Cut-Through Forwarding (CTF) in Bridges and Bridged Network – Considerations on Modelling, Compatibility and Locations

Johannes Specht

(Self; Analog Devices, Inc.; Mitsubishi Electric Corporation; Phoenix Contact GmbH & Co. KG; PROFIBUS Nutzerorganisation e.V.; Siemens AG; Texas Instruments, Inc.)

DCN 1-22-0021-00-ICne

Introduction

- The discussion on April 27, 2022 based on contribution https://www.ieee802.org/3/ad_hoc/ngrates/public/calls/22_0427/jones_nea_01_220427.pdf provided several insights on understanding different concerns on CTF/the proposed project P802.1DU.
- This slide set
  - summarizes the author's interpretation of the concerns, and thoughts/options on addressing these,
  - is an attempt for further discussing and analyzing concerns,
  - is an individual contribution (not a WG statement), and
  - limits on the first topic listed in the following.

Topics and Aspects from April 27

- Topics
  - Main CTF operation – frame transmission start before reception completed
  - Frames with inconsistent FCS
    - Processing by the 802.3 MAC
    - Passing between 802.3 MAC ⇔ MAC Client (bridge)
    - “FCS stomp” variations
  - Management counters
  - Options for locating CTF in IEEE 802 WGs and projects
- Aspects
  - Modelling
    - In existing 802 Stds
    - In new 802 Stds for CTF (P802.1DU)
  - Conformance/Compatibility
    - Of existing S&F implementations – related to 1.2.2 of the P802.1DU CSD draft
    - Of existing CTF implementations – no strong relationship to existing 802 Stds

Aspects over Topics

Topic \ Aspect	Modelling: Existing 802 Stds	Modelling: New 802 Stds on CTF	Conformance/Compat.: Existing S&F Impl.	Conformance/Compat.: Existing CTF Impl.
Main CTF operation	X	X	X	[X]
Frames with inconsistent FCS: Processing by 802.3 MACs	X		X	
Frames with inconsistent FCS: Passing between 802.3 MACs ⇔ MAC clients (bridge)	X		X	
Frames with inconsistent FCS: “FCS stomp” variations		X		X
Management counters		X		X
Locating CTF in IEEE 802 WGs/projects		X		

Main CTF Operation

Main CTF Operation: Introduction

- Author's recollection and interpretation of related concerns discussed:
  1. Changing the 802.3 MAC model could be a huge Stds development task.
     1. The 802.3 MAC, as it is right now, passes frames to higher layers (i.e., Std 802.1AC) as atomic unit after the end of serial reception by the MAC sublayer.
     2. CTF could require serial transfer from MAC sublayer to higher layers.
  2. Existing S&F implementations conformant to IEEE Stds 802, 802.1AC and 802.1Q could be non-conformant/incompatible with P802.1DU.
- Related items presented on April 27
  (https://www.ieee802.org/3/ad_hoc/ngrates/public/calls/22_0427/jones_nea_01_220427.pdf)
  - Slide 5
  - Slide 7
  - Slides 8 (except "without error")
  - Slides 9 and 10
  - Slide 11 (except "without error")
  - Slides 12 and 13

Main CTF Operation: Modelling (1)

- At least two approaches for **modelling** the main CTF operation were presented
  - Modelling limited “as much as possible” to externally visible behavior (e.g., https://www.ieee802.org/1/files/public/docs2021/new-specht-ctf-802-1-1121-v01.pdf)
  - Modelling by look-ahead of frame reception service primitive invocations (https://mentor.ieee.org/802.1/dcn/22/1-22-0015-01-ICne-idealistic-model-for-p802-1du.pdf)
- The second approach, modelling by look-ahead of frame reception service primitive invocations, is considered in the following:
  - Appears good for progressing discussions in the joint NEA/Nendica ad hoc meetings
  - Along the idea of showing potential approaches to address concerns for discussion

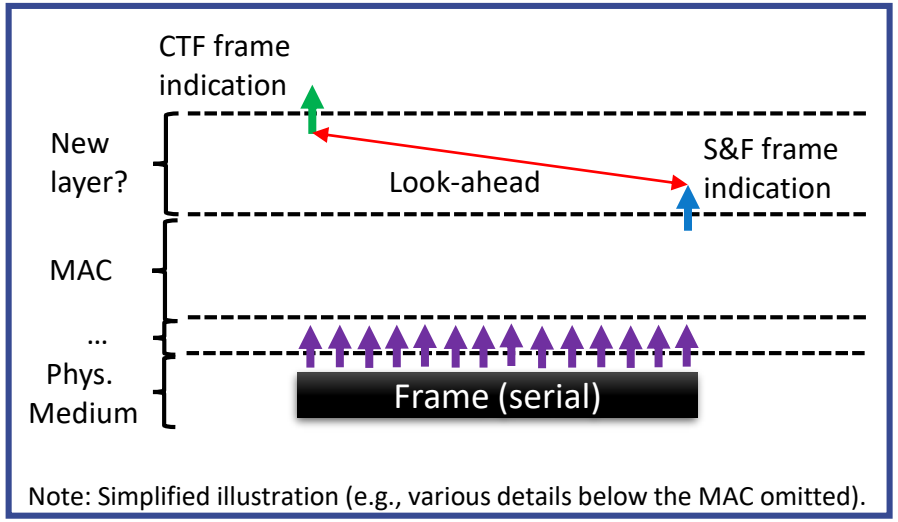
Main CTF Operation: Modelling (2)

- Modelling by look-ahead of frame reception service primitive invocations (https://mentor.ieee.org/802.1/dcn/22/1-22-0015-01-ICne-idealistic-model-for-p802-1du.pdf)
- Summary of the approach
  - Look-ahead of S&F frame indication primitive invocations (i.e., on RX), resulting in new CTF frame indication primitive invocations a frame duration earlier. I.e.:

    → **Atomic (and instantaneous)** invocations on per-frame resolution.

