



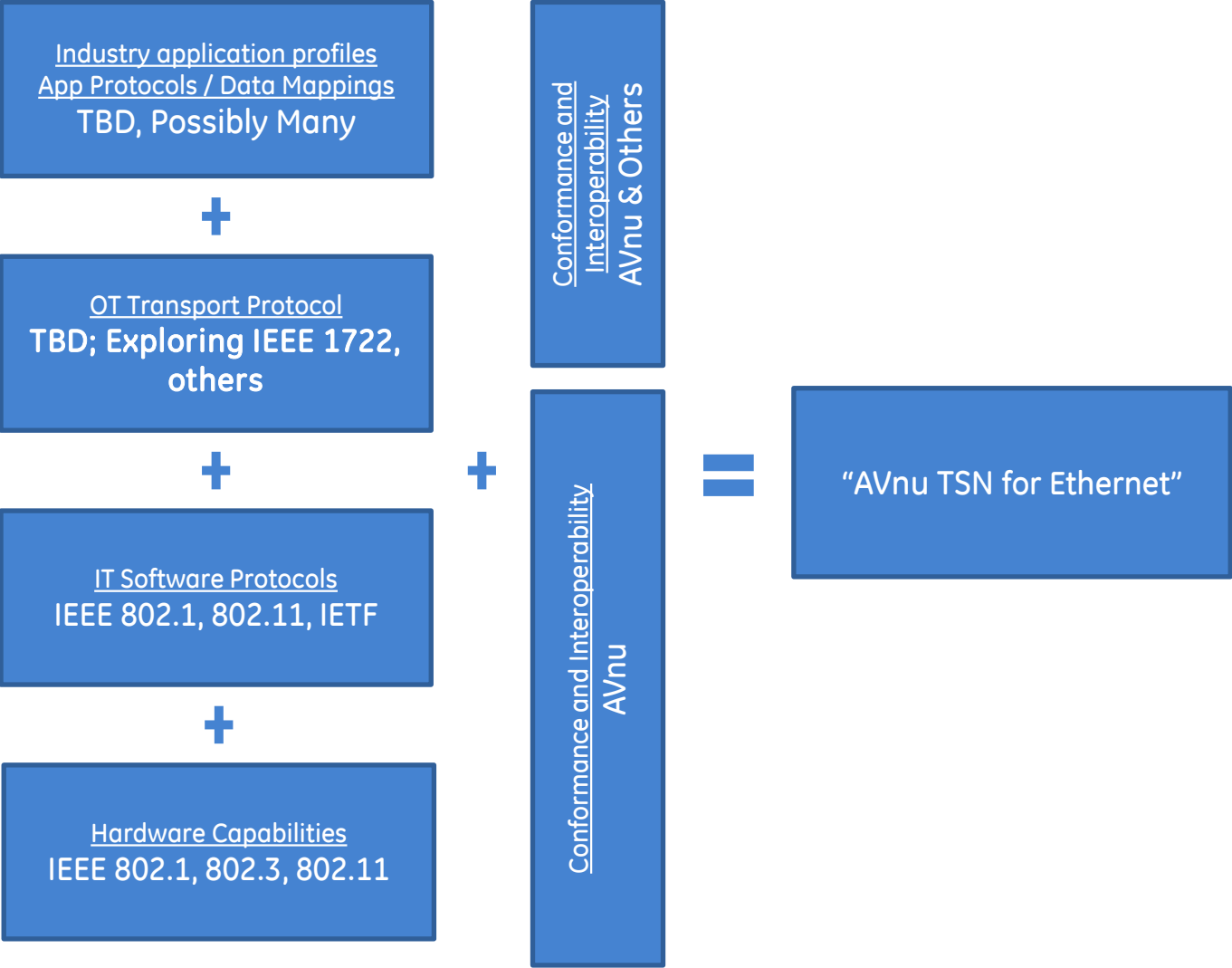
# Industrial Market Working Group – Current Thinking

(Not Completely Vetted)

