Time as a Service in the Enterprise Network

Norman Finn, April 4, 2017

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We can take the title two ways:

Time as a Service in the Enterprise Network

- Time as a Service **supplied by** the Enterprise Network
  - How the enterprise network can supply various applications with time.
- Time as a Service **used by** the Enterprise Network
  - How the network can use its own time service to supply new features for the applications using the network

Supplying applications with time

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IEEE 1588 Precision Time Protocol

- A tremendous advance in time synchronization.
- Deployment is exploding!
- The IEEE 1588 can be thought of as a toolbox. To implement precision time in a network, you must make choices among alternatives in IEEE 1588, and may need to add features. That is, you need a **Profile**.

Current profiles of IEEE 1588

- IEEE 1588 default profile, in IEEE 1588
- IEEE 802.1AS
- IEEE C37.238
- ITU-T G.8265.1
- ITU-T G.8275.1
- SMPTE ST-2059-2
- IETF draft-ietf-tictoc-ptp-enterprise-profile
- (more?)

Each assumes it owns the world

- Each assumes that the network runs only that one profile.
- Some require this.
- They make different assumptions about how many master clocks, failure modes, start-up times, accuracy, capabilities of different systems, etc.
- **None**, as yet, fully addresses the users' needs for
  - Reliability and robustness when failures occur or are repaired, or
  - Security against malicious attack.
- Experts pretty much agree that time security = multiple master clocks, delivering PTP along multiple paths to the clients.

So, if I have *N* applications in my enterprise …

- I run *N* different independent profiles of PTP.
- Multiplied times at least two, and maybe four, for security and robustness.
- Did I mention that all this has to be configured and managed?
  - Network administrators must understand all the profiles enough to configure them and diagnose errors.
  - Master clocks must be found that operate with all of the profiles, hopefully more than one at the same time.
  - Network devices must be found and upgraded that understand the latest features (e.g. security) for each of the profiles.

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- **Not attractive**

Time as a Service *supplied by* the enterprise network

- I pick **one** profile—hopefully, one that is deployable, reliable, and secure, and implement it in the core bridges and routers of my enterprise network.
- Near the edges of the network, I identify those nodes that are **Time Servers**.
- A Time Server:
  - Syncs reliably, robustly, and securely across the enterprise.
  - Supplies time to any given host, end station, or small network that needs it, in whatever profile is required, pretending to be a Master Clock in that profile.

Time as a Service *supplied by* the enterprise network

- Simpler for **network administrators**, simpler for **network equipment vendors:** One complex protocol, one function (master) for each profile, to build, understand and maintain.
- Simpler for **users**: They each get the profile that fits the application they are running.
- Simpler for **standards developers**: No “arms race” among profiles for reliability and security. Only one profile needs everything.
- Less burdensome to the network: Fewer PTP packets.

Using time to supply applications with new Qualities of Service

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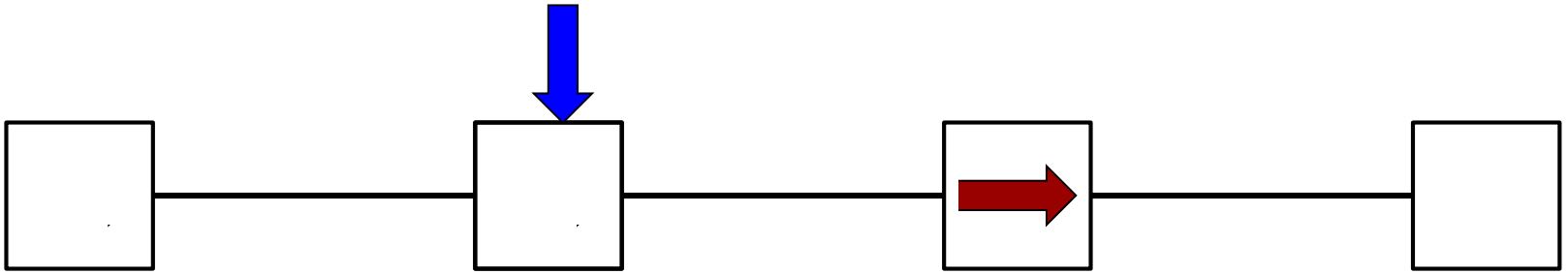
Time as a Service *used by* the enterprise network

