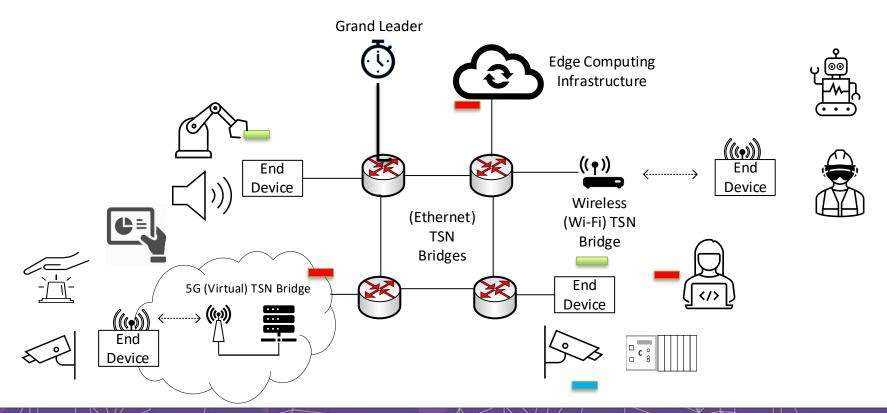Alon Regev, Keysight Technologies & Avnu SVTG co-chair

**AVNU®**
RELIABLE SYNCHRONIZED NETWORKING

Avnu Alliance is enabling Converged Networks where applications (mixed criticality) coexist, and real-time applications just work

# Converged Network Architecture



Applications and Network Devices synchronized to the same time reference

Grand Leader

Edge Computing Infrastructure

End Device

Wireless (Wi-Fi) TSN Bridge

End Device

(Ethernet) TSN Bridges

5G (Virtual) TSN Bridge

End Device

End Device

End Device

# Converged Network Architecture



Grand Leader

Edge Computing Infrastructure

Data delivered under bounded latency with high reliability

End Device

(Ethernet) TSN Bridges

Wireless (Wi-Fi) TSN Bridge

End Device

5G (Virtual) TSN Bridge

End Device

End Device

# Applications (mixed criticality) coexisting

# Avnu Alliance Certification Programs

COMPONENT

NETWORK DEVICES

MILAN

AUTOMOTIVE

AV⟳U

# Avnu TSN Component Certification

**TSN Profile Agnostic**

**Certified Product Registry:**
*Latest Products*

Currently certifying:
- Timing & Synchronization for Time-Sensitive Applications (802.1AS)
- Enhancements for Scheduled Traffic (802.1Qbv)

Upcoming components:
- Interspersed Express Traffic (802.1Qbu)
- Forwarding and Queueing of Time-Sensitive Streams (802.1Qav)

**Intel Corporation** ↗
**Intel® Ethernet Controller I226**
i226 Series
Component
*Certification Date*
09/10/2024

**Moxa, Inc.** ↗
**TSN-G5000 series**
TSN-G5000 series
Component
*Certification Date*
08/07/2024

**Conformance with base TSN standards is the foundation for converged networks across industries/profiles**

# Avnu Certified TSN Components used across segments



PROFESSIONAL AV



AUTOMOTIVE



INDUSTRIAL



AEROSPACE

Time-Aware Scheduling
802.1Qbv

Preemption
802.1Qbu

Credit based shaper (802.1Qav)

802.1AS Time Synchronization

# Avnu Network Device Certification

TSN Profile Specific Certification for Network Devices

**ProAV**

Currently certifying:
• 802.1BA Bridges*

- Streamlined certification addressing evolving needs of networking industry

- New testing procedures and tools for performance and interoperability

- Devices that pass the pilot tests receive conditional certification

**Industrial**

Upcoming programs (under development):
• Industrial TSN devices (based on IEC/IEEE 60802 profile)

*The (legacy) ProAV Bridge program has been replaced by 802.1BA Bridge program

# Other Avnu Certification Programs

**ProAV**

MILAN™ Certification (ProAV specific)

– Application layer network protocol for real-time media

**Auto**

Avnu Automotive Certification

– 802.1DG

- Under development/consideration:

  – TSN over Wireless (Wi-Fi and 5G): 802.1AS and 802.1Qbv

  – 802.1DP – TSN Profile for Aerospace
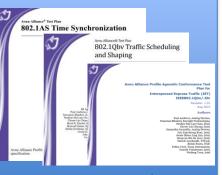
# Avnu testing and certification framework

# Testing TSN for Industrial Automation

- TIACC's primary deliverable is a **shared test plan** for IEC/IEEE 60802 TSN profile
- Avnu is contributing TSN test plans and testing expertise through its members



www.tiacc.net/

TIACC Test Specification

| Tests for TSN Components | + | Profile-specific tests for Industrial Automation Stations (IA-Stations) |
|---|---|---|

Examples: 802.1AS, 802.1Qbv, 802.1Qbu, …

Profile-specific configurations, minimal performance requirements …

**Avnu Plugfests: Helping members develop, test and validate TSN-based interoperable devices**

- Next Plugfest/Plenary events:
  - **April 2025, Malaga, Spain**
  - **September 2025, Berkeley, USA**

- Academic/Research Institutions can participate under new membership option (see details at Avnu.org)

# Conclusions

- Avnu certified components and network devices are enabling converged networks across markets
  - Testing coverage includes core TSN capabilities required across markets
  - ProAV (802.1BA, Milan), Automotive (802.1DG), Industrial (60802), Aerospace (802.1DP)
- Avnu's testing & certification framework is built on collaboration/co-development between vendors/test tools/labs
  - Members drive priorities and testing scope based on market needs
  - Plugfest/interop events enables product development and V&V for test tools and test houses

Thank you!