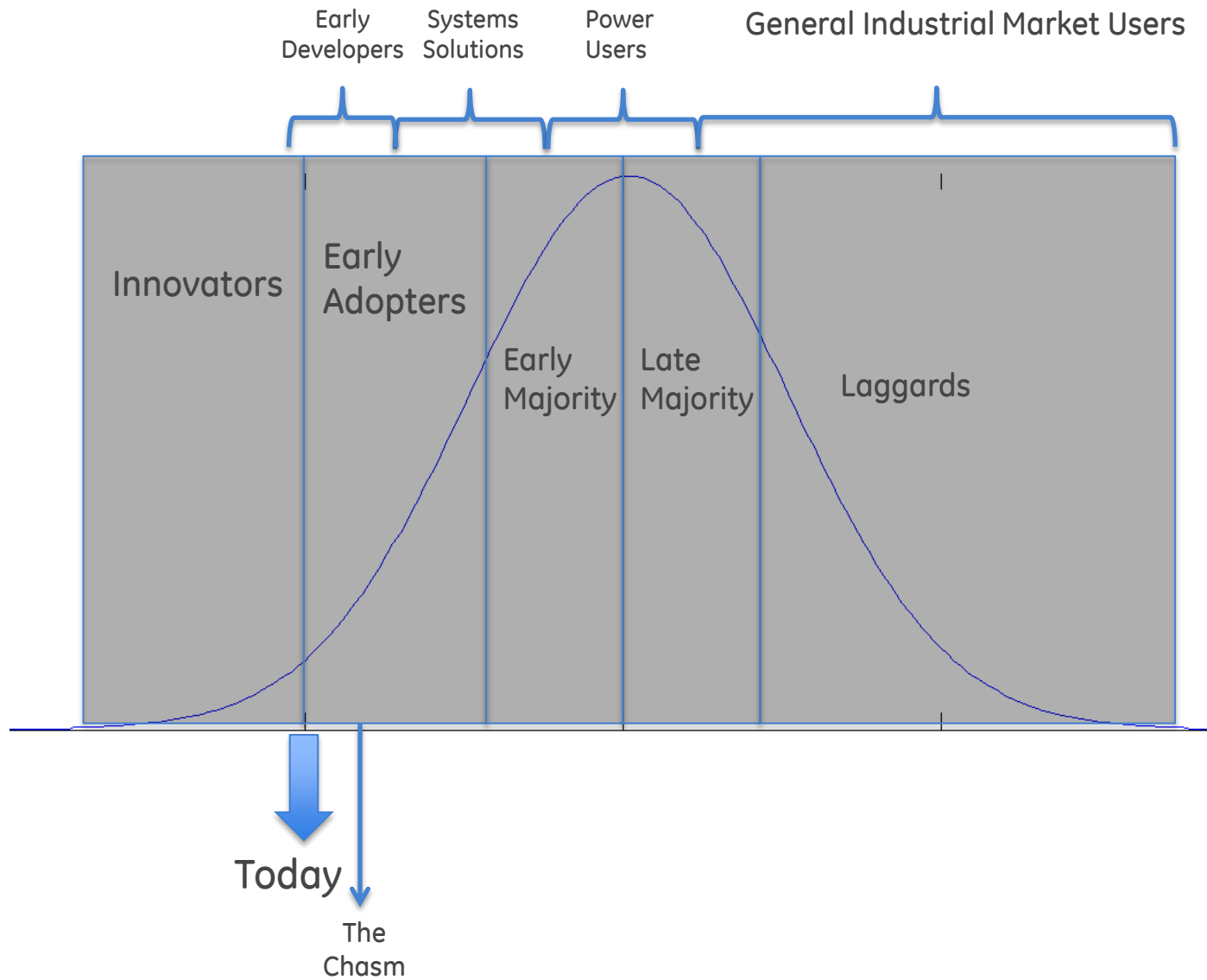
Dan Sexton – GE

Todd Walter (Chair) - NI

# What Standards Specify AVnu TSN for Ethernet?



# Innovation Adoption Lifecycle



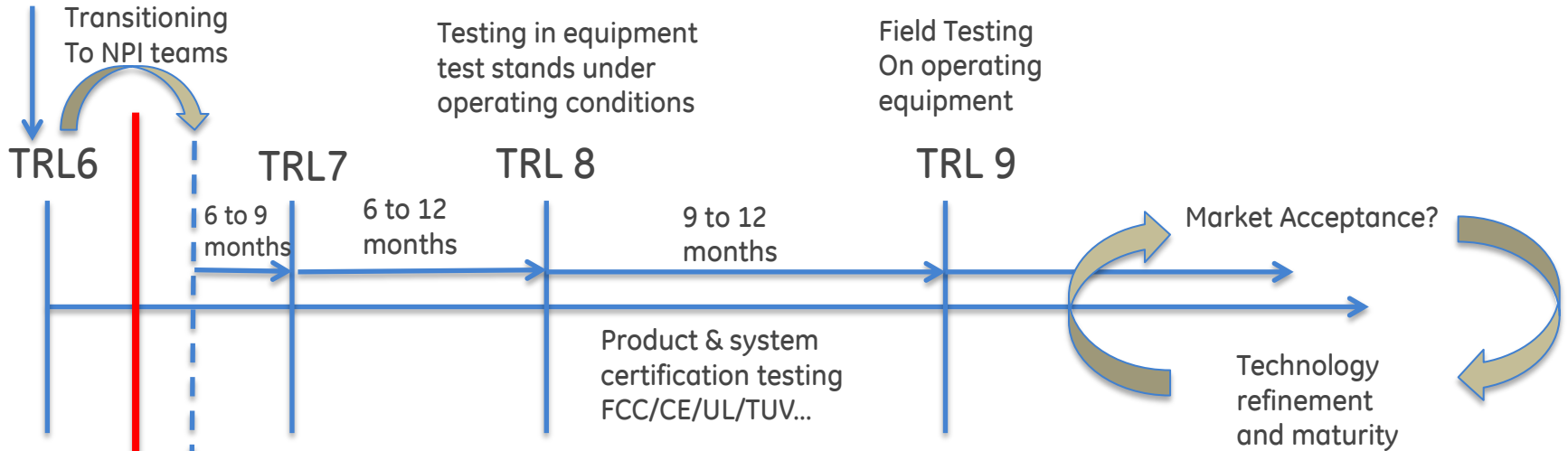
# Industrial Product Deployment Cycle - Example

Small Networks  
Hand crafted  
Demo boards,  
Eval kits & Repurposed  
hardware

Testing on dry rigs  
and Simulators

Testing in equipment  
test stands under  
operating conditions

Field Testing  
On operating  
equipment



FPGA Implementations  
POCs of representative  
applications,  
Simulations

Are we  
Stuck  
Here?

First Silicon  
Prototypes

Pre-production  
Early Production  
hardware

Standards approaching finalization  
(functions & interfaces nailed down)  
Core IP available (Silicon, VHDL, SW, etc)

