Potential Nendica Study Item: Evolving IEEE 802 Architecture Requirements

Roger Marks (EthAirNet Associates)

roger@ethair.net

+1 802 capable

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Background

- Rev 0 (802.1-21-0014-00) presented to Nendica 2021-03-25
- Rev 1 (802.1-21-0014-01), with minor updates, posted 2021-03-25
- Rev 2 (802.1-21-0014-02), with minor updates posted 2021-06-23
  - Presented to Nendica June 8; see minutes (section 8B)
- Technical Coherence sub-ad hoc of IEEE 802 Restructuring ad hoc has progressed
- Contribution to Technical Coherence sub-ad hoc meeting of 2021-06-22, entitled "Views on Revision of IEEE Std 802," drew heavily from 802.1-21-0014-01
  - https://mentor.ieee.org/802-ec/dcn/21/ec-21-0131-00-00EC.pptx
  - Suggested that preparation for a revision to IEEE Std 802 could be developed in "a focused pre-PAR activity, conducted in, for example, a Study Group or an Industry Connections Activity such as Nendica."
- Response to contribution was positive, though venue needs further discussion
- Technical Coherence sub-ad hoc met July 9
  - Generally favorable view of Nendica progressing the architecture issue (see minutes)
- A Nendica Study Item could help to progress decisions on planning a revision of IEEE Std 802
- The remainder of this contribution follows Rev 2, up to Slide 15
- The proposal on Slide 16 is new in Re. 3.

Architecture and 802 Restructuring

- IEEE 802 Restructuring ad hoc has been meeting monthly
  - https://mentor.ieee.org/802-ec/dcn/21/ec-21-0071-00-00EC.docx
- "Technical Coherence sub-ad hoc" has discussed
  - the value of 802-wide technical coherence
  - the "IEEE 802 Network"
  - the history of the IEEE 802 architecture
  - See https://mentor.ieee.org/802-ec/dcn/21/ec-21-0068-00-00EC.pptx

Nendica, per current ICAID

- *IEEE 802 technologies are mainly deployed in communication infrastructures outside of the IMT domain, and may require enhancements to address the emerging requirements of networks for the next decade.*
- *The goal of this activity is to … identify commonalities, gaps, and trends not currently addressed by IEEE 802 standards and projects, and facilitate building industry consensus towards proposals to initiate new standards development efforts.*
- *Encouraged topics include enhancements of IEEE 802 communication networks and vertical networks as well as enhanced cooperative functionality among existing IEEE standards in support of network integration.*

IEEE 802 Architecture

- The IEEE 802 Architecture is specified in
  - IEEE Std 802, "IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture"
- Originally IEEE Std 802-1990
- Revision IEEE Std 802-2001
- Revision IEEE Std 802-2014
  - Amended by IEEE Std 802d-2017: *Amendment 1: Allocation of Uniform Resource Name (URN) Values in IEEE 802 Standards*
  - Amended by IEEE Std 802c-2017: *Amendment 2: Local Medium Access Control (MAC) Address Usage*
  - Third amendment in progress: P802f: *Amendment: YANG Data Model for EtherTypes*
  - Procedurally, revision should follow before further amendments

What is the IEEE 802 Family?

- IEEE Std 802 says:
  - *This standard serves as the foundation for the family of IEEE 802 standards published by IEEE for local area networks (LANs), metropolitan area networks (MANs), personal area networks (PANs), and regional area networks (RANs).*
  - *several types of medium access technologies are currently specified in the family of IEEE 802 standards*
- What is a "Family of Standards"?
- In what way are the standards "related":
  - The nature of the relationship is not explained or explored.
- What do IEEE 802 standards have in common?
  - They largely share addresses.
- So, is this a family, or simply a group of "roommates" with shared addresses?

What is the IEEE 802 Architecture?

