

Further consideration for enhanced mechanism for flexible factory

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Introduction

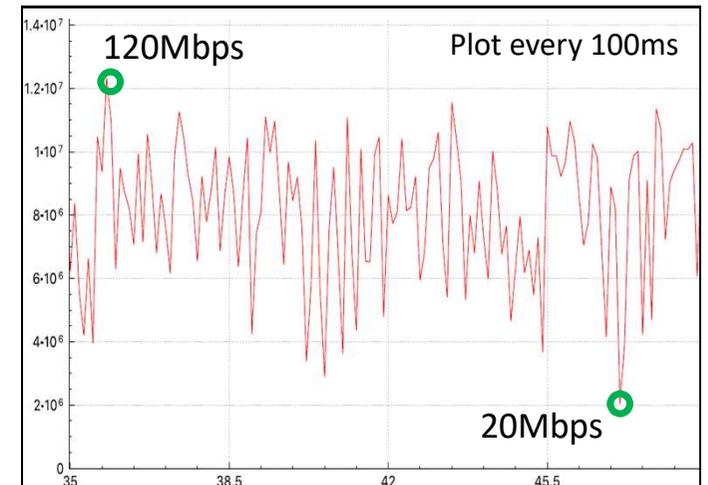
- This document shows an opportunity to increase market potential of TSN in a manufacturing area.
- “Flexible Factory,” where many and various equipment and devices coexist and attached to the wired network via wireless connections, is introduced.
- In the TSN session of 2019 January interim meeting, market potential of wireless communications in factories, positioning compared to Industrial automation at P60802, and the technical issue regarding dynamically changes of available wireless bandwidth are presented.

<http://www.ieee802.org/1/files/public/docs2019/new-FFIoT-maruhashi-enhancement-considerations-for-flexible-factories-0119-v01.pdf>

<http://www.ieee802.org/1/files/public/docs2019/new-FFIoT-kondo-gap-analysis-in-1Qcc-for-enhanced-mechanism-for-flexible-factories-0119-v01.pdf>

Revisit: Background

- Available wireless bandwidth dynamically changes due to various reasons
 - Path loss, fading, interference, MAC layer adaptation, ...
- In addition, required bandwidth dynamically changes since traffic pattern is not uniform
 - Burst data flow, cyclic data flow, ...
- Shortage of wireless bandwidth is difficult to avoid even if it occurs infrequently
 - In order to avoid the shortage, required bandwidth must be limited to very low. It is not an efficient way.

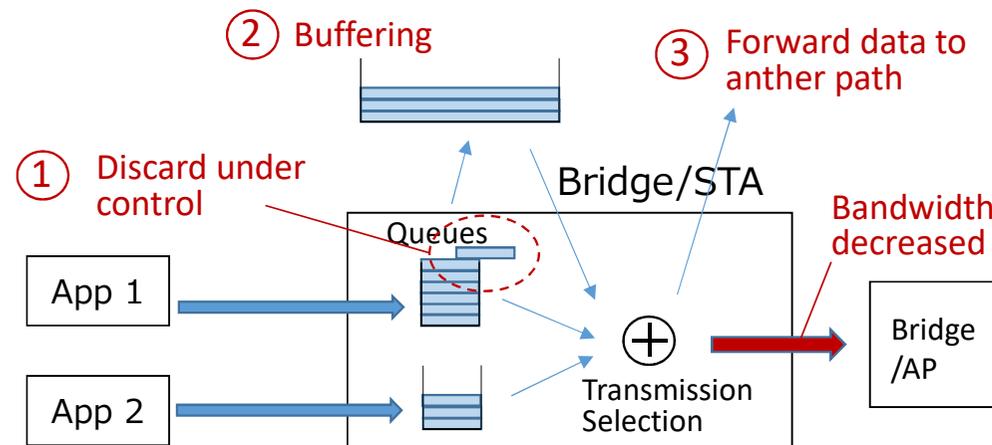


Example of measured UDP throughput
2.4GHz Ch.11 (20MHz band wise)

Revisit: Advanced Forwarding

- Sophisticated and enhanced methods:

