Comparing IEC61850 and DNP3

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Objective

- Provide a comparison of IEC61850 (UCA2.0) and DNP3 in terms of:
  - Where they came from/Original purpose
  - Standard structure
  - Protocol profile
  - Services
  - Objects
- Acknowledgements:
  - SubNet Solutions for DNP3 info.

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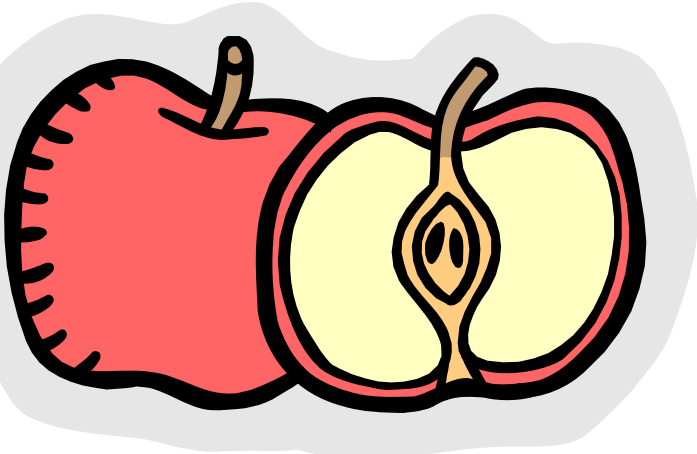

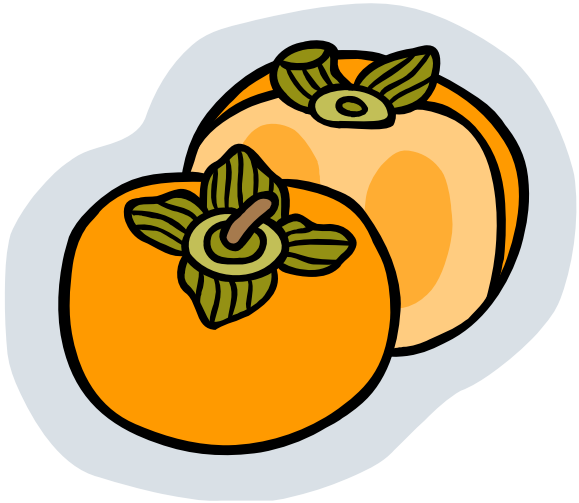

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Disclaimer

Apples and oranges are very different from one another in taste, texture, and origin.

You make apple pie from apples.

You make orange juice from oranges.

Just because they are made from different fruits doesn't mean that you can never enjoy orange juice with apple pie.

IEC61850 and DNP3 are also made from different stuff and came from very different origins. However, both technologies have their place and can co-exist in systems.

