**IEEE P802.24**

**Vertical Applications Technical Advisory Group**

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| Project | IEEE P802.24 Vertical Applications Technical Advisory Group |
| Title | **IEEE 802 Solutions for Vertical Applications White Paper** |
| Date Submitted | 3 July, 2019 |
| Source | 802.24 TAG |  |
| Re: | N/A |
| Abstract |  |
| Purpose |  |
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# Background and Introduction

What is the value and differentiation of the IEEE 802 architecture in the context of vertical markets? How is IEEE 802 better suited to deployment in the communication infrastructure of private enterprise, industry, and the individual user?

Compared to network architectures oriented towards service providers.

The IEEE 802 architecture enables networks that are like Ethernet: Well understood, mature, predictable. A “cleaner” integration of disparate technologies under the common architecture and addressing.

# Requirements of Vertical Applications

Define Vertical Applications – various systems including network connectivity that preform specific tasks or enable use cases for their industry.

Vertical markets involved specific usage models:

* Industrial automation
* Building Automation
* Smart Cities
* Smart Grid / Utility
* Automotive / transportation
* Agriculture
* Connected Supply Chain
* Critical infrastructure protection and control
* Wide area gaming (including AR/VR)

Define some reference specifications for vertical markets

Unique requirements, may be specific to the vertical markets

Vertical markets often required highly-engineered networks. Not commodity service.

Vertical markets operate on a different lifecycle – the vertical network is expected to remain in service for a longer time than a service-provider network.

Vertical markets may have different cost models. Some are opex averse, others are capex averse.

# Key Aspects of the IEEE 802 Network Model

* IEEE 802 is a transport network
* IEEE 802 is Layer 2
* 3GPP RAN is layer 3 only, Layer 2 is not available
* Direct support of IPv4 and IPv6 or pure layer 2 protocols
* Trade-off between flexibility (L2) and scalability (L3)
* Routing provides path to higher scale
* Smaller scale to provide more flexibility
* Smaller scale provides opportunity for real-time
* IEEE 802 can route via L3 when needed. 3GPP cannot offer L2
* IEEE 802 can also offer L2 routing when appropriate (e.g. 802.15.10)
* Not an alternative to L3 routing, but there to address a different problem
* 802 does not provide as many means control a specific end device and its traffic on a path.
* There are some management facilities in some standards
* 3GPP networks provide more tools for subscriber management
* 802 provides local networks that may be (but don’t have to be) connected into an Internet.
* Operator networks are focused on services for single devices, while 802 networks support and include multiple devices (networks of networks) – devices can communicate with each other as well as with other networks

# IEEE 802 compared to other wireless IoT Networks

* Commercial, proprietary IoT services
	+ They don’t have an ethernet like L2. The system does not have the concept of a LAN. It is terminal to central “gateway” only. Star topology only.
	+ Similar to LTE UE to UE traffic that must route through core. (DTD Proximity services have addressed that to some extent)
* 5G URLLC, and MMTC.
	+ IEEE 802 has already developed TSN in wired, and now being developed for wireless.
	+ Latency is impossible to guarantee in unlicensed, shared spectrum. However it can be highly optimized by the MAC layer.
	+ IEEE 802 has a history and internal coordination of coexistence between different standards operating in unlicensed spectrum. 3GPP is oriented towards exclusively licensed spectrum, “sharing” is a foreign concept.
* 3GPP has a common strategy for the three use cases. IEEE 802 has a common architecture, but not a common business strategy.
* License exempt can provide higher economic value per MHz of spectrum.
* See WFA economic value. Cisco Visual Networking Index. Wi-Fi carries more data than all cellular spectrum
* Wi-Fi created the expectation of broadband wireless that led to the development of LTE
* What would it look like to combine multiple IEEE 802 standards into a single offering?
	+ Some vendors already do that – integrating 802 technologies into systems.
	+ The “Package” offered by the “5G” ecosystem is clearly articulated.
	+ What is the comparable offering from IEEE 802?

# IEEE 802.1CF “OmniRAN” in vertical application networks

IEEE’s AANI is about integrating 802.11 into 5G domain. There is nothing corresponding in 3GPP for integrating into 802.

Industry connections – NENDICA: Flexible Factory IoT, Data Center Bridging

What’s missing – a picture of 802 as a peer to 5G. 5G promises they will do “everything”.

But, they don’t define any wired standards, but they support them.

5G requires an extensive PLMN to support it.

It is designed to help the cellular operator grow their market.

Verticals might not want an operator in the middle of their network.

However, private 4G or 5G networks are possible.

Value proposition: 802 networks are customer-owned.

Example – Santa Clara Emergency services issues

# Provisioning and service discovery in vertical application networks

Is there a need for an IEEE 802 activity for improving provisioning?

Security, Network Health, Better sharing and coexistence in spectrum

What can IEEE 802 do to enable “SD-WAN” types of services for the heterogeneous network in a vertical?

* Application-sensitive provisioning?
* What is the role of edge computing?
* What is the IEEE 802 analogy for 5G Network Slices?

Slices to be adapted to the set of application requirements

# Business Models for Vertical Application Networks

The network “enables creating/delivering a product” vs “the network is the product”

* IEEE needs to think about how to create that package without a “subscription model”
	+ IEEE 802 is often free
* IEEE 802 is deployed in vertical markets, where the network is owned and operated by the user of the services.
* Are there other models for IEEE 802 other than subscription that can provide ancillary economic value?
	+ Is management of shared spectrum a candidate?
* IEEE 802 and unlicensed spectrum enables faster innovation
	+ Many of the breakthrough innovations were not as planned
	+ The story of why IEEE 802 complements everything else, and everything else (alone) is not sufficient.
* IoT is built around many specialized niches. The challenge is meeting the diverse requirements. IEEE 802 provides multiple standards to address multiple IoT applications.

# Conclusion

Future perspectives – how can IEEE 802 evolve to better serve vertical markets?

# References