- ① Discard under control -> reduce data not to stop high priority application
- ② Buffering -> use additional buffer to peak-rate shaving
- ③ Forward data to another path -> use another path or link aggregation



Flow Diagram

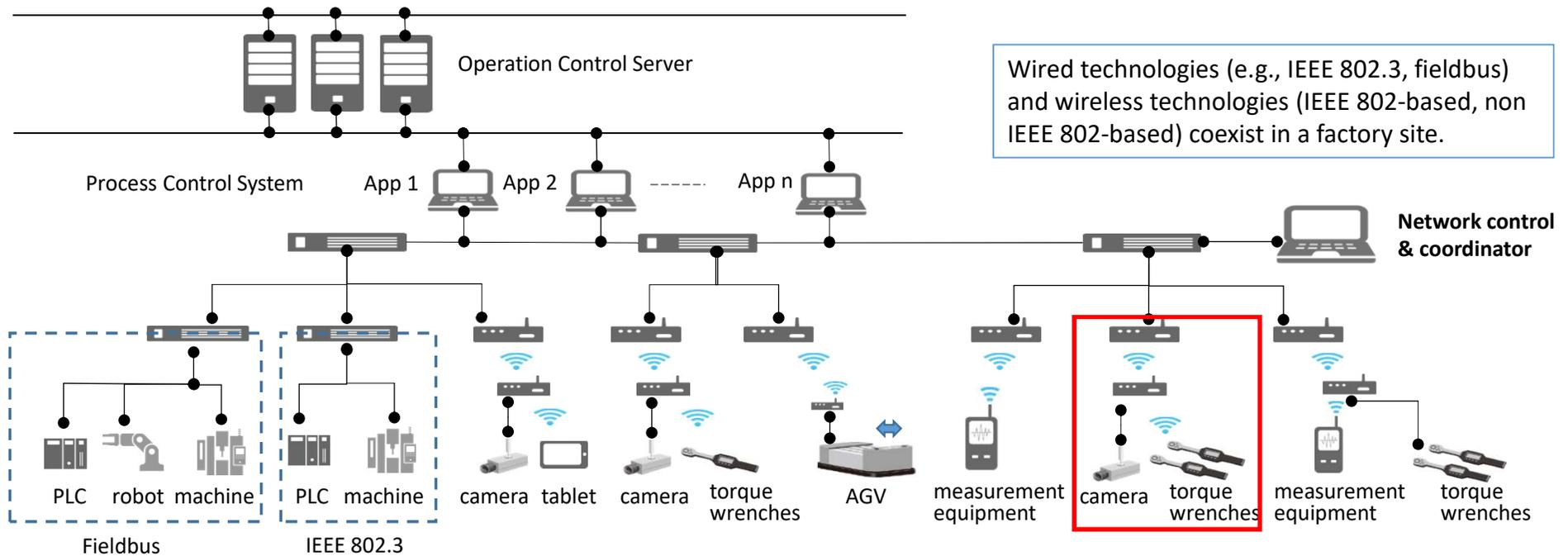
Bridge needs to know attributes of each flow for decision

Issues of Advanced Forwarding

- Data attributes (discussed in January Interim meeting)
 - Carry QoS requirement to the bridge
- Bandwidth estimation (discussed in January Interim meeting)
 - Cooperate with wireless media
- In the previous meeting, some comments pointed out that assumed system model, where the advanced forwarding works, should be clarified for further discussions.

=> Assumed system model and related issues to be discussed in following slides.