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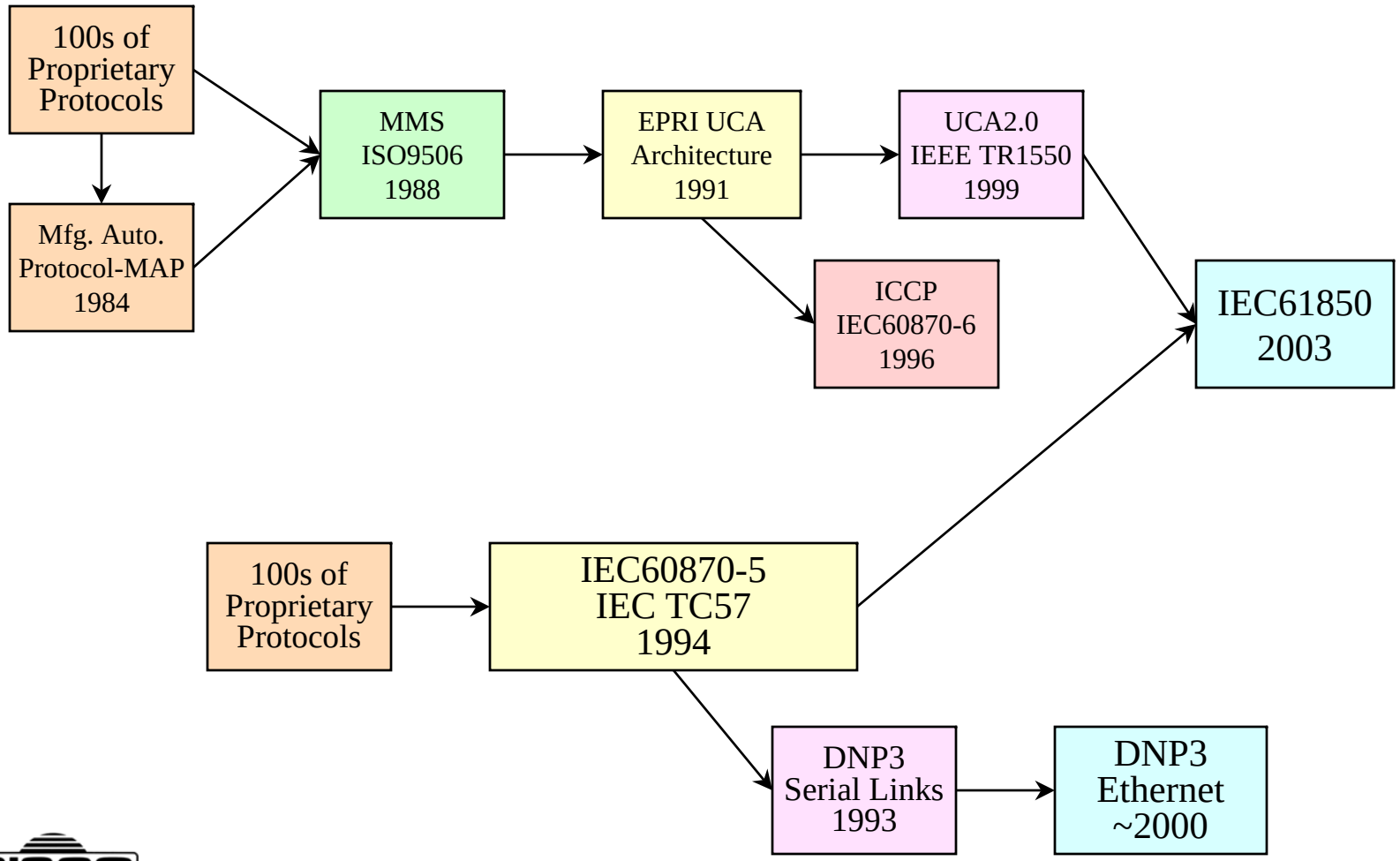
Evolution



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Comparison of Roots

- DNP3 addressed North American requirements from IEC60870-5 work.
- IEC61850 addressed European requirements from UCA2.0 work.

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Comparison of Roots

- UCA2.0 was developed for LAN/WAN and profiles added for serial links.
- DNP3 was developed for serial links and profiles were added for LAN/WAN.

Comparison of Roots

- DNP3 has roots in the RTU world where byte efficiency for low-speed links was important.
- IEC61850 has roots in the LAN/WAN world where independence from the organization and storage of “bytes” was important.

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Impact of Roots

- DNP3 is very byte efficient optimized for low-bandwidth applications.

- IEC61850 is feature rich with capabilities optimized for LAN/WAN based systems.

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Standard Structure

- DNP3 consists of:
  - Protocol specification that defines the bytes sent/received, data formats, and timing (the “Basic 4”)
  - DNP3 subset specifications for specific devices
- IEC61850 consists of:
  - Definition of architecture and requirements.
  - Abstract definition of objects and services.
  - Mapping of these abstracts to a specific profile (MMS and Ethernet).

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Impact of the Standard Structure

- The DNP3 specifications look simpler.
- IEC61850 defines more externally visible behavior for a device.

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Profiles

- A profile is a specification for how protocols are put together to implement a complete “stack”.
- Directed Communications = Connection oriented communications between two specific entities.
- Multi-Cast Communications = Connectionless communications from one to many.

