

CONTROL SYSTEMS AT SCANDINOVA

Jonas Gustafsson,
Software & System design

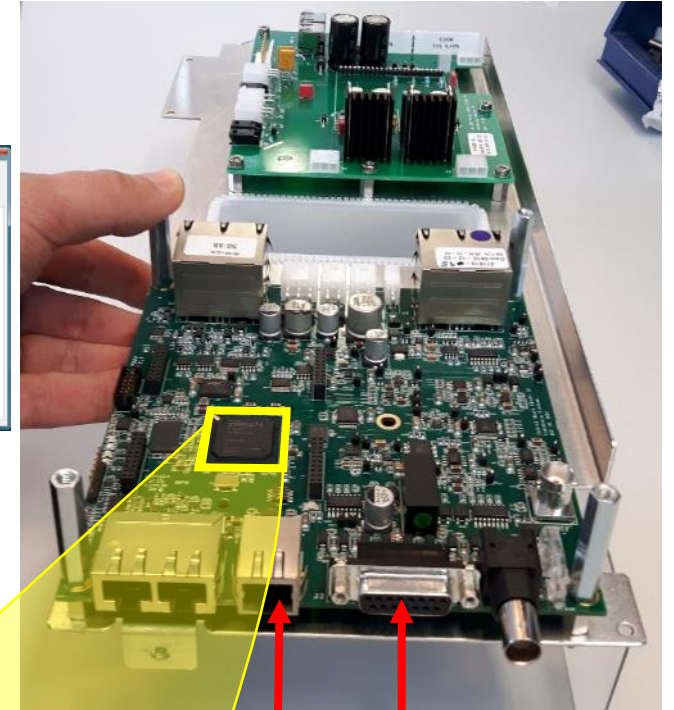
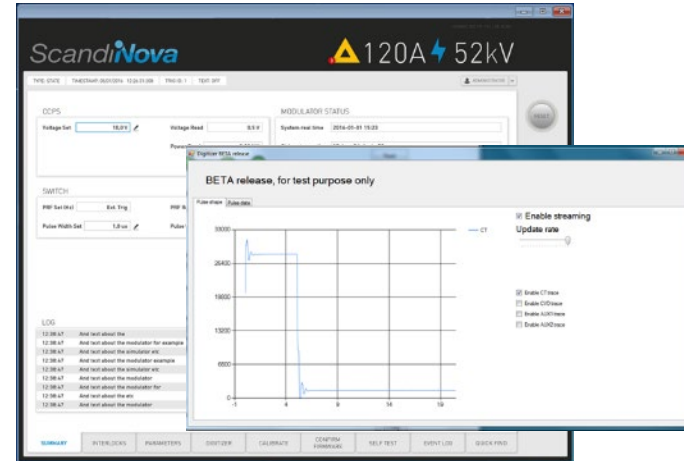
IN OUR PRODUCTLINE WE HAVE...

- Two different controlsystems
- With some similarities



M&E-SERIES

- CS name: MK.IV or LORANGA
- Has a GUI
- One controller*
- High performance
- Not modular/flexible

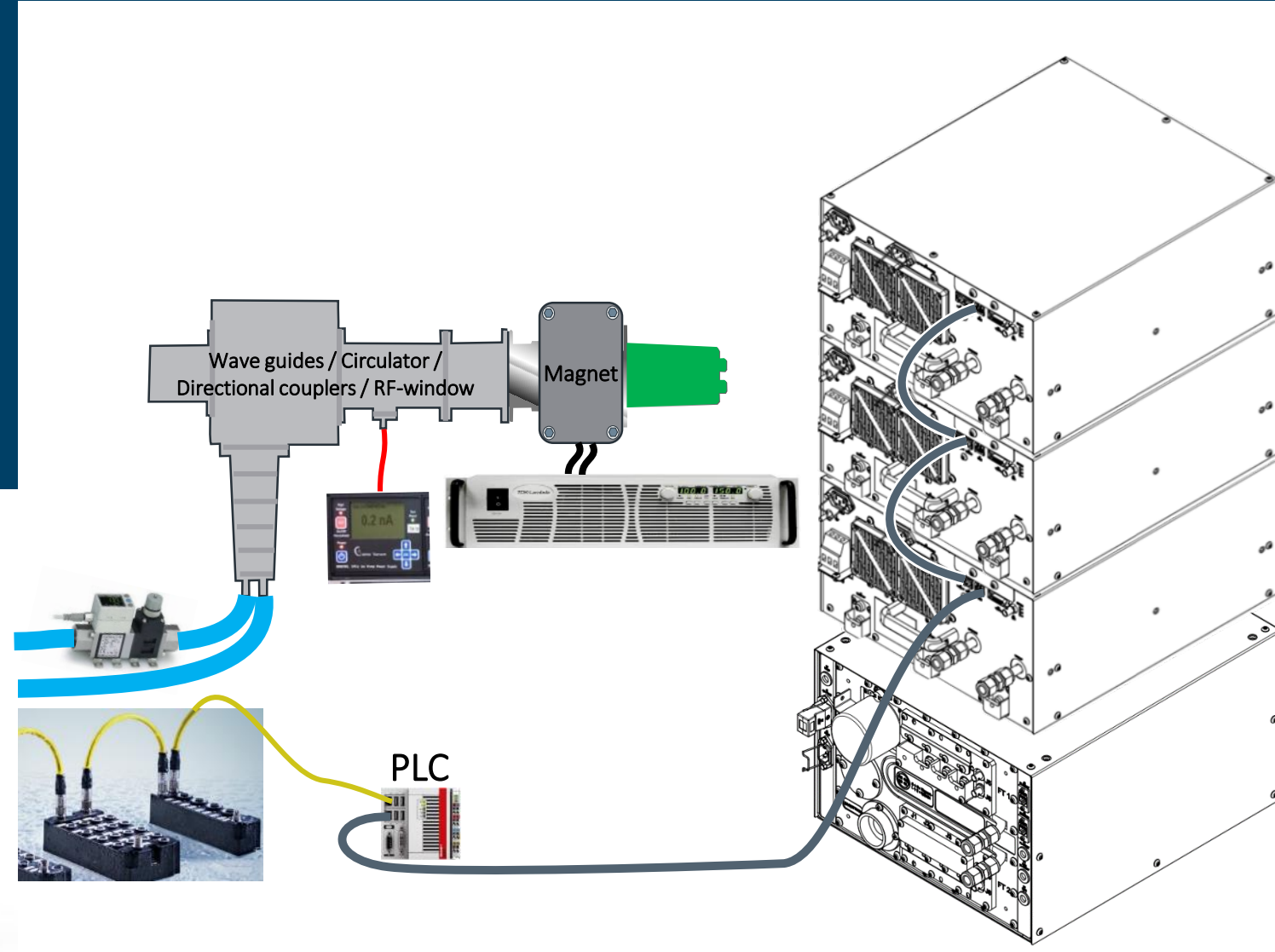


HwCtrl



WE DO SOME HYBRIDS

- A mix of the K and the M-SERIES



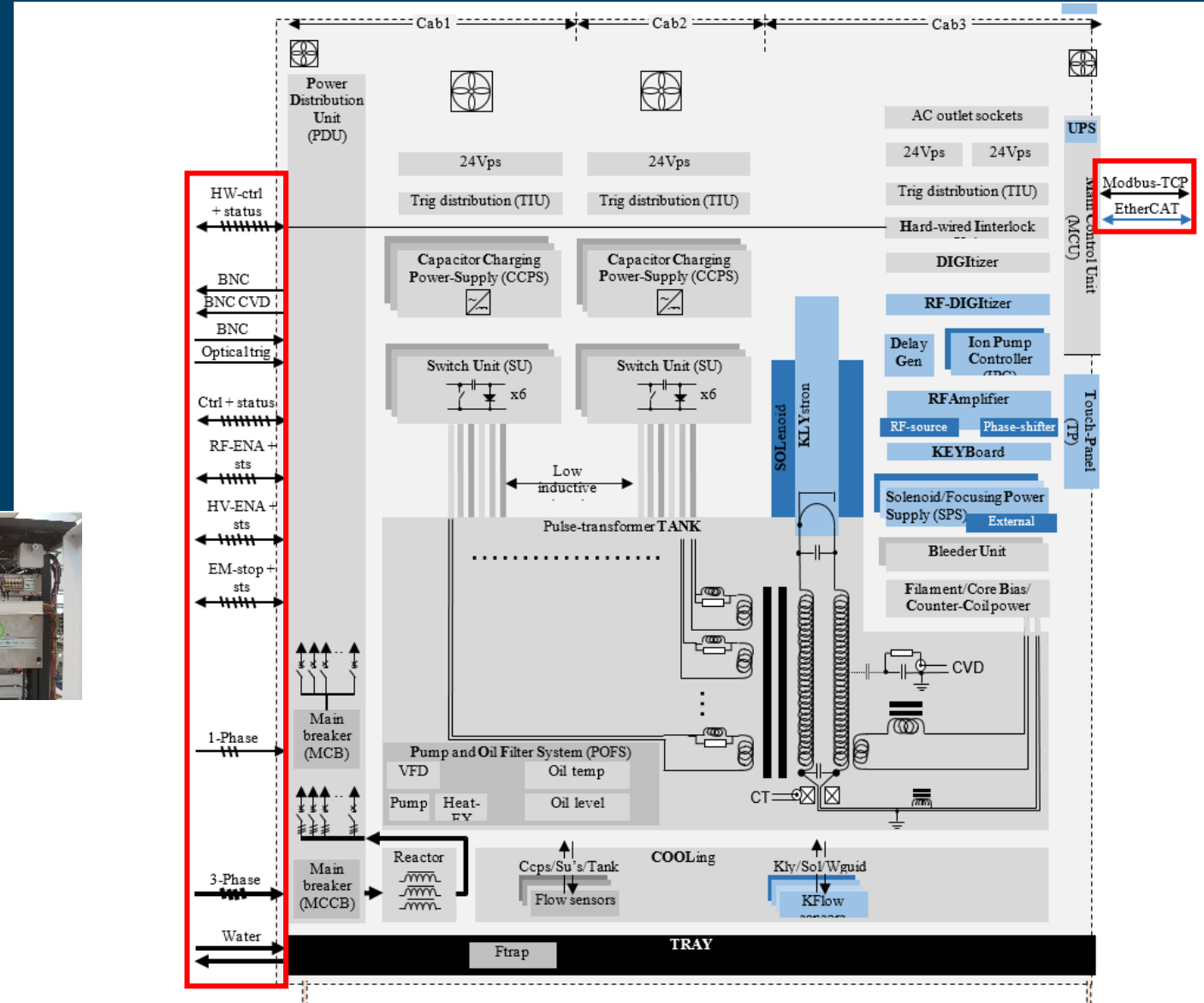
K & PG-SERIES

- ScandiCAT (because its based on EtherCAT)
- Multiple nodes
- High performance
- Modular/flexible