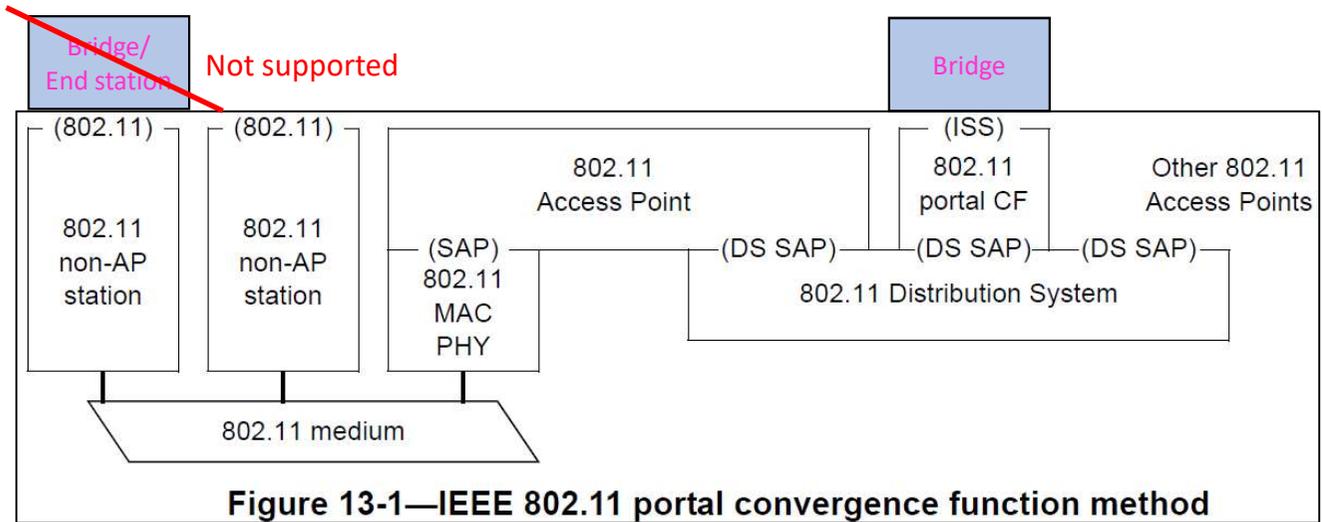
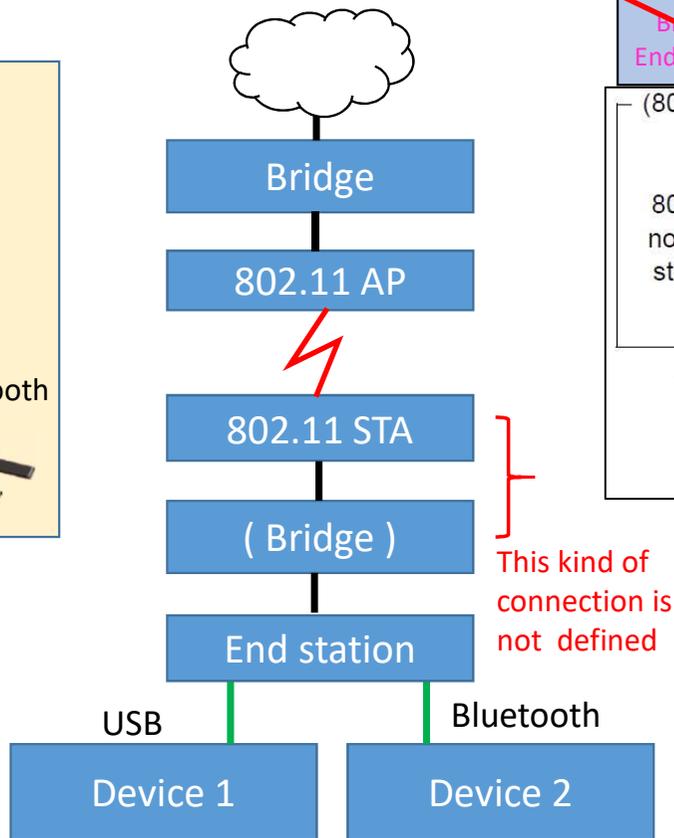
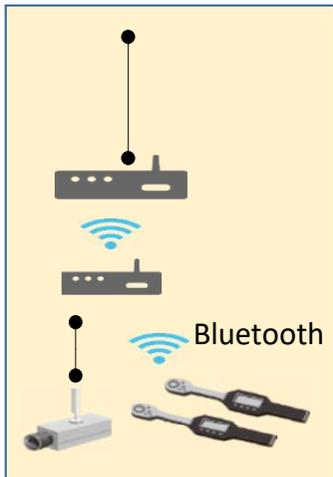
Factory Network Today



Typical vehicle assembly line needs many torque wrenches:
<https://drishtikona.files.wordpress.com/2012/08/ch8.pdf>

Uplink traffic becomes more important in factory IoT scenarios
Multiple uplink streams need to be handled in a wireless link

System Model in 1Q and 1AC



- Bridge can connect to 802.11 DS via 802.11 portal CF
- 802.11 AP can connect to DS, but STA cannot have any direct connections with DS
- Bridge cannot be located on STA of 802.11
- Forwarding on Bridge with STA cannot be realized with current 1Q

In the current model (as defined in 1Q Annex C and 1AC), End station/Bridge can not be connected with STA. Need amendment.