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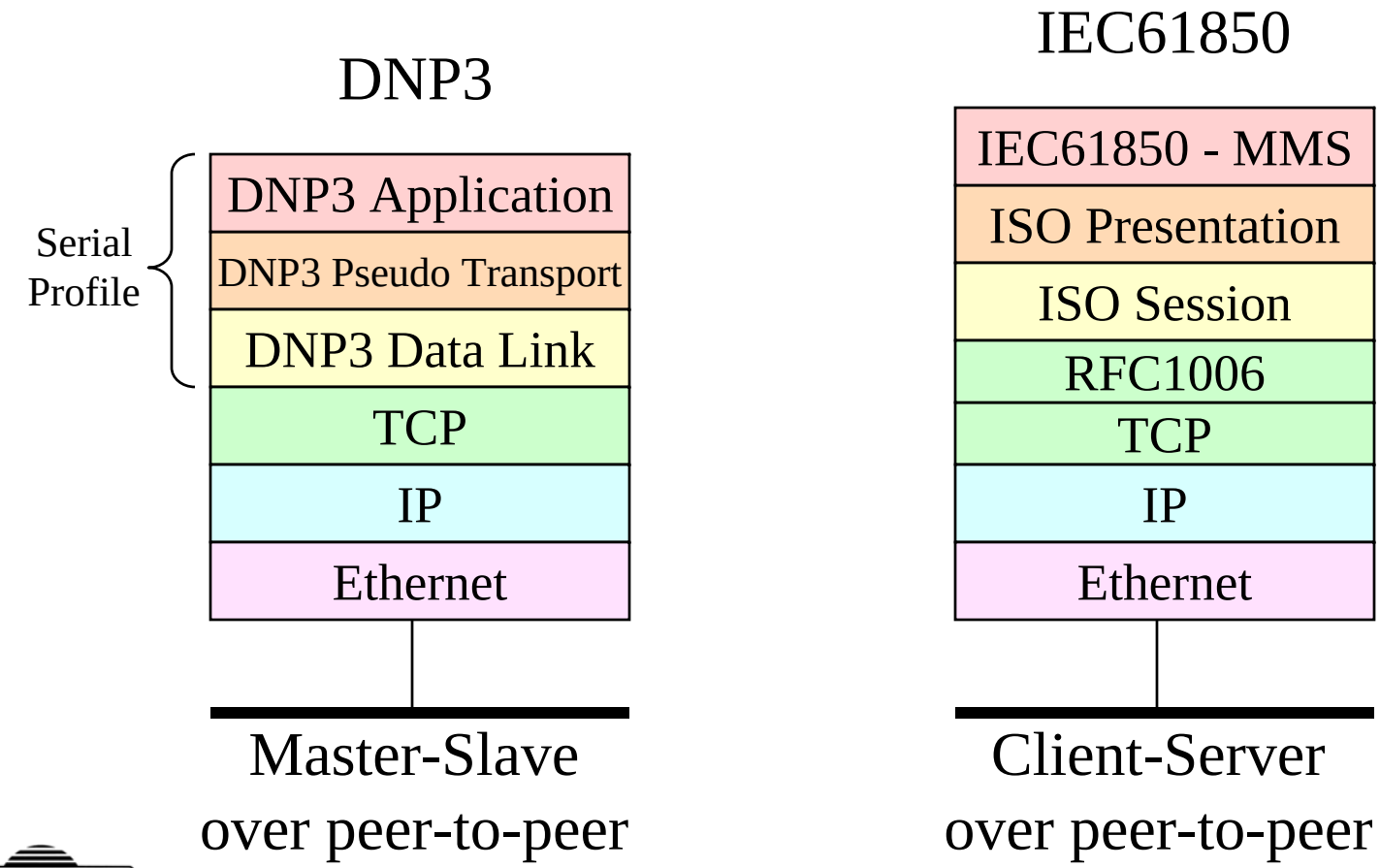
Profile Comparison