- The IEEE 802.1 Time-Sensitive Networking Task Group and the IETF Deterministic Networking Working Group are both working on standards to enable **one network** to carry:
  - Time-critical data controlling real-time physical processes such as machine control, automated driving commands, or video studio live broadcasts; AND
  - The same enterprise data they've always carried.
- Many of the techniques used to accomplish this require the network nodes (bridges, routers, etc.), themselves, to be time-synchronized.

Time as a Service *used by* the enterprise network

For example, long chains of two-port devices are a cost-effective way to deploy actuators and sensors. But, the end-to-end latency inherent in long chains lengthens the control cycle time.

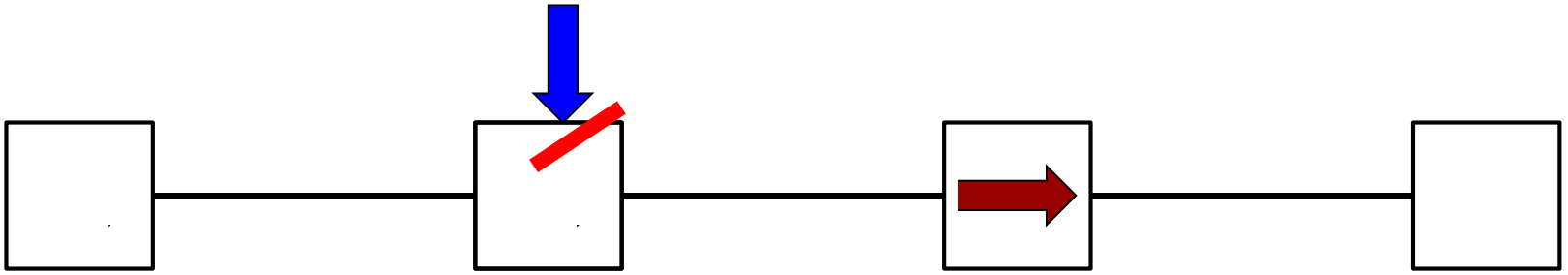
- Hop by hop: Interfering packets cause delays.



Time as a Service *used by* the enterprise network

For example, **long chains of two-port devices** are a cost-effective way to deploy actuators and sensors. But, the end-to-end latency inherent in long chains lengthens the control cycle time.

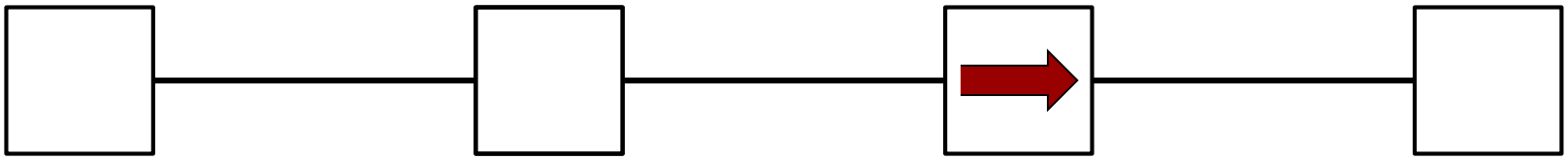
- **Hop by hop**: **Scheduled transmissions** prevent interference, but it takes a long time to get data to controller



Time as a Service *used by* the enterprise network

For example, **long chains of two-port devices** are a cost-effective way to deploy actuators and sensors. But, the end-to-end latency inherent in long chains lengthens the control cycle time.

- **Scheduled cut-through**: Time-synchronized devices open regular windows for “cut-through”. Packets start transmitting before being completely received. Much lower latency.



Questions and comments

Thank you