MSRP and 802.11 (1Q Annex C and 1AC)

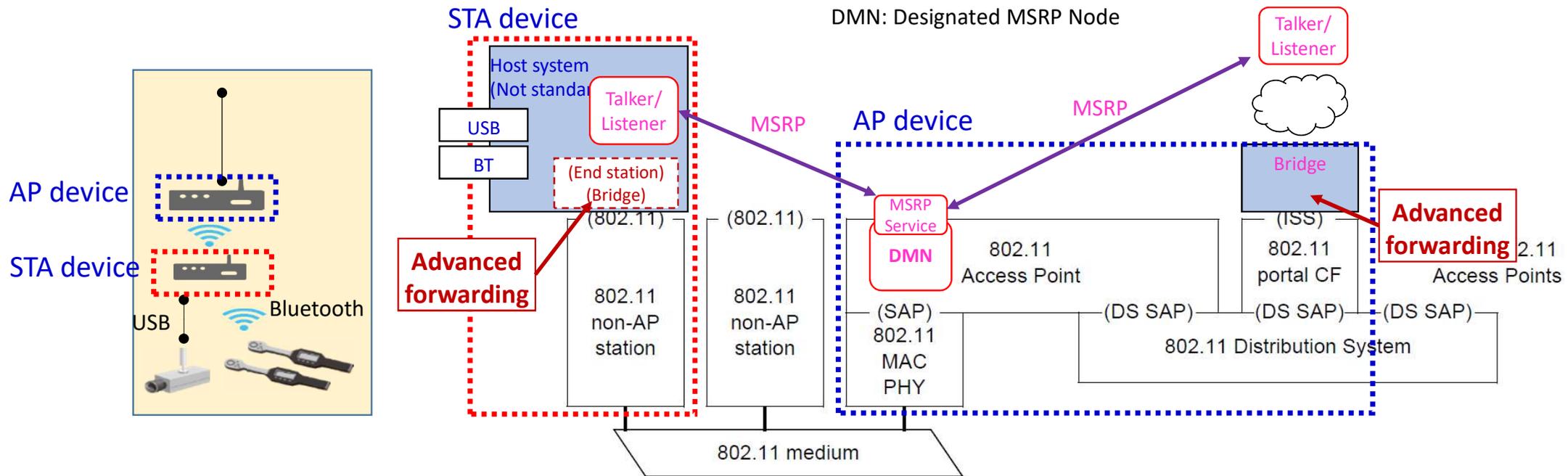


Figure 13-1—IEEE 802.11 portal convergence function method

- 802.11 supports MSRP by DMN accessing SAP of AP. Stream reservation is handled by AP
- In case of the advanced forwarding, uplink traffic needs to be handled in STA device
- Bridge or End station which has the advanced forwarding features needs to be located in STA device
 - 1Q Annex C does not cover the advanced forwarding even if it supports 802.11

What's Next?

- There is no available system model in 1Q and 1AC for other wireless standards.
- To extend end-to-end deterministic services to networks which have wireless, new system model and bridge function i.e., advanced forwarding need to be defined.

Straw Poll

- Straw Poll:
Would you support a new Project for extending existing system model in 1Q for advanced forwarding and necessary bridge functions for the flexible factory applications (to handle up-stream traffic from IoT devices to AP) and submission of a PAR for approval at the July Plenary meeting?

for detail definition of Flexible factory network and applications, see
[new-FFIoT-maruhashi-enhancement-considerations-for-flexible-factories-0119-v01.pdf](#)
Nendica draft FFIoT report

Y/N/A