Directed Communications – Connection Oriented



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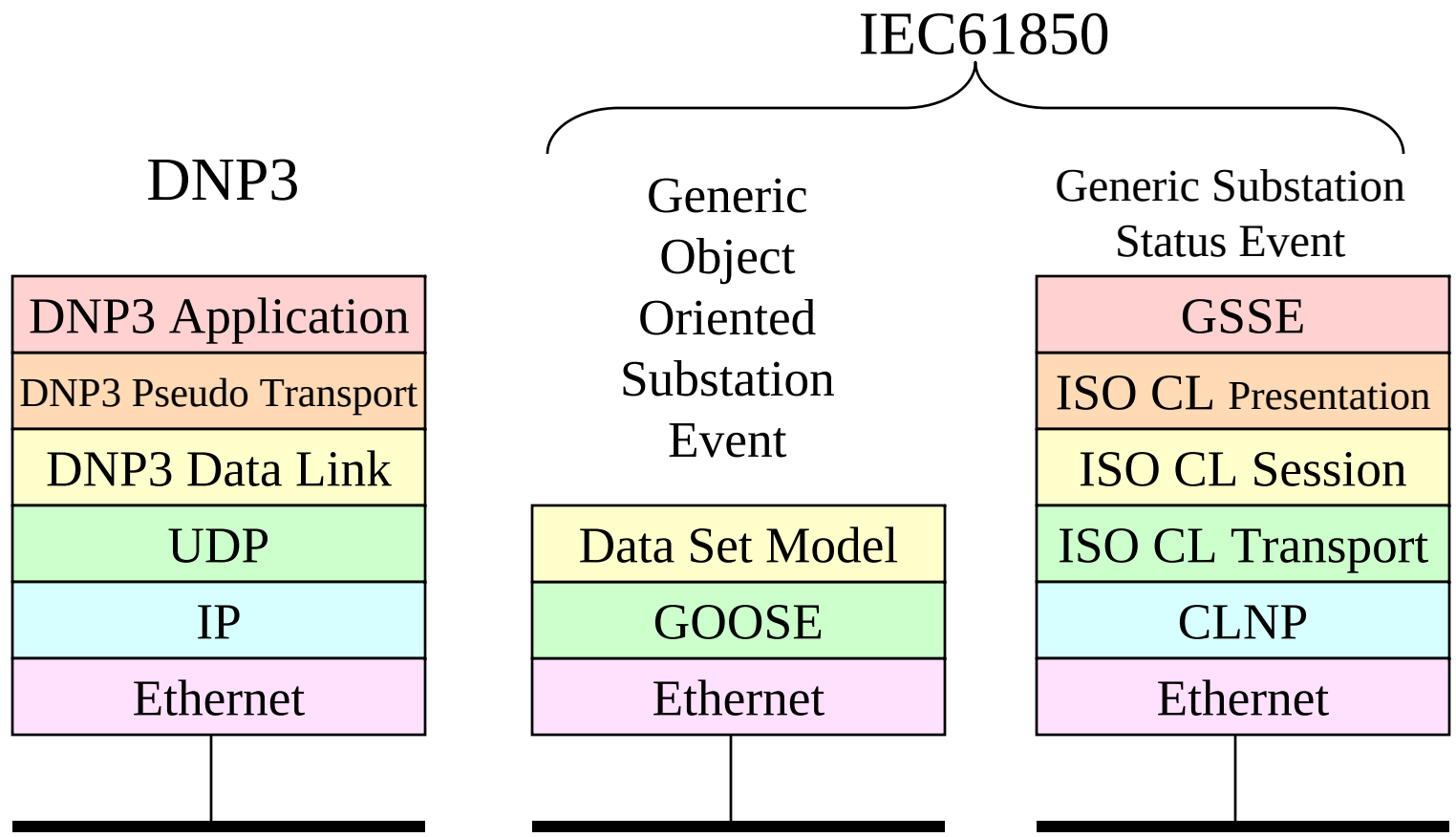
Profile Observation

- Serial link characteristics are preserved on TCP/IP Ethernet although some timing issues are removed by eliminating data link confirmations.

Profile Comparison

Multi-Cast Communications - Connectionless



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Multi-Cast Profile Observations

- Little room for comparison due to radically different approaches to implementation:
  - IEC61850 GOOSE/GSSE is designed specifically for very high-performance (4ms) in LAN for peer-to-peer messaging.
  - DNP3 over UDP applies the serial link profile over UDP to deliver DNP3 packets to multiple nodes.
    - Segmentation/sequencing issues for UDP based networks with multiple routing paths.

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Service Comparison

Service Description	DNP3	IEC61850
Read/Write	YES	YES
Reporting	YES	YES
Control (SBO and Direct)	YES	YES
Enhanced Control (with Reports)	*	YES
Files	YES	YES
Start/Stop	YES	*
Event Logs	*	YES
Substitution (Forcing)	YES	YES
Object Discovery	-	YES
Substation Configuration Language (XML)	-	YES
Peer-to-Peer Messaging (GOOSE/GSSE)	-	YES

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* Not in the standard, but can be implemented

Observation on Service Comparison

- IEC61850 does have more services and options most notably:
  - Buffered reporting
  - GOOSE/GSSE (multi-cast messaging)
  - **Object Discovery Services**
  - Substation Configuration Language
- Both DNP3 and IEC61850 provide sufficient services for many applications.

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Object Model Similarities

- Both support discrete, digital, analog, counter, and floating point data types.
- Both support pre-defined quality flags
- Both support time stamped data.