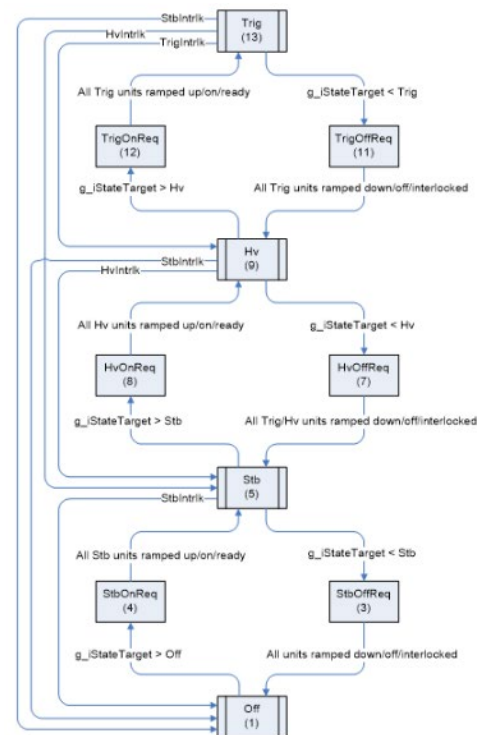
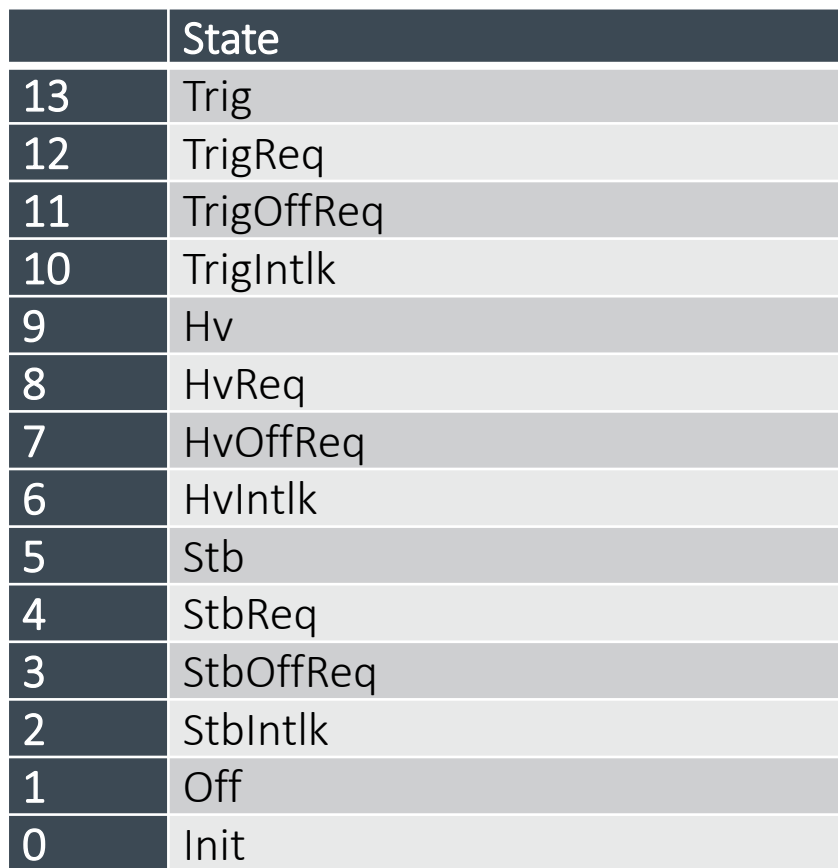


SCANDICAT

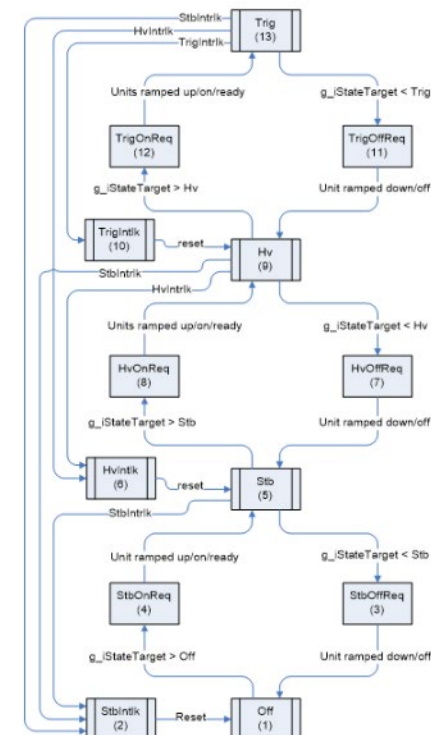
- Signal interface on the sides (inside covers)
- All inputs / outputs are handled by an SSM



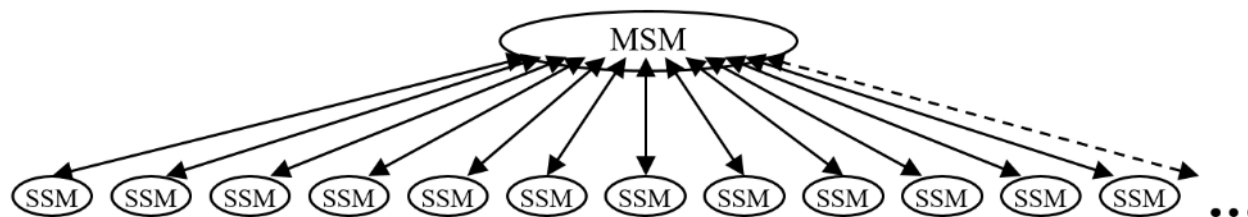
- MSM & SSM's



The state transitions of a Master State Machine with four states.



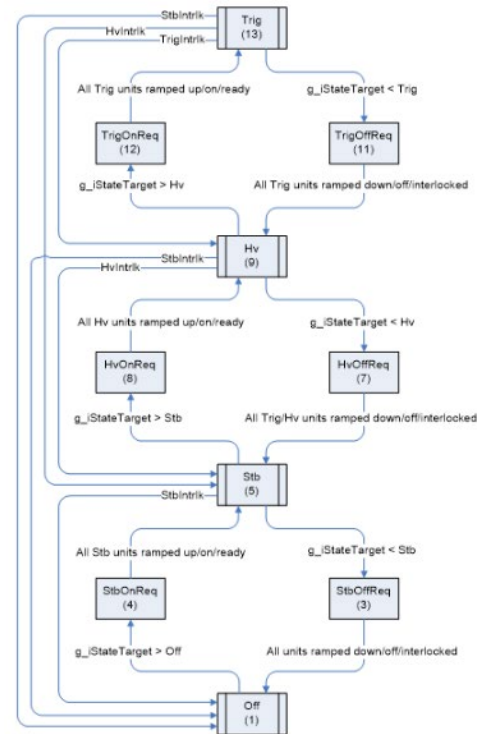
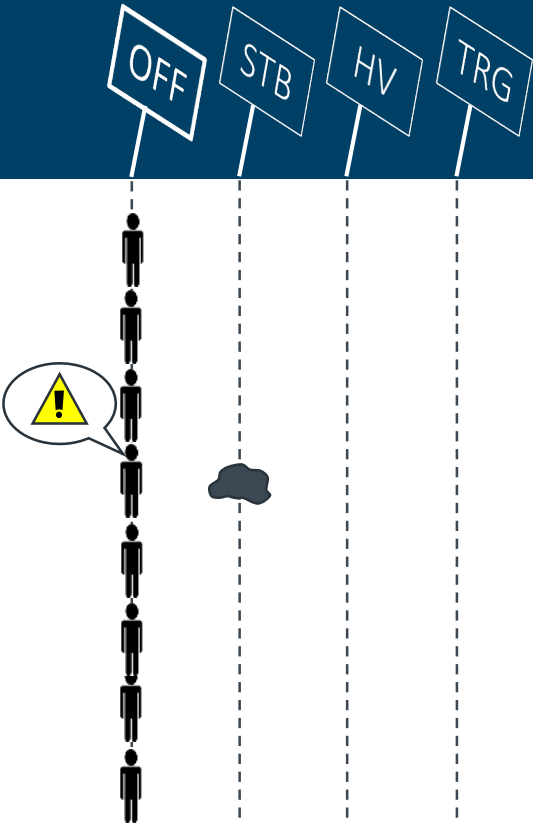
The state transitions of a Slave State Machine with four states.



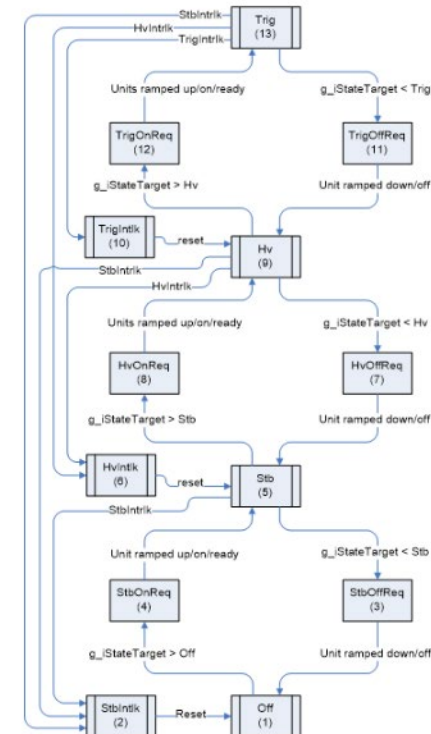
The relation between master and slave state machines.

SCANDICAT SOFTWARE

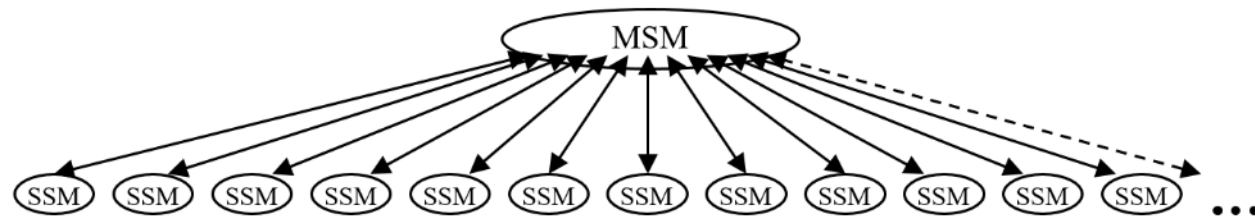
- MSM & SSM's
- Warning if something blocks next state



The state transitions of a Master State Machine with four states.



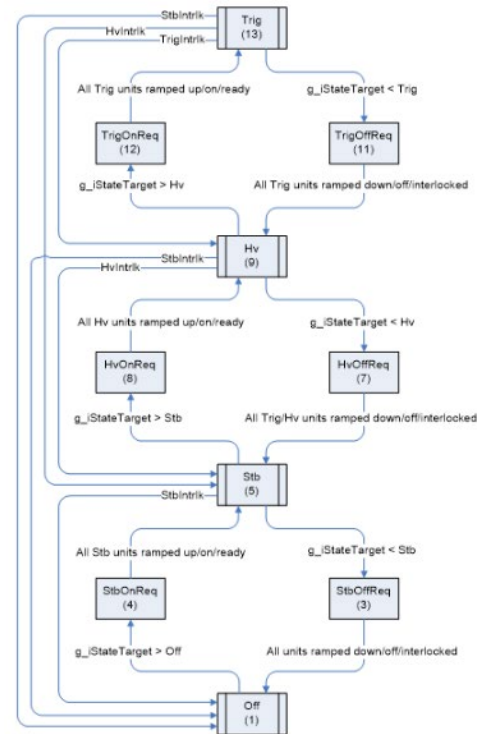
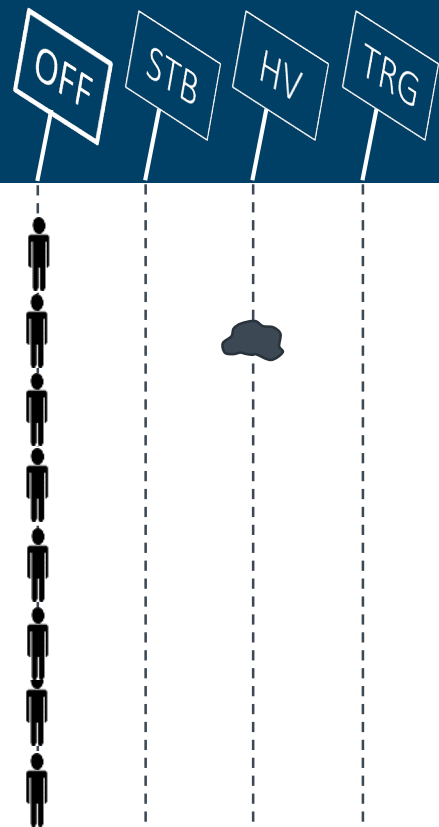
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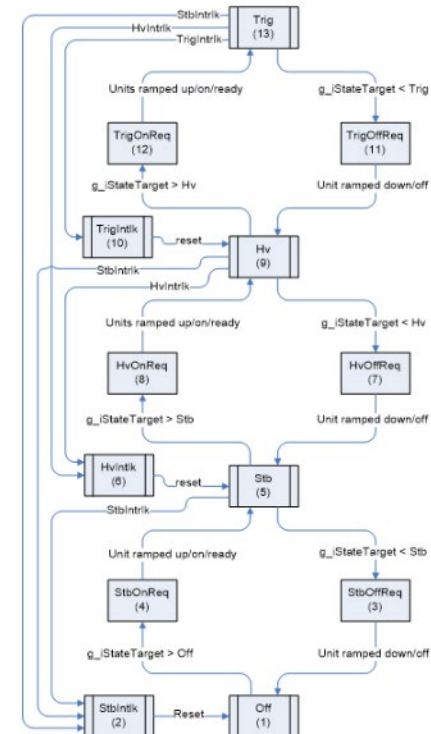
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SCANDICAT SOFTWARE

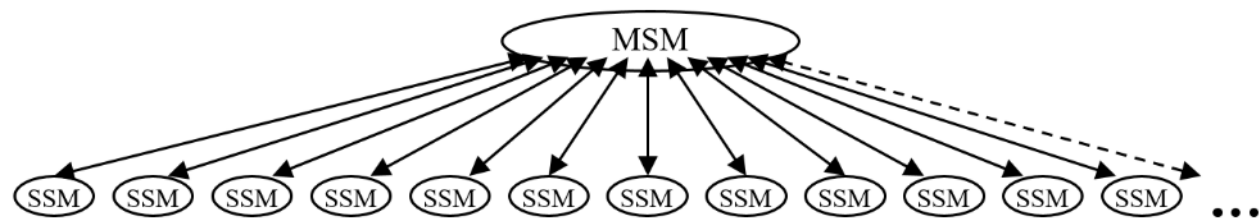
- MSM & SSM's
- Now imagine that the TargetState is...