    → **No need for serial transfers from MAC to MAC client at a resolution below frames (e.g., octets)!**
  - Similar look-ahead approaches are found in the models of lower sublayers in IEEE Std 802.3-2018 ["prescient" functions in some PCS clauses, Reconciliation Layer (65.2.3.4.5) and MAC Merge Sublayer (99.4.7.4)]
  - Could be done in P802.1DU (e.g., located on top of where the ISS is in 802.1AC)

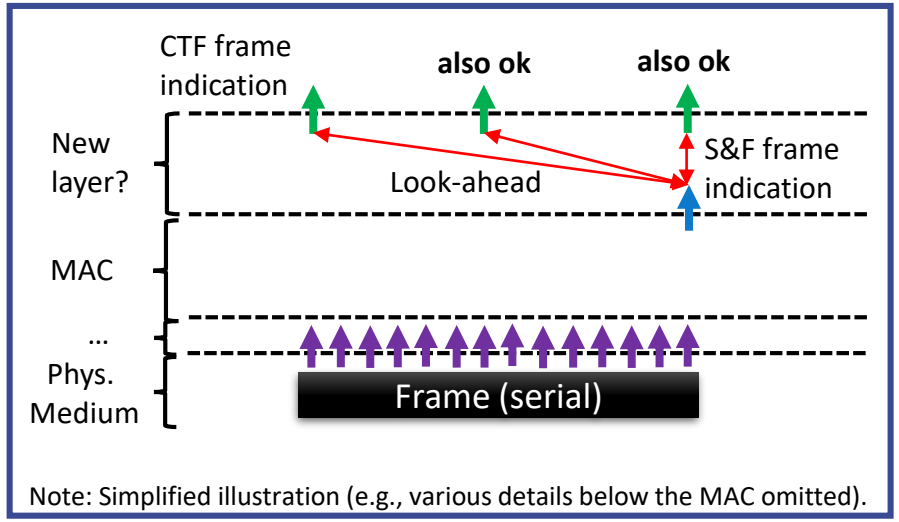
    → **No need for changing the 802.3 MAC!**



Main CTF Operation: Conformance (1)

- <u>Interpreted concern</u>
  As soon as P802.1DU would require bridge implementations to start frame transmission (TX port) prior to completed frame reception (other RX port), existing S&F implementations conformant to IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q could turn out non-conformant to P802.1DU.
- A technical approach
  - Extend the look-ahead based modelling approach by permitting CTF frame indication primitive invocations within an implementation-dependent range
    - Earliest: The frame duration earlier than the (non-CTF) indication primitive invocation
    - Latest: At the same time as (non-CTF) indication primitive invocation

  → **Conformance of existing S&F implementations**
  (even if frame transmission start prior to compete frame reception is not supported by an existing S&F implementation)

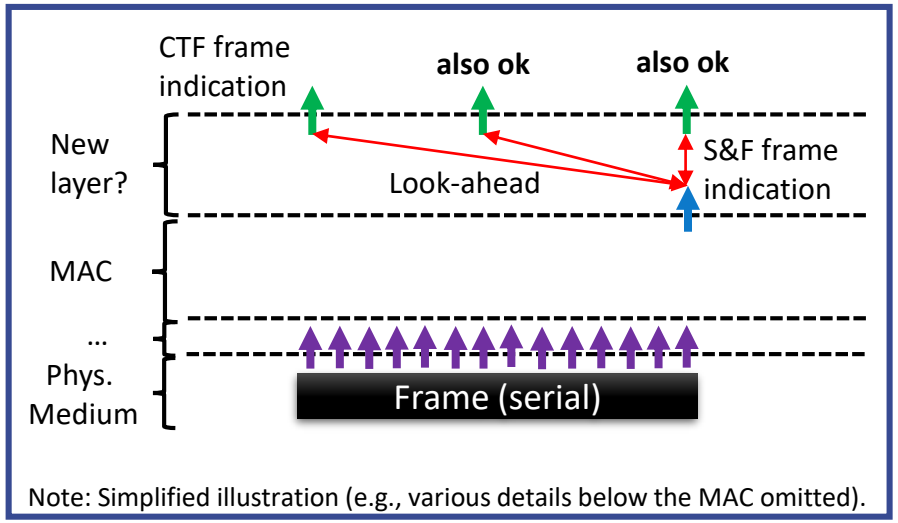


Main CTF Operation: Conformance (2)

- Thoughts on compatibility with IEEE Stds 802, 802.1AC and 802.1Q
  - CTF frame indications earlier than the associated S&F frame indication are like an optional feature of bridge implementations
  - Similar, several amendments to 802.1AC and 802.1Q introduced optional features (e.g., new traffic shapers)

  →It may be acceptable if WG 802.1 would answer "Yes" in "1.2.2 Compatibility" of the P802.1DU CSD draft (similar to past amendment projects)

  →If acceptable, WG 802.1 should be responsible for ensuring compatibility during development of P802.1DU
- Necessary but not sufficient …
  - The main CTF operation may be the most important topic to with regard to "1.2.2 Compatibility" in CSD drafts of P802.1DU, but not the only one.
  - Achieving "1.2.2 compatibility" = "Yes" by retaining elements as optional features may apply for elements from topics other than the main CTF operation (next slides).



Note: Simplified illustration (e.g., various details below the MAC omitted).

Thank You for Your Attention!

Questions,
Comments,
Opinions,
Ideas?