- What does IEEE Std 802 say about the IEEE 802 architecture?
  - Very little
  - The Scope says “The IEEE 802 architecture is defined”
  - The word “architecture” appears sparsely.
  - Subclause 7.2.2 (“Management architecture”) includes three brief paragraphs about management that do not refer to architecture.
  - Annex B.6 uses the word ““architecture” in reference to the 802.22 RM.
  - No content purports to specify the architecture.
  - The closest to a specification of the architecture is in Clause 5 (“Reference models (RMs)”) says “Figure 3 shows the architectural view of IEEE 802 RM for end stations and its relation to the OSI/RM. A variation of the model applies within bridges, as described in 5.3.2.”
  - Conclusion: The IEEE 802 architecture is neither defined nor specified here.

The “Common” LLC

- In relation to the IEEE 802 RM figure (Fig. 3), IEEE Std 802 says:
  - *For the mandatory data services supported by all IEEE 802 networks, the DLL is structured as two sublayers, with the logical link control (LLC) sublayer, described in 5.2.2, operating over a MAC sublayer, described in 5.2.3.*
- So, the LLC is the commonality in the 802 architecture.
- IEEE Std 802.2 is “Logical Link Control.” IEEE Std 802 says:
  - *IEEE Std 802.2-1989 (reaffirmed 2003) was administratively withdrawn as an IEEE standard on 11 January 2011 in deference to the stabilized standard ISO/IEC 8802-2:1998 where the same material continues to be available.*
- IEEE Std 802 does not detail a role for 8802-2 in the architecture.
- IEEE Std 802 explains 8802-2 only in relation to protocol identification; however, it requires support for a different method of protocol identification, and the Introduction says:
  - *While the protocol identification mechanism specified by ISO/IEC 8802-2 (IEEE Std 802.2™, withdrawn) is still used, its use for new standards has been deprecated.*
    - See EPD and LPD
- So, what exactly is the common LLC?

Data Link Layer per OSI

- Open Systems Interconnection (OSI) specifies seven layers.
- ITU-T X.212 (OSI "Data Link Service [DLS] Definition") describes the service provided by the DLS to the Network Layer, including:
  - *Provides for the transparent transfer of DLS user-data. It does not restrict the content, format or coding of the information, nor does it ever need to interpret its structure or meaning.*
  - *The DLS relieves the DLS user from loss, insertion, corruption or, if requested, misordering of data which may occur. In some cases of unrecoverable errors in the Data Link Layer, duplication or loss of DLSDUs may occur.*
  - *Data Link addresses have only local significance within a specific Data Link configuration over a single transmission medium (point-to-point or multi-point physical connection) or a group of parallel transmission media (multi-link or splitting function). Therefore it is not appropriate to define a global addressing structure.*
  - and more
- Connectionless-mode and Connection-mode services are specified
- How does 802 specify the 802 Data Link Layer Service?
  - Not currently specified, except in 802.2/8802-2.

IEEE 802: General requirements

- IEEE Std 802 Clause 6 is a single page detailing “General requirements for an IEEE 802 network”
  - *capabilities to support the MAC service specified in IEEE Std 802.1AC, between two or more MSAPs… the ability to convey LLC sublayer data from one MSAP to n other MSAPs*
  - Minimal error performance is specified, excluding wireless.
  - A network outage due to a station change is limited to around 1 s.
- Basic characterization of the service is unspecified; e.g.
  - Frame duplication?
  - Frames misordering?
  - Latency or latency bounds?
  - Priorities?
  - VLANs?

802 Service Requirements

- per 802.2, Data Link Layer Service has three forms:
  - Unacknowledged connectionless-mode
    - *may be useful when higher layers provide any essential recovery and sequencing services so that these do not need replicating in the data link layer*
  - Connection-mode
    - *includes support of sequenced delivery of data link layer data units*
  - Acknowledged connectionless-mode
    - *in-sequence delivery is guaranteed for data sent by the initiating station*
- Per 802.1AC, the MAC service is connectionless
  - *In general, the MAC Service provider can perform any or all of the following actions: Discard objects, Change the order of the objects*
  - *The MAC Service exhibits a negligible rate of the following: Object duplication, Reordering of objects for a given priority*
    - But "priority" is not part of the IEEE 802 Architecture
  - *Awareness of the characteristics of the MAC Service provided, e.g., the rate at which objects can be discarded, duplicated, or misordered, is part of the MAC Service user's a priori knowledge of the environment.*

What else is in the 802 Architecture?