The state transitions of a Master State Machine with four states.



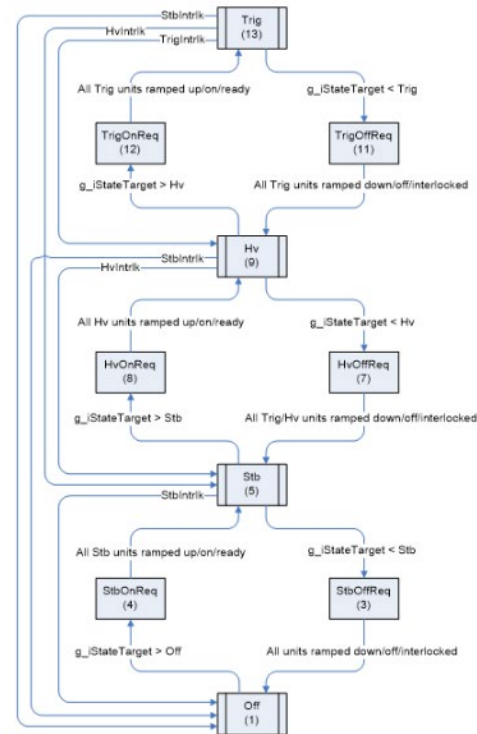
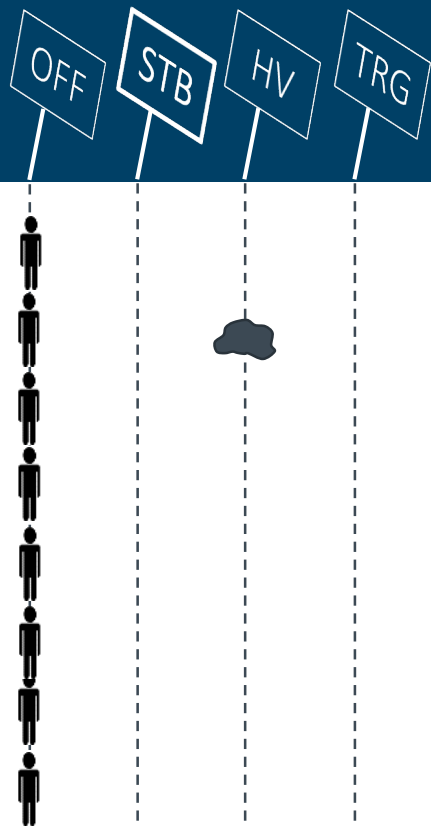
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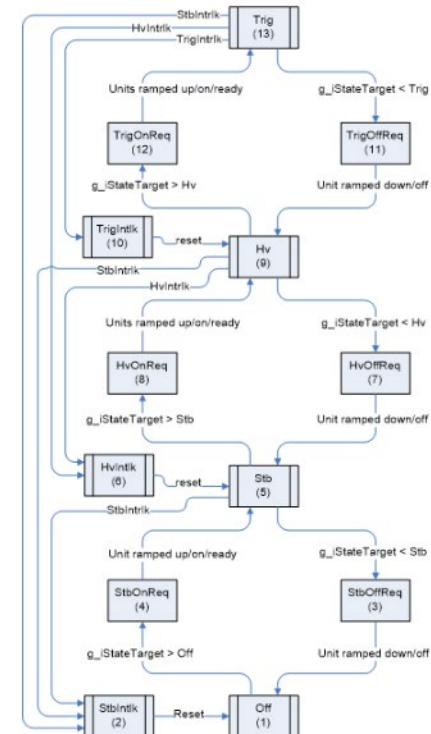
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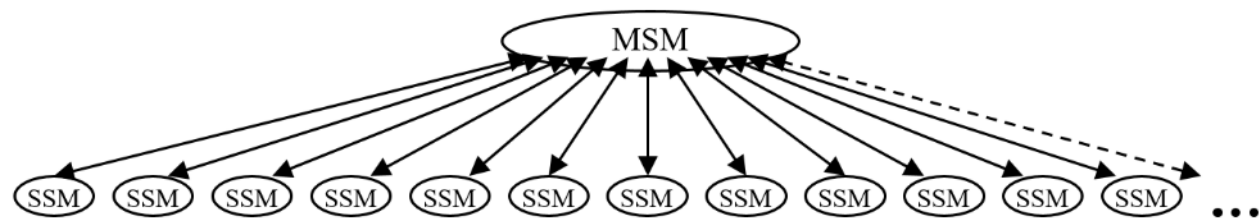
- MSM & SSM's
- Now imagine that the TargetState is raised to StandBy



The state transitions of a Master State Machine with four states.



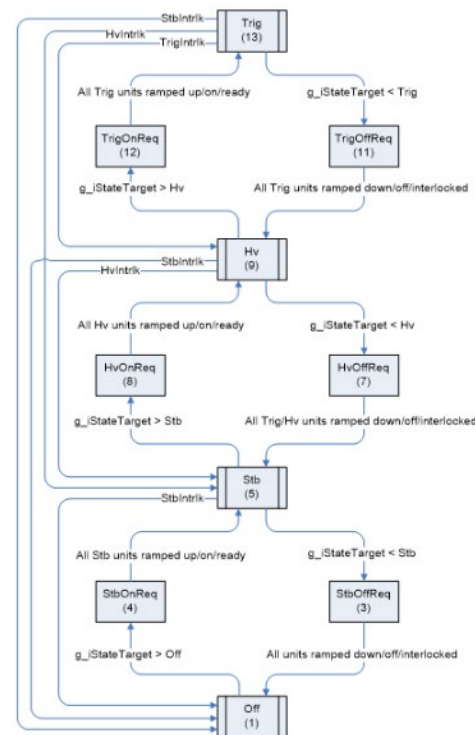
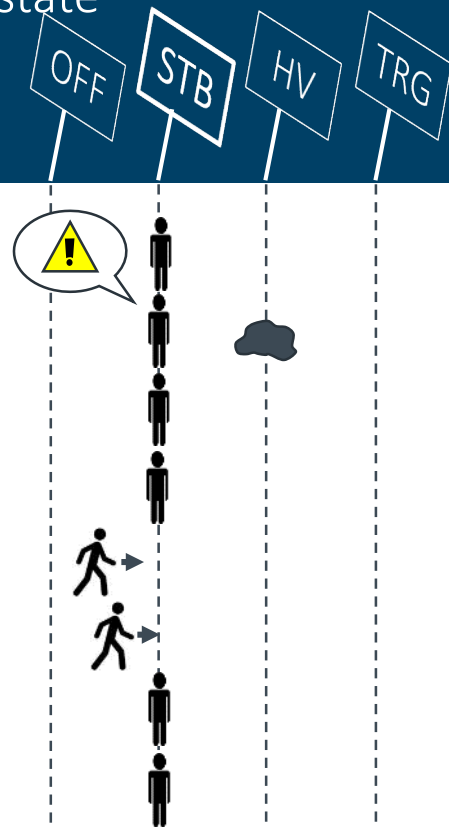
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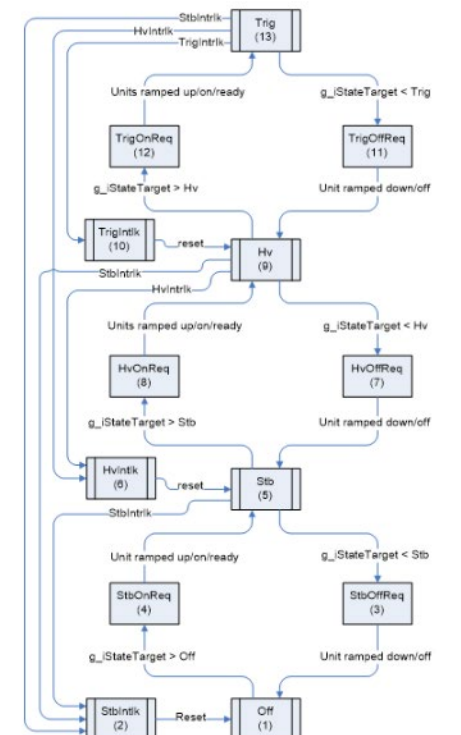
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SCANDICAT SOFTWARE

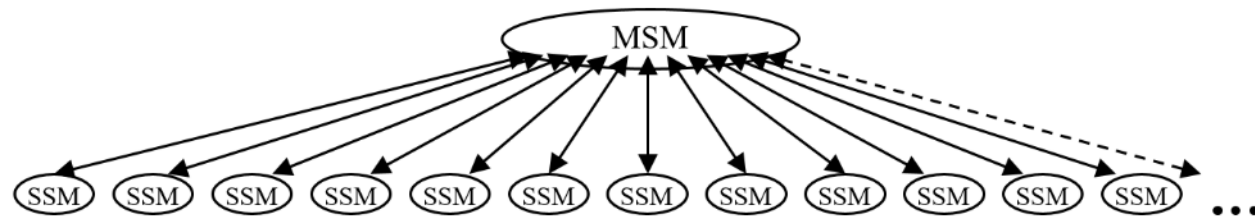
- SSM's
- Some units have a ramp or delay
- A new SSM detects a problem at the next state



The state transitions of a Master State Machine with four states.



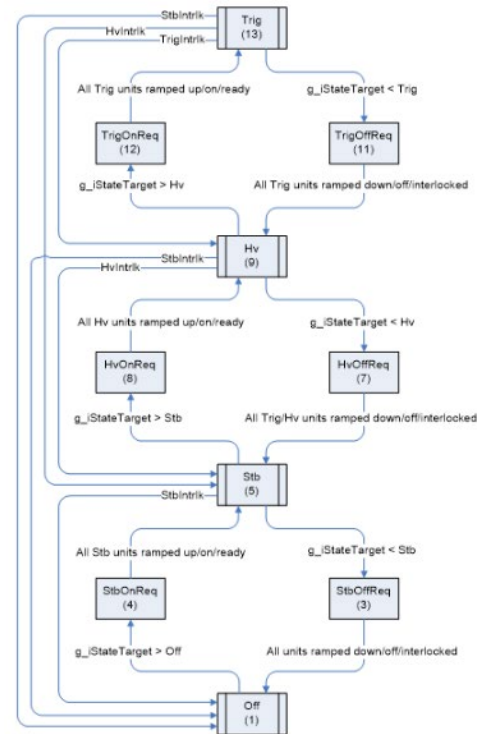
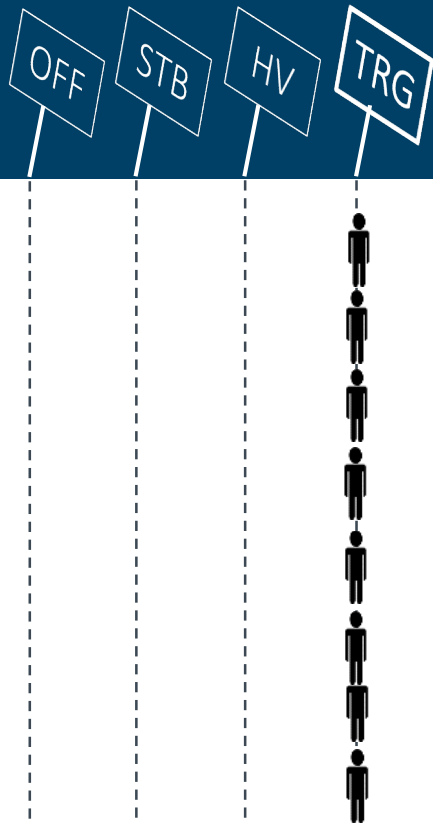
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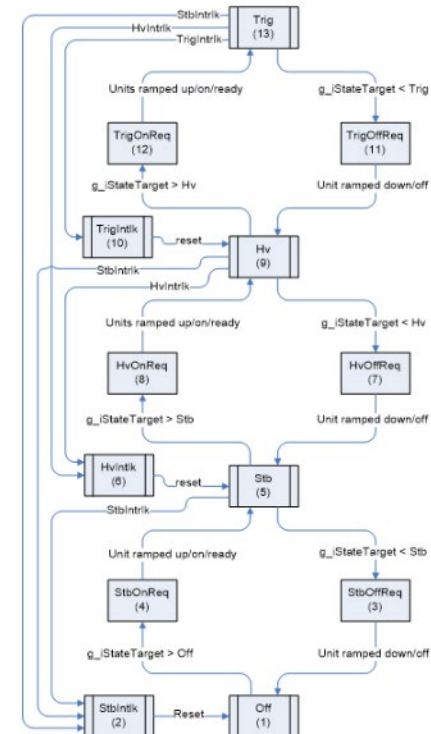
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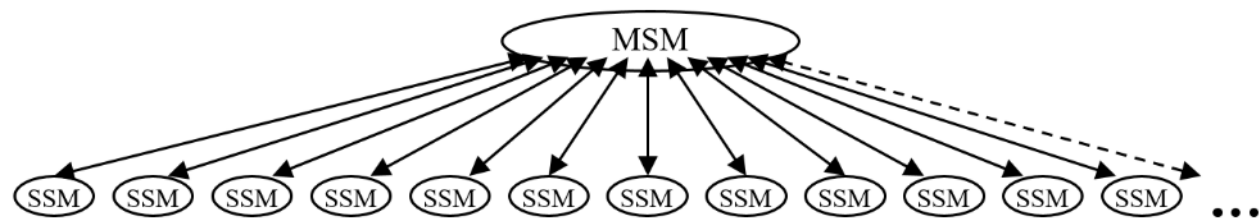
- SSM's
- At Trig...



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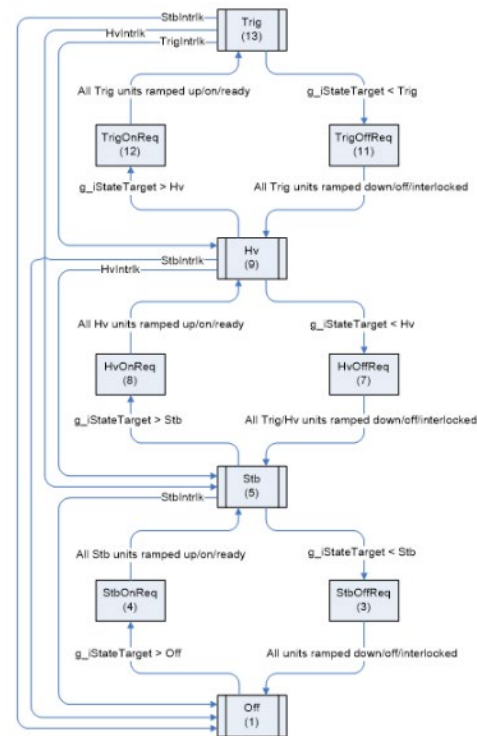
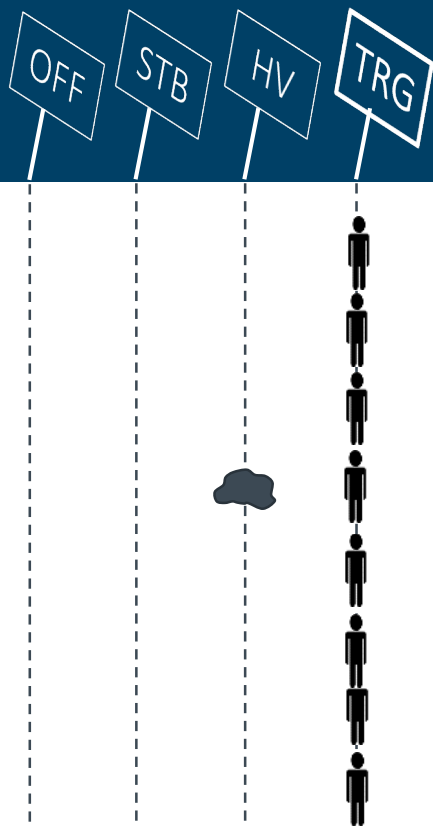
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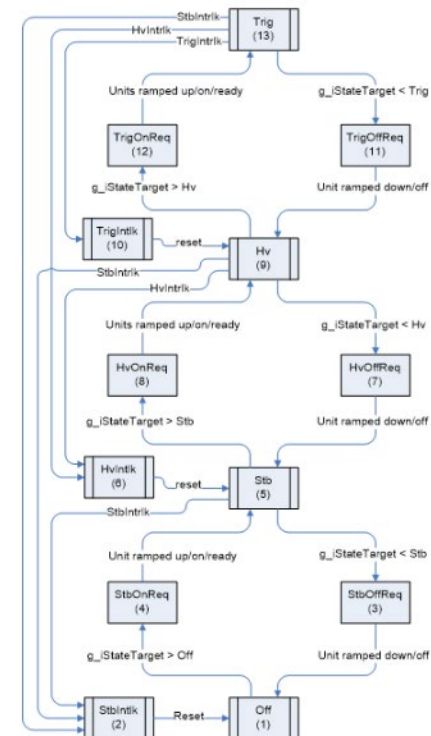
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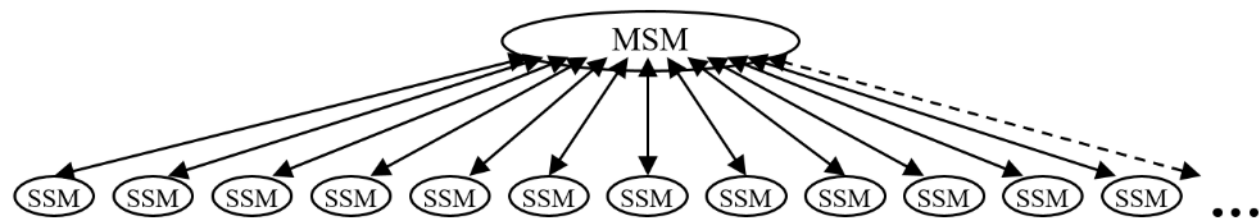
- SSM's
- At Trig suddenly one SSM has is missing a signal or it's value is outside limits...



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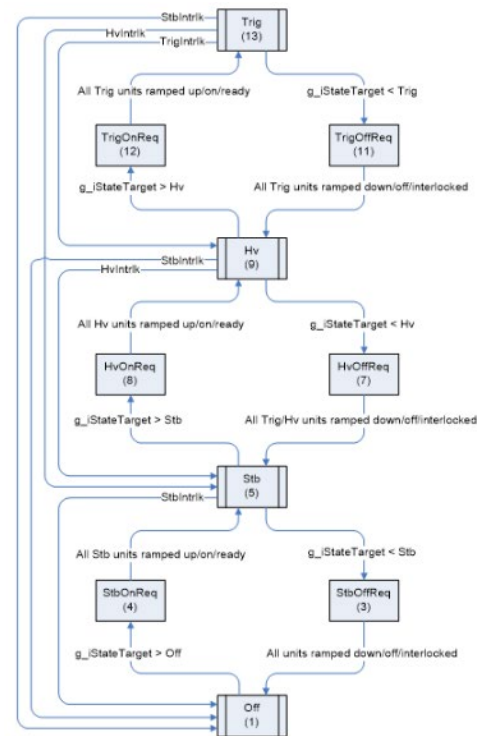
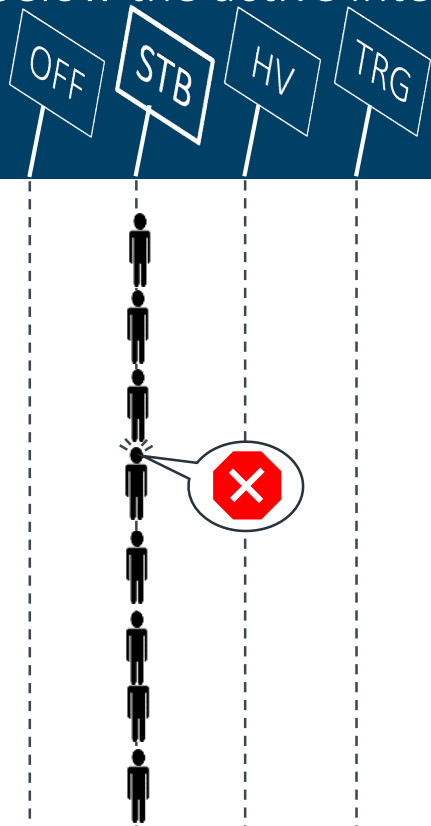
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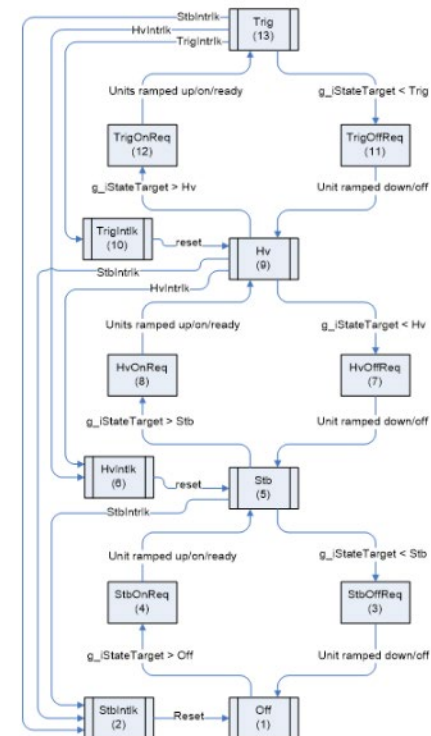
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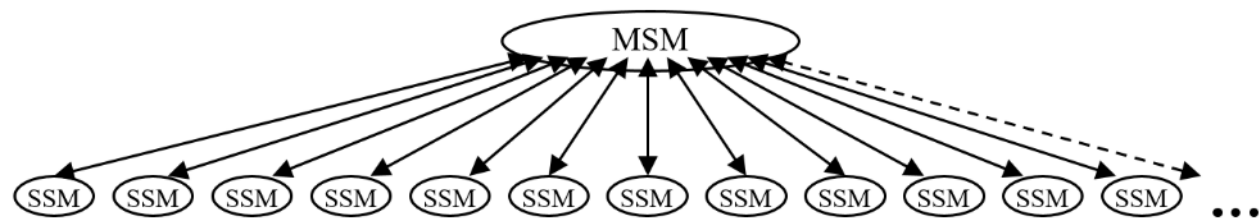
- SSM's
- An alarm is generated
- The modulator is immediately set to the state below the active interlock



The state transitions of a Master State Machine with four states.



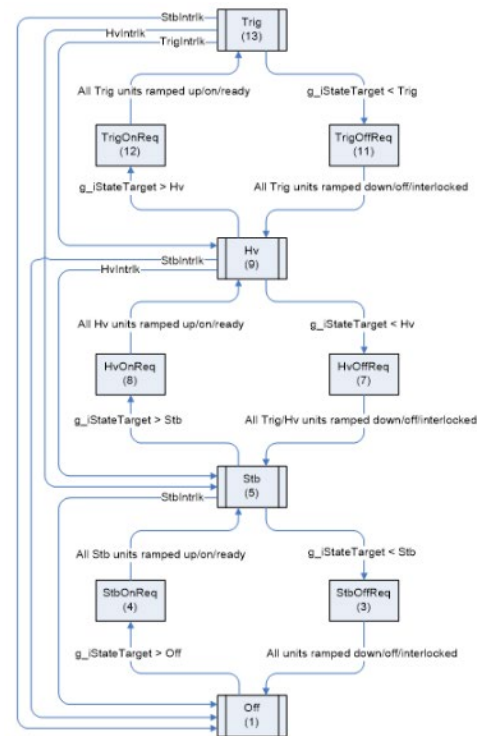
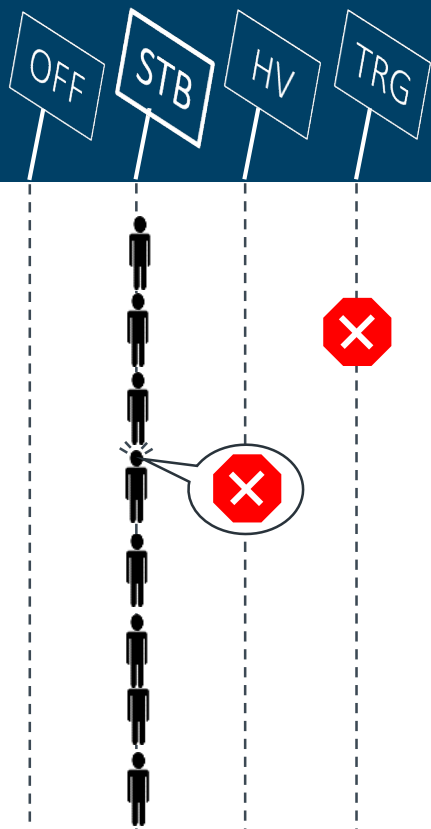
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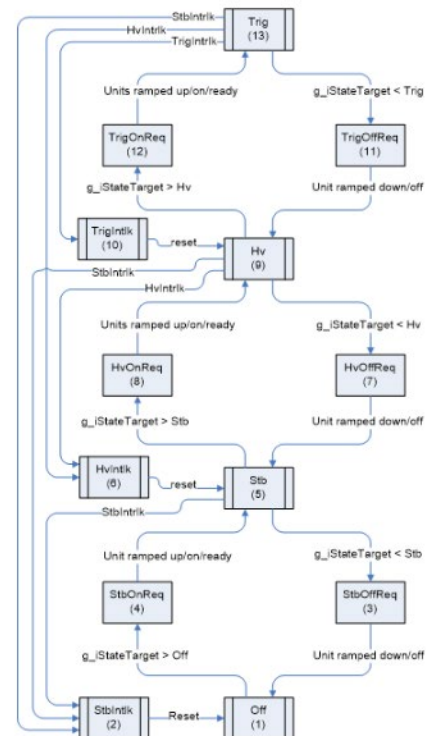
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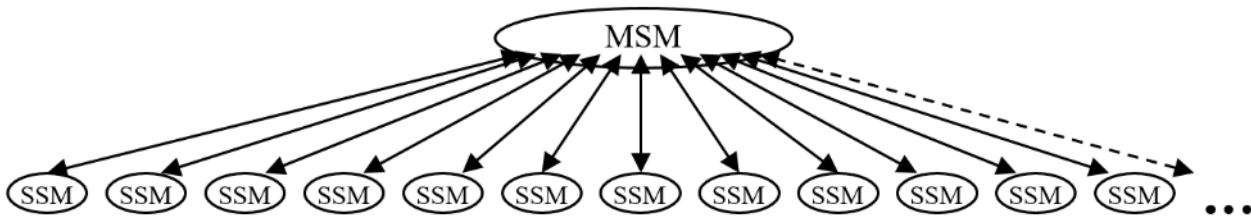
- SSM's
- Problems further up will be detected but will not affect the overall status



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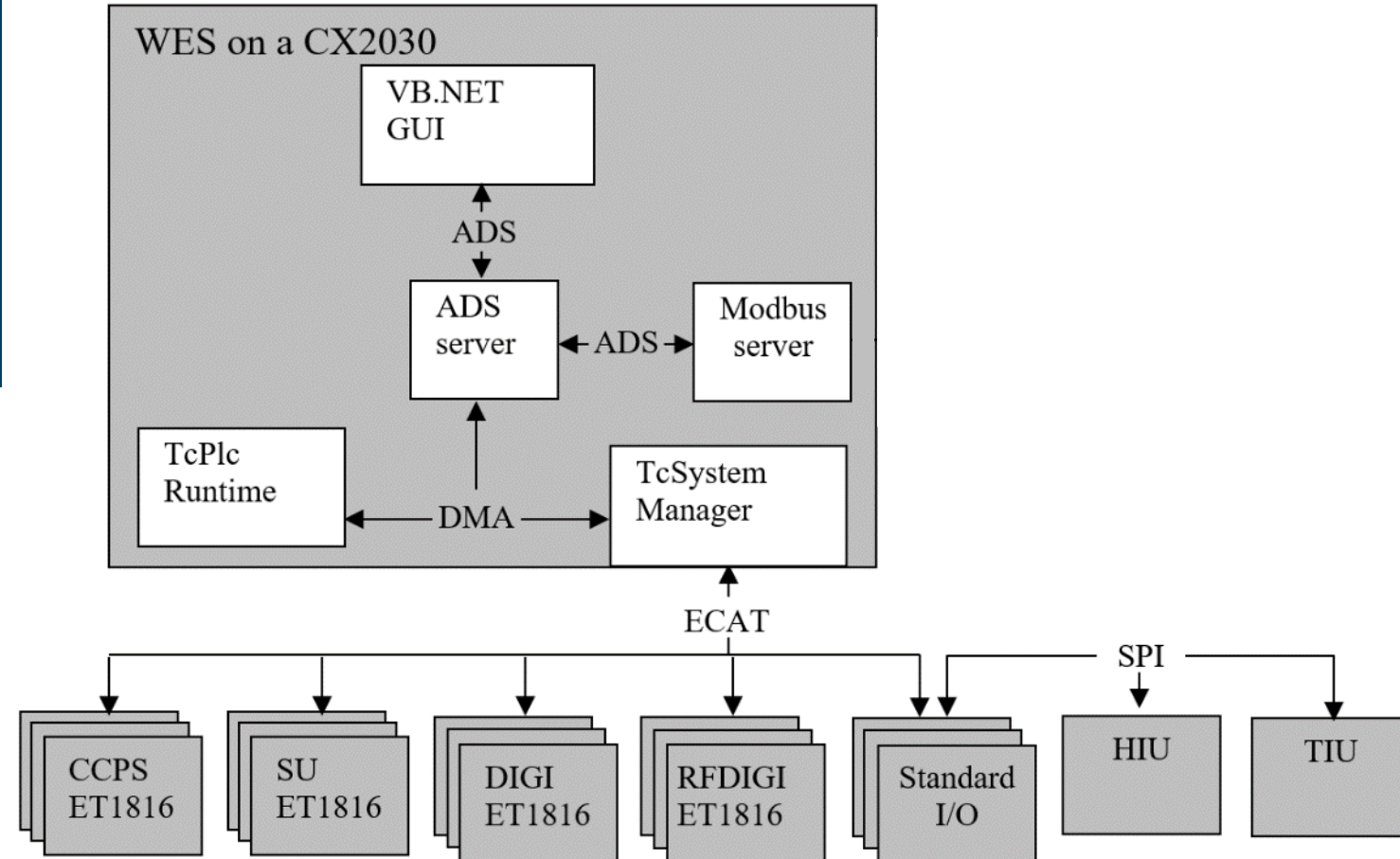
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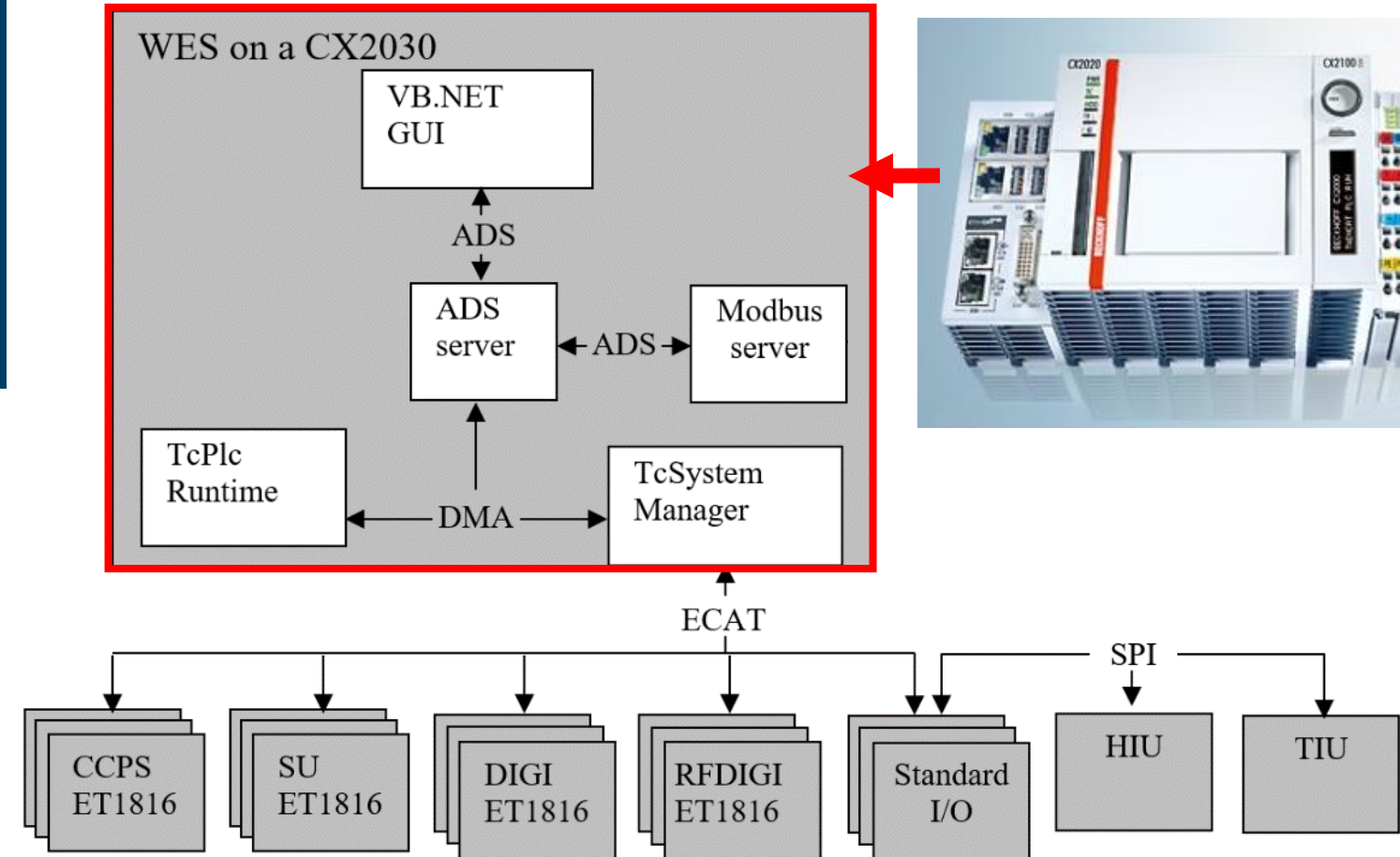
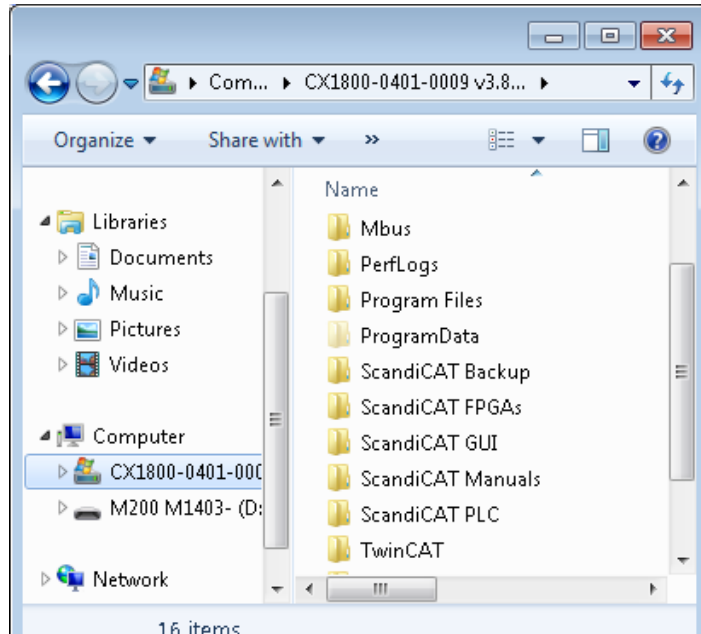
SCANDICAT SOFTWARE

- These are the different softwares/controllers



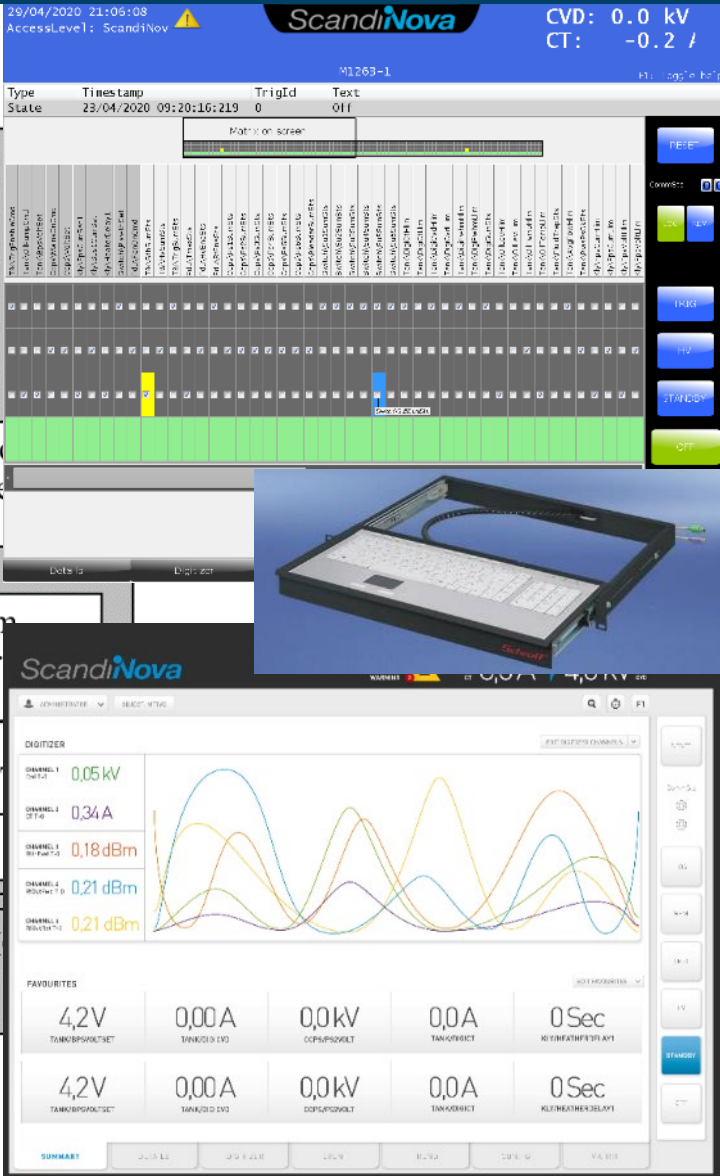
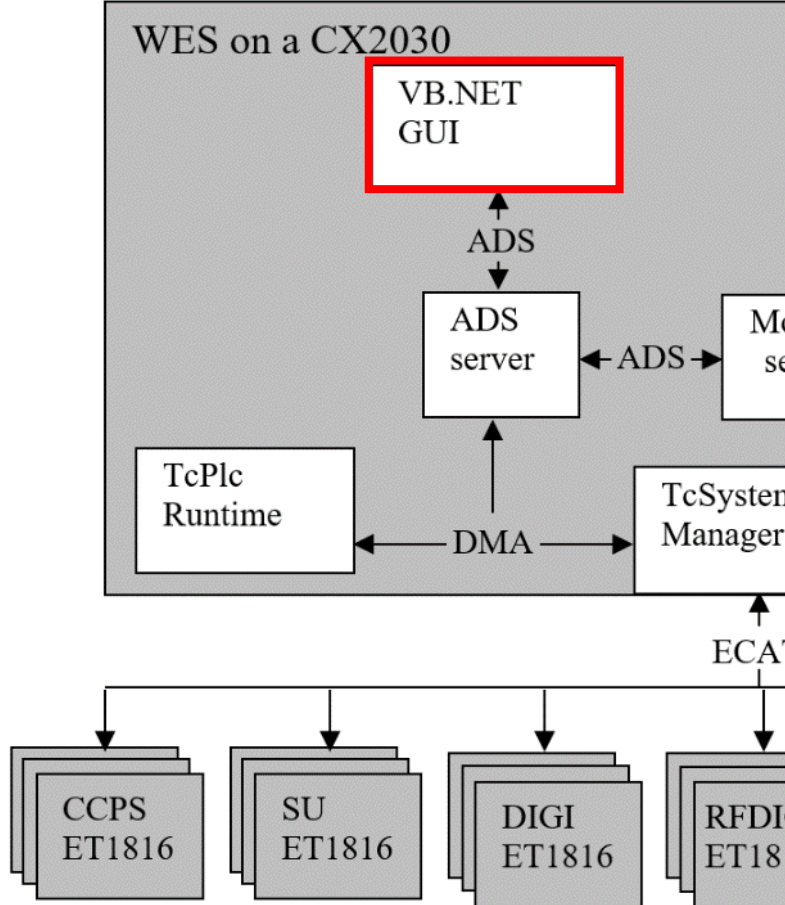
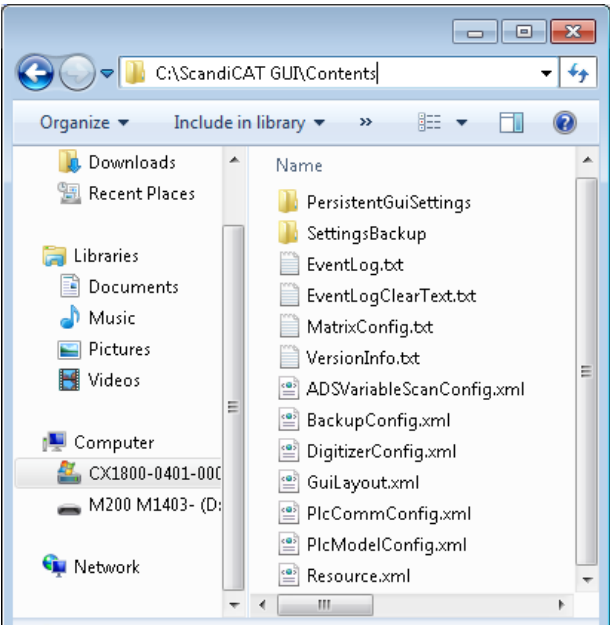
SCANDICAT SOFTWARE

- Central PC



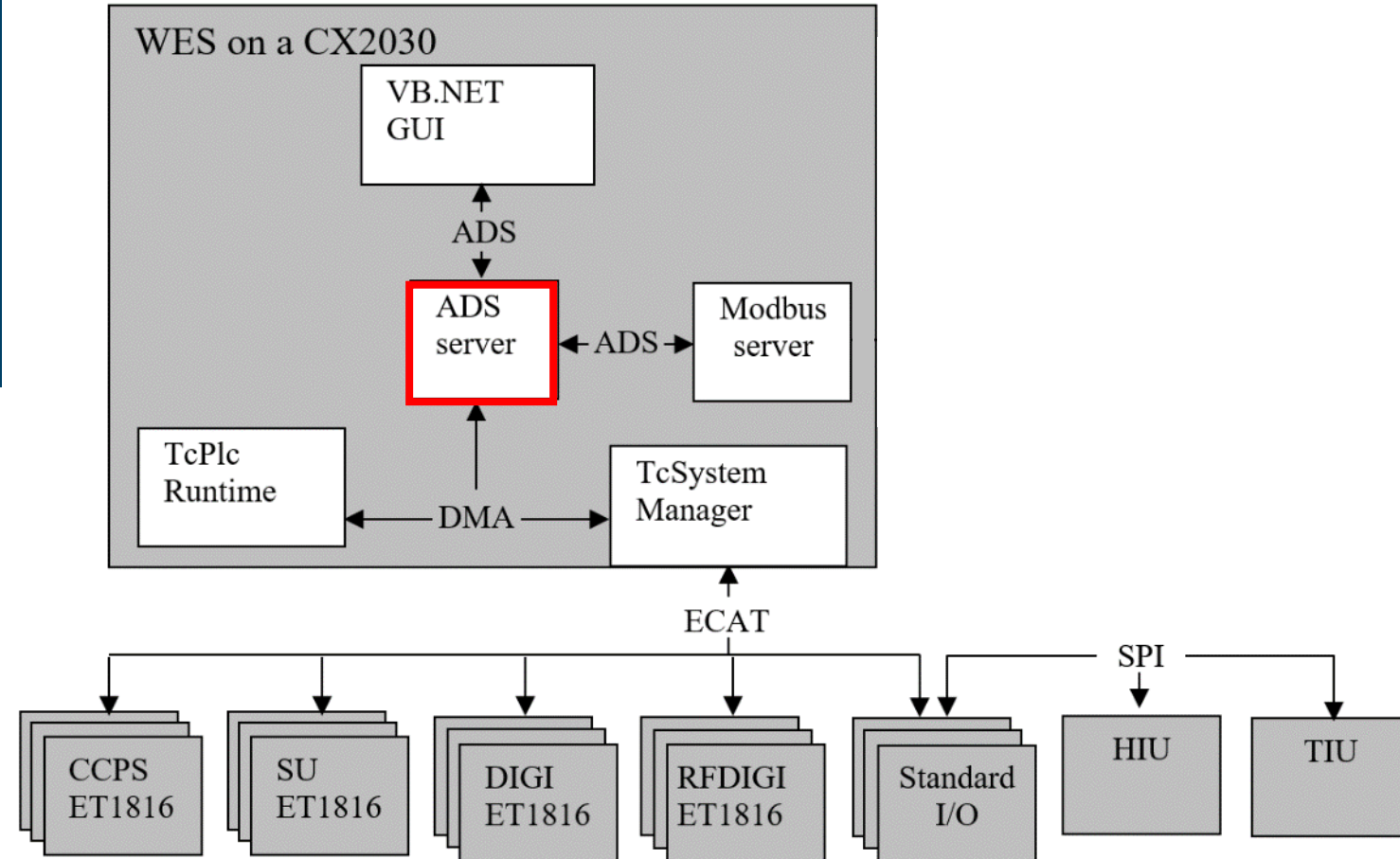
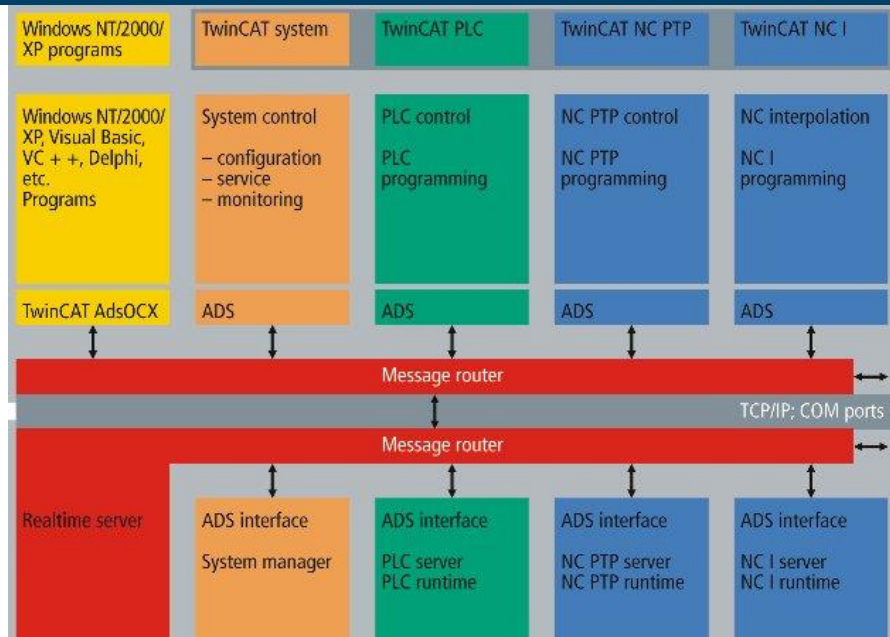
SCANDICAT SOFTWARE

- .NET Graphical User Interface
- Locally installed
- Can also be accessed via RDP



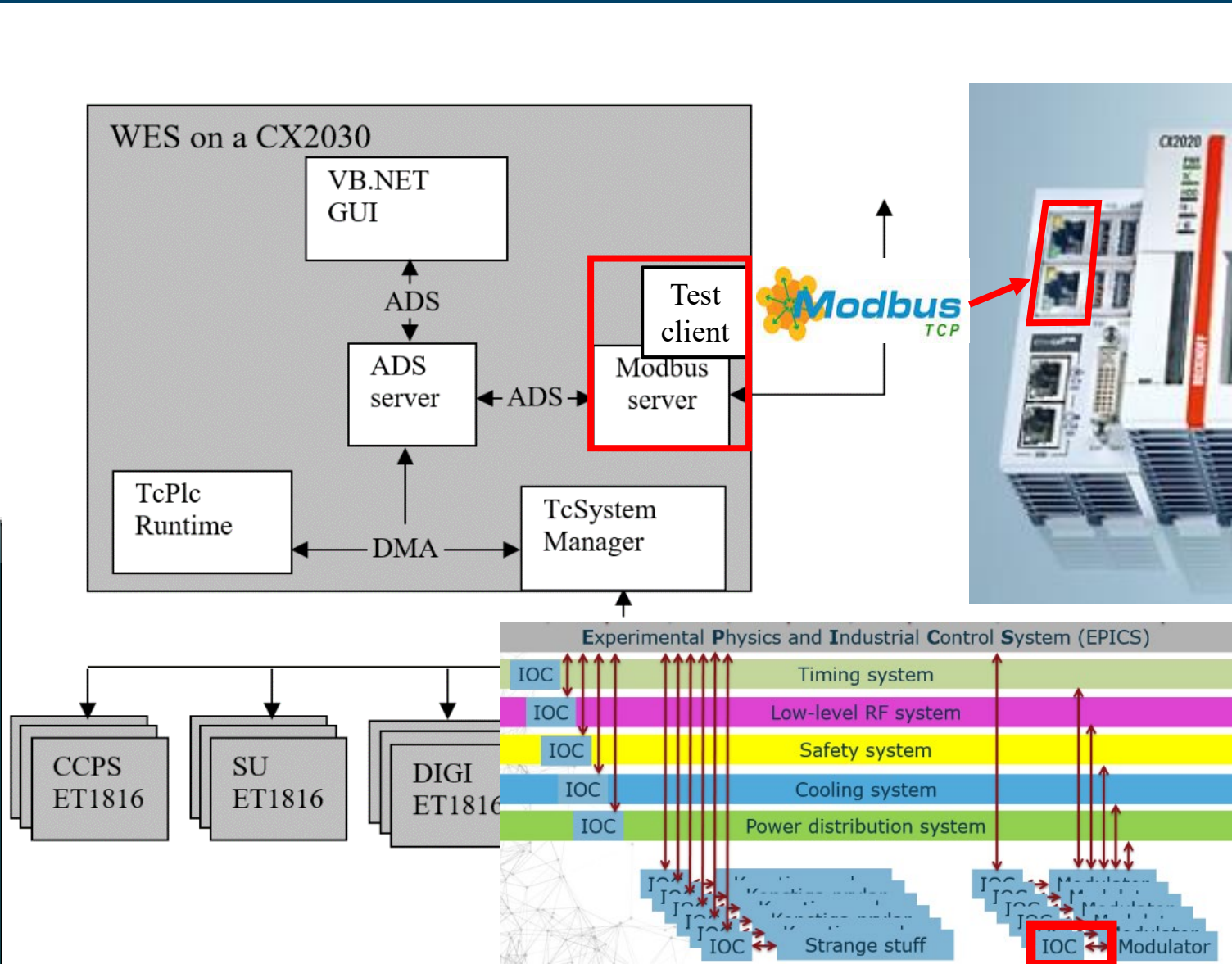
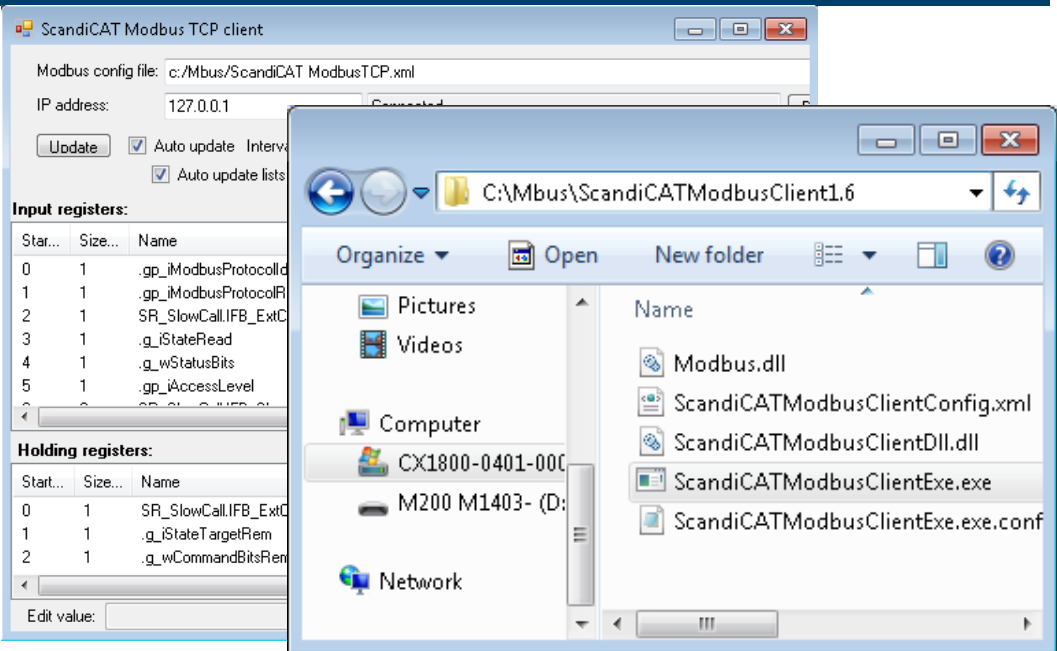
SCANDICAT SOFTWARE

- ADS = Automation Device Specification
- Handles all PC-internal non-realtime communication



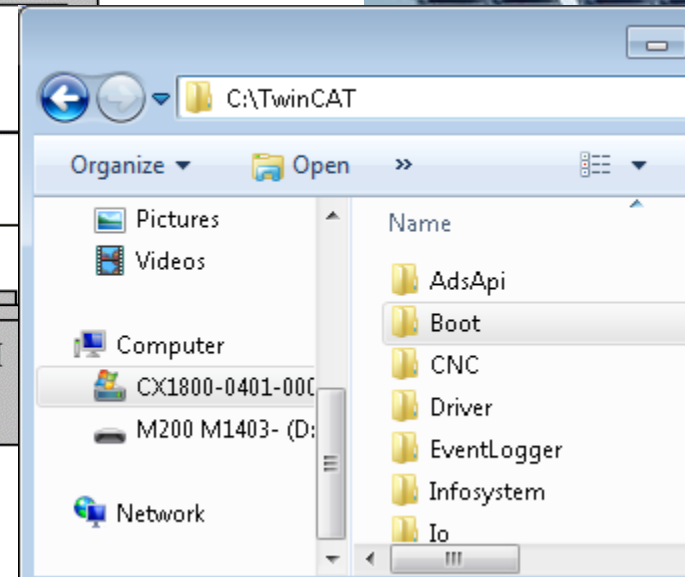
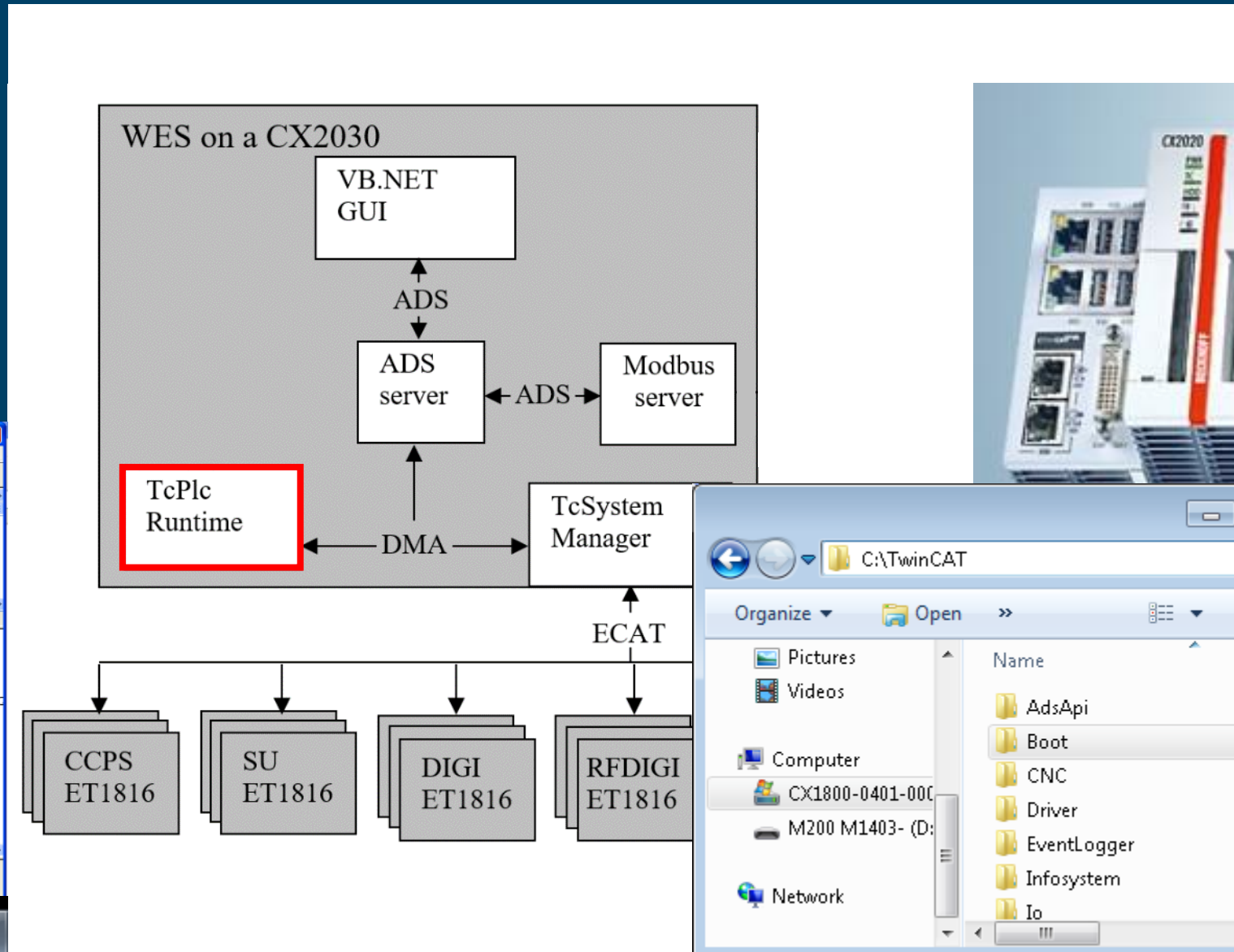
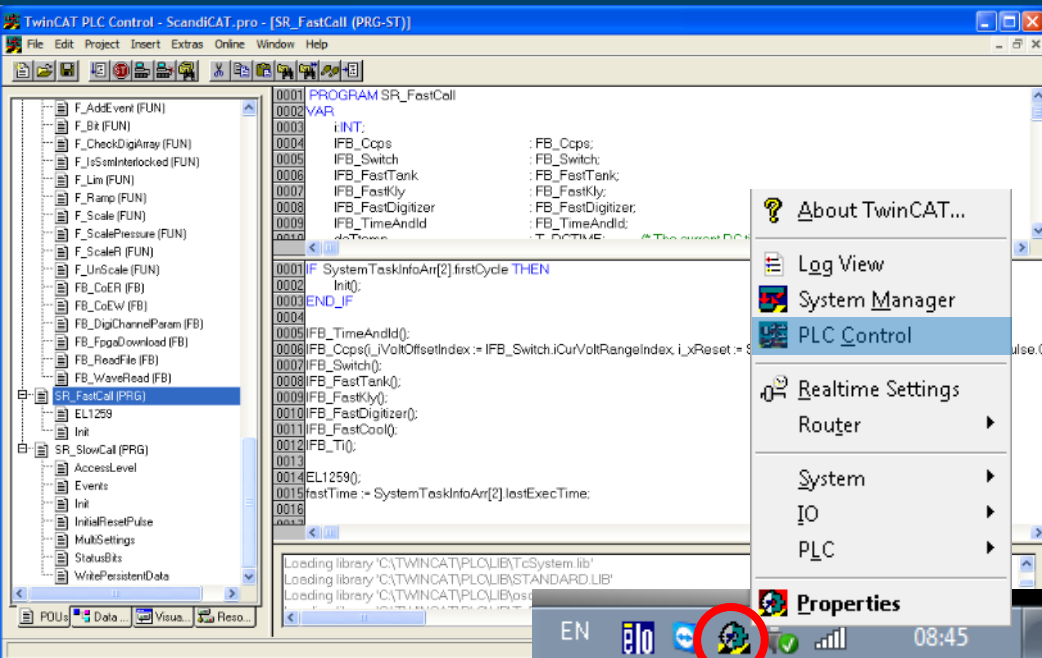
SCANDICAT SOFTWARE

- The Modbus-TCP server makes certain variables available for external control-systems
- Handles PC-external non-realtime communication



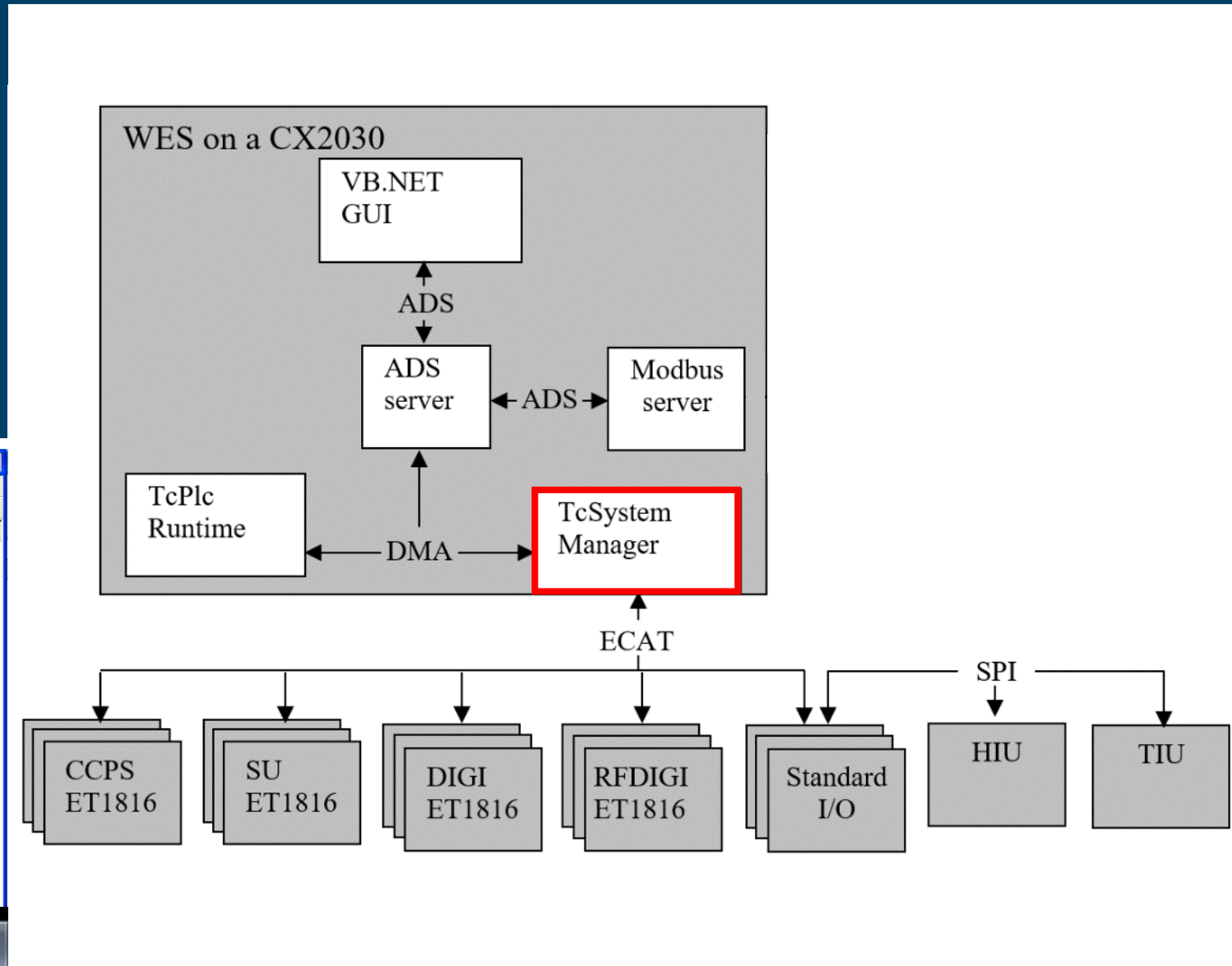
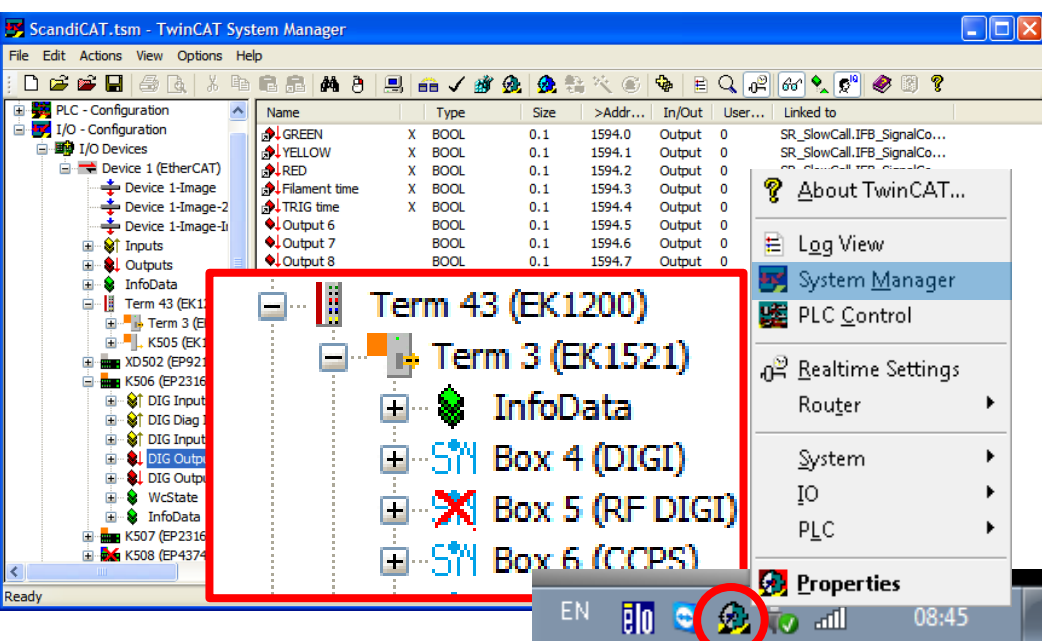
SCANDICAT SOFTWARE

- Soft-PLC
- Runs side-by-side with Windows
- Only programmed/manipulated by ScandiNova



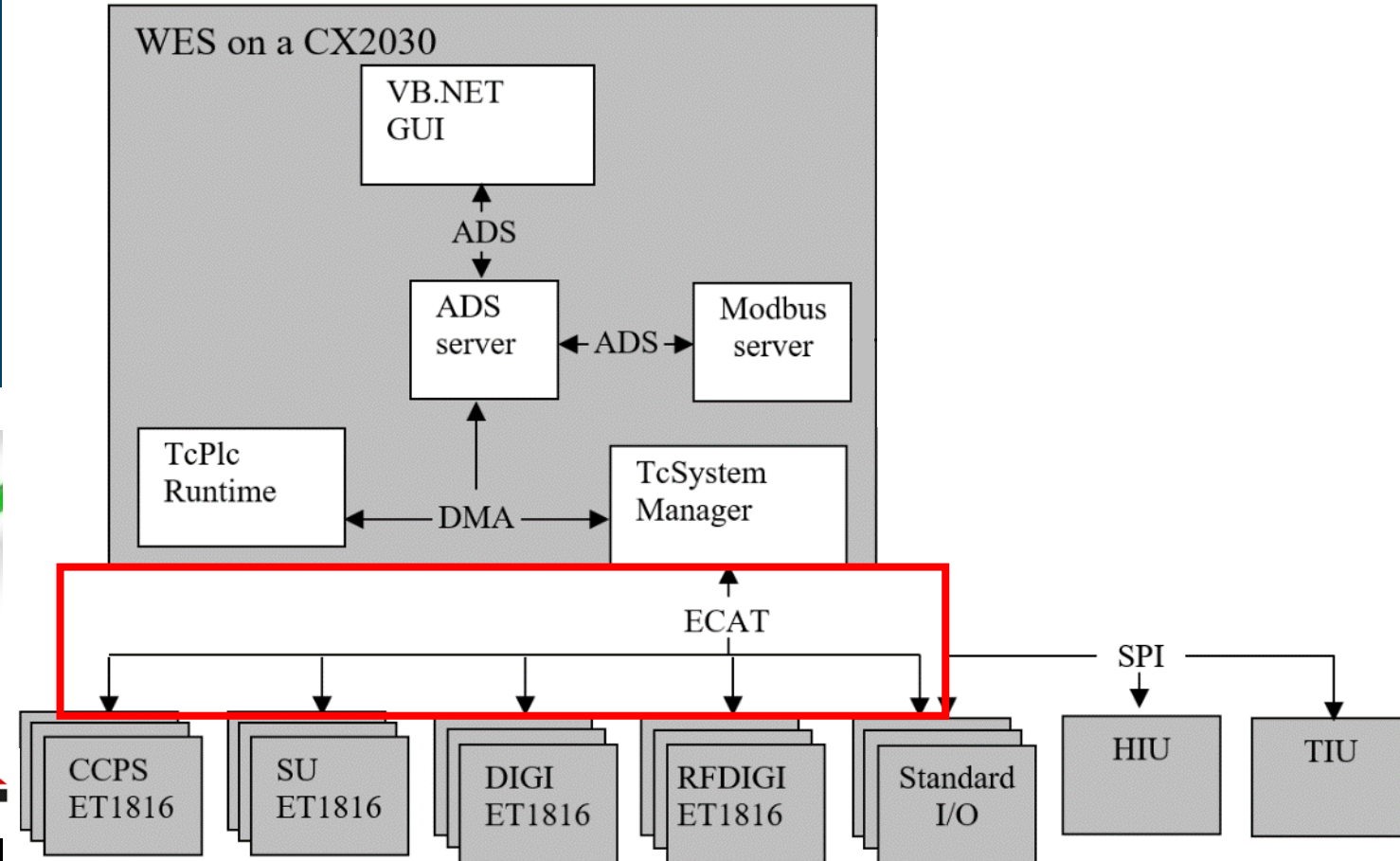
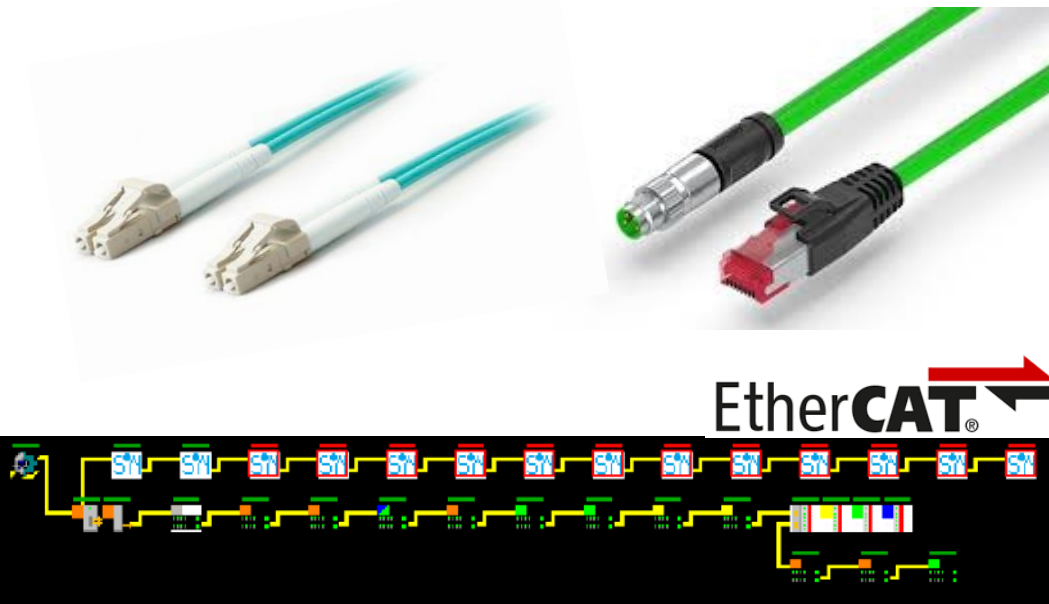
SCANDICAT SOFTWARE

- TwinCAT System connects the PLC runtime with the I/O