Until we ship the first  
systems we won't know  
what the market really  
wants

# Standards situation

New work being discussed

No work underway

Work in progress

Standard complete

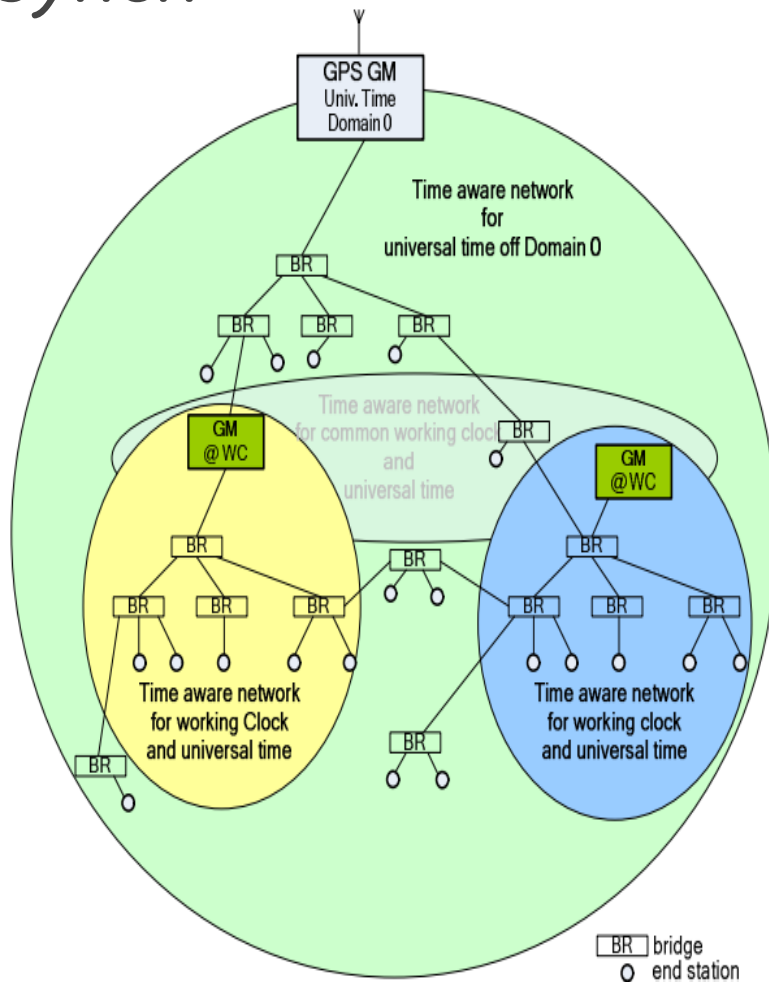
Complete, revision in progress

Activity	Standard L2 Hardware		Standard L3 Hardware	Standard L2 Software		Standard L3 Software
Time Synch	1588			802.1AS-REV		1588
AVB Streams	AVB			AVB		DetNet
				802.1Qcc		
Scheduling	802.1Qbv			802.1Qcc		DetNet
0 Congestion Loss TSN	802.1Qch Cyclic Queuing and Forwarding			802.1Qcc		DetNet
Preemption	802.1Qbu, 802.3br			802.1Qbu		N/A
Multipath	HSR	PRP	MPLS, SPUD	HSR	PRP	DetNet
	802.1Q			802.1Qca		
Seamless Redundancy	HSR	PRP	DetNet	HSR	PRP	DetNet
	802.1CB			802.1CB		
Robustness	802.1Qci		DetNet	802.1Qcc		DetNet

# AVnu Industrial Minimum Viable Feature Timeline and Priority

Priority	Requirement	Project(s)	2015	2016	2017
1	Network time synch with static config	ASrev	Y	Y	Y
1	Scheduling	Qbv	Y	Y	Y
1	Centralized config	Qcc, Restconf/Netconf 1722?	Y	Y	Y
2	Seamless redundancy including time synch	CB, ASrev	N	Y	Y
2	Ingress policing including BE limiting	Qci	Y/N	Y	Y
2	Frame preemption	Qbu	N	N	Y
2	L3 support		N	N	Y
3	Cyclic schedule	Qch	N	N	TBD
3	Credit based shaper	Qav	N	N	TBD
3	Stream management (SRP)	Qat	N	N	TBD
-	ISIS	Qca	N	N	TBD

# What will initial deployments look like for Time Synch



End stations and switches are grouped according to time domain  
A common “working clock” defines the domain using .1AS

Domain has its own GM and is independent of traceable time

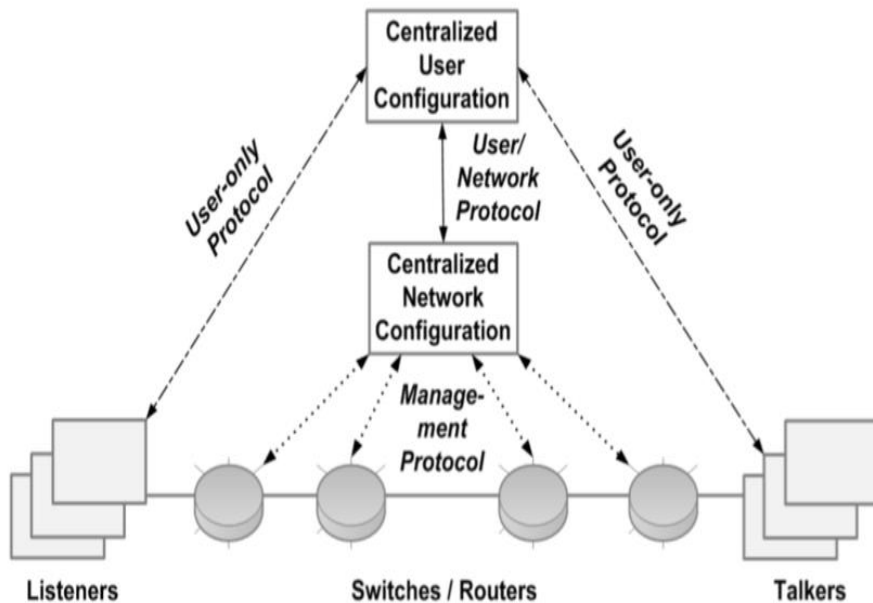
“Universal clock” can apply to multiple working clock domains