- Is bridging in the 802 Architecture?
  - *A secure data exchange standard and MAC bridging standards are intended to be used in conjunction with the MAC standards.*
  - Subclause 5.3.2 covers "MAC-sublayer interconnection: Bridges" and provides basic detail:
    - *A bridge processes protocols in the MAC sublayer and is functionally transparent to LLC sublayer and higher layer protocols. MAC frames are forwarded between access domains, or filtered (i.e., not forwarded to certain access domains), on the basis of addressing and protocol information contained in the MAC frame. Figure 7 shows the position of the bridging functions within the MAC sublayer; note particularly that relaying and filtering are considered to belong entirely within the MAC sublayer.*
    - *IEEE Std 802.1D and IEEE Std 802.1Q specify transparent bridging operation, so called because the MAC bridging function does not require the MAC user frames transmitted and received to carry any additional information relating to the operation of the bridging functions; end-station operation is unchanged by the presence of bridges.*
- Not in the 802 Architecture:
  - VLANs
  - priorities and queuing
  - PDU size limits

IEEE Std 802.1CF

- IEEE Std 802.1CF-2019: ("IEEE Recommended Practice for Network Reference – Model and Functional Description of IEEE 802® Access Network")
- *Abstract: An access network (which connects terminals to their access routers) utilizing technologies based on the family of IEEE 802 ® standards is specified in this recommended practice. An access network reference model (NRM) that includes entities and reference points along with behavioral and functional descriptions of communications among those entities is provided in this recommended practice.*
- 5.2 "Basic architectural concepts and terms" (in its entirety) says:
  - *The architectural concepts used in this and other IEEE 802.1™ standards are based on the layered protocol model introduced by the OSI Reference Model (ISO/IEC 7498-1:1994 [B25]) and used in the MAC Service definition (IEEE Std 802.1AC), in IEEE Std 802, in other IEEE 802 standards, and, with varying degrees of fidelity, in networking in general. IEEE 802.1 standards in particular have developed terms and distinctions useful in describing the MAC Service and its support by protocol entities within the MAC sublayer.*

Some architecture questions

- What architectures are in 802?
- What architectures were in 802?
- What architectures could have been in 802?
- What architectures could be in 802?
- Are there, or should there be, specified versions of the 802 architecture for specific MACs
  - e.g., should we have an architecture specific to Ethernet networks?

Questions for Nendica to consider

- Would 802 benefit from a Nendica Study Item on Evolving IEEE 802 Architectural Requirements, leading to a formal Nendica Report or an informal report?
- What should it contain?
  - Requirements for documentation of existing architecture
  - Requirements for new architectural details
  - Role of LLC
    - Including EPD and LPD
  - Role of new and evolving technologies; e.g.
    - Time-Sensitive Networks
    - Structured addresses
    - Cut-through forwarding
    - etc.
  - Possible Ethernet-centric architecture optimization
- Would such a study aid IEEE 802 in planning for a revision of IEEE Std 802?
- Should these questions be addressed in a Nendica Study Item?

Proposal

- For Nendica to initiate a Study Item on Evolved Link Layer Architecture (ELLA), with the goal of producing, by the November 802 Plenary, an informal report documenting:
  - Summary of aspects missing from current IEEE 802 Architecture documentation
  - Potential benefits enabled by additional architectural details
  - Impact of new and evolving technologies on architecture
  - Architectural optimization in specific network environments
  - Possible standardization recommendations