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Object Models: DNP3

- DNP3 Objects are described by:
  - Object #: 1=Binary Input Static, 2=Binary Input Event, etc.
  - Variation #: 1=With status, 2 = without status, etc.
  - Index #: Refers to a specific instance of an object.

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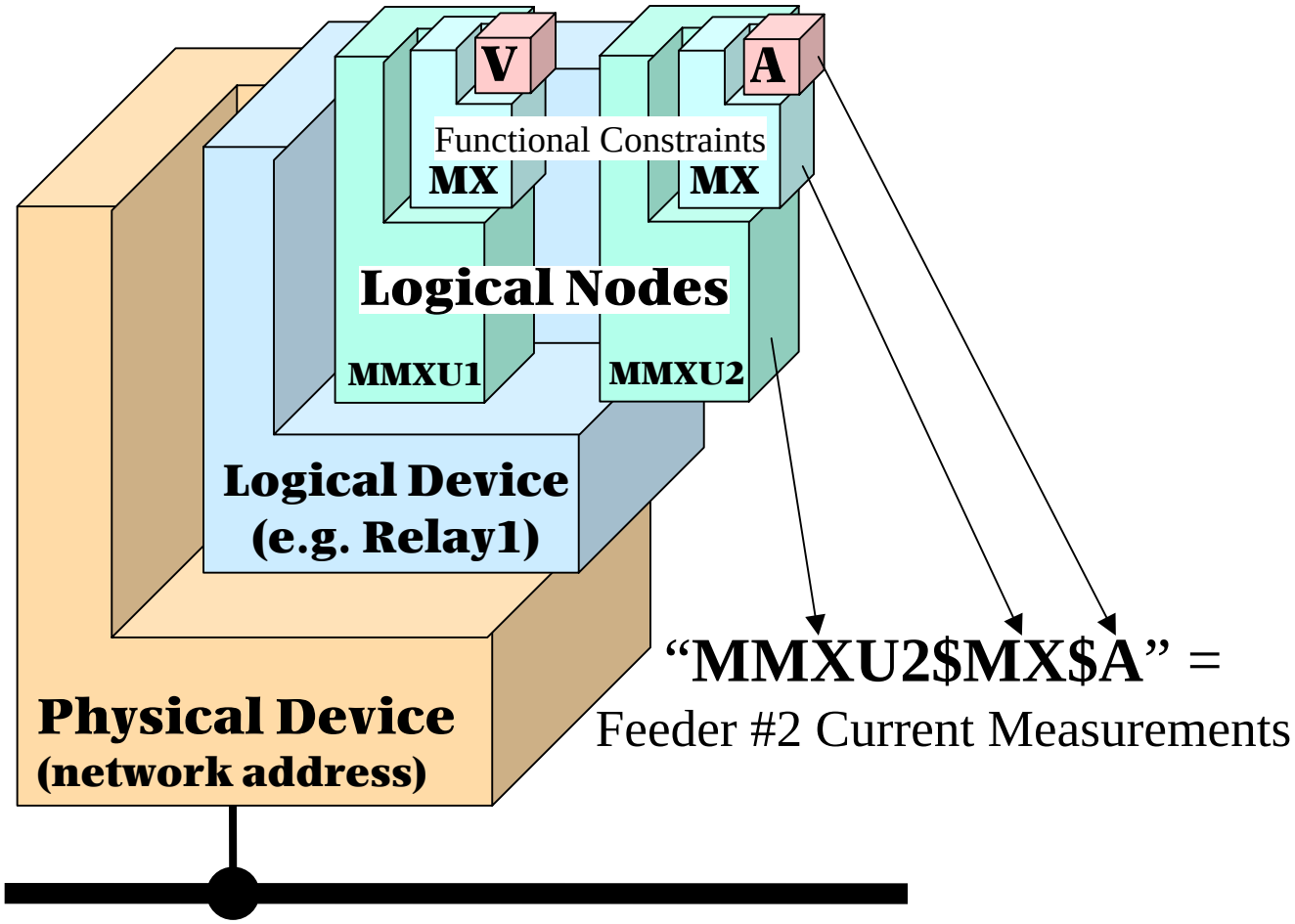
Object Models: IEC61850



Names v.s. Indexes

- Names convey context and meaning improving understanding.
- Names need more bandwidth to communicate.

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Conclusions

- Both can be optimal for a given application depending on the requirements.
- Both can be applied successfully in sub-optimal applications.
- Using one does not preclude the use of the other. Both can easily co-exist.

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Questions - Discussion

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Thank You

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