Enables correlation to global traceable time (GPS, etc.)

Implemented as second timescale

Could be .1AS or other PTP profiles

# What will initial deployments look like



## Centralized User Configuration

“User-only protocol” to set-up end-stations

User/Network Protocol using Qcc UNI

Centralized Network Configuration performs software defined networking setup of switches

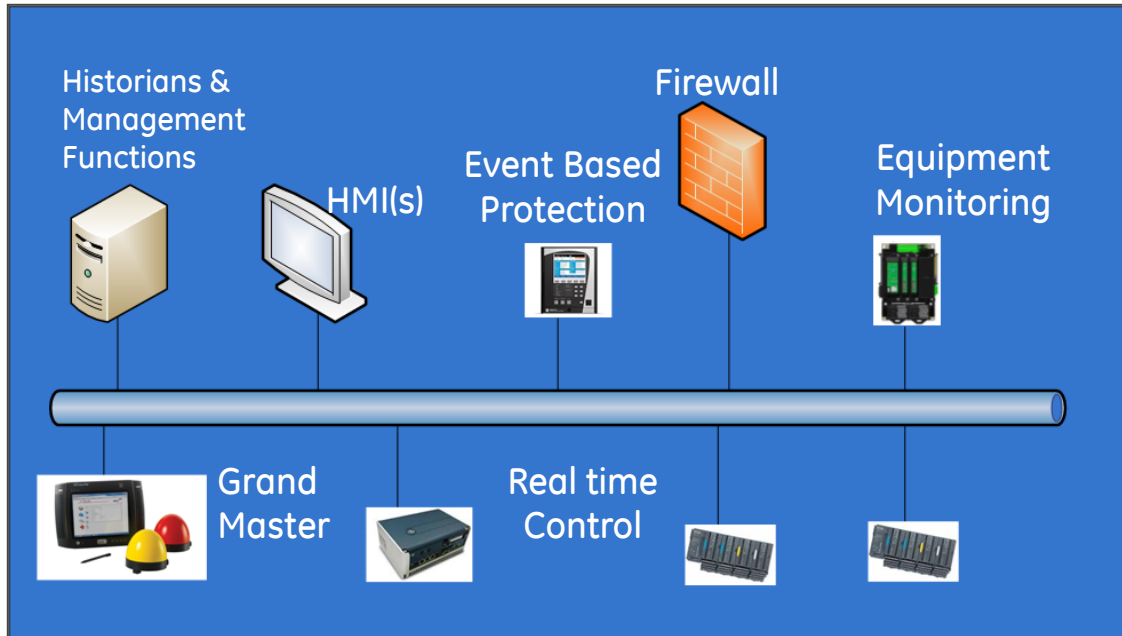
AVnu investigating and will select one of:

- RestConf
- NetConf
- 1722



# What will initial (2016) deployments look like

## Fixed Application Deployments Dedicated System



### Examples:

- Power Island
- Substation
- Automation Cell
- Vehicle Platform

### Features:

- HSR/PRP redundancy
- Mixed traffic
- Fixed Schedules - Offline

### Management Functions:

- Security, Authentication
- Topology Verification
- System Startup

### Network Traffic

- Insecure best effort
- Secure best effort
- Secure event based
- Secure cyclic

### Application Time Standards

- 802.1AS
- C37.238
- PTP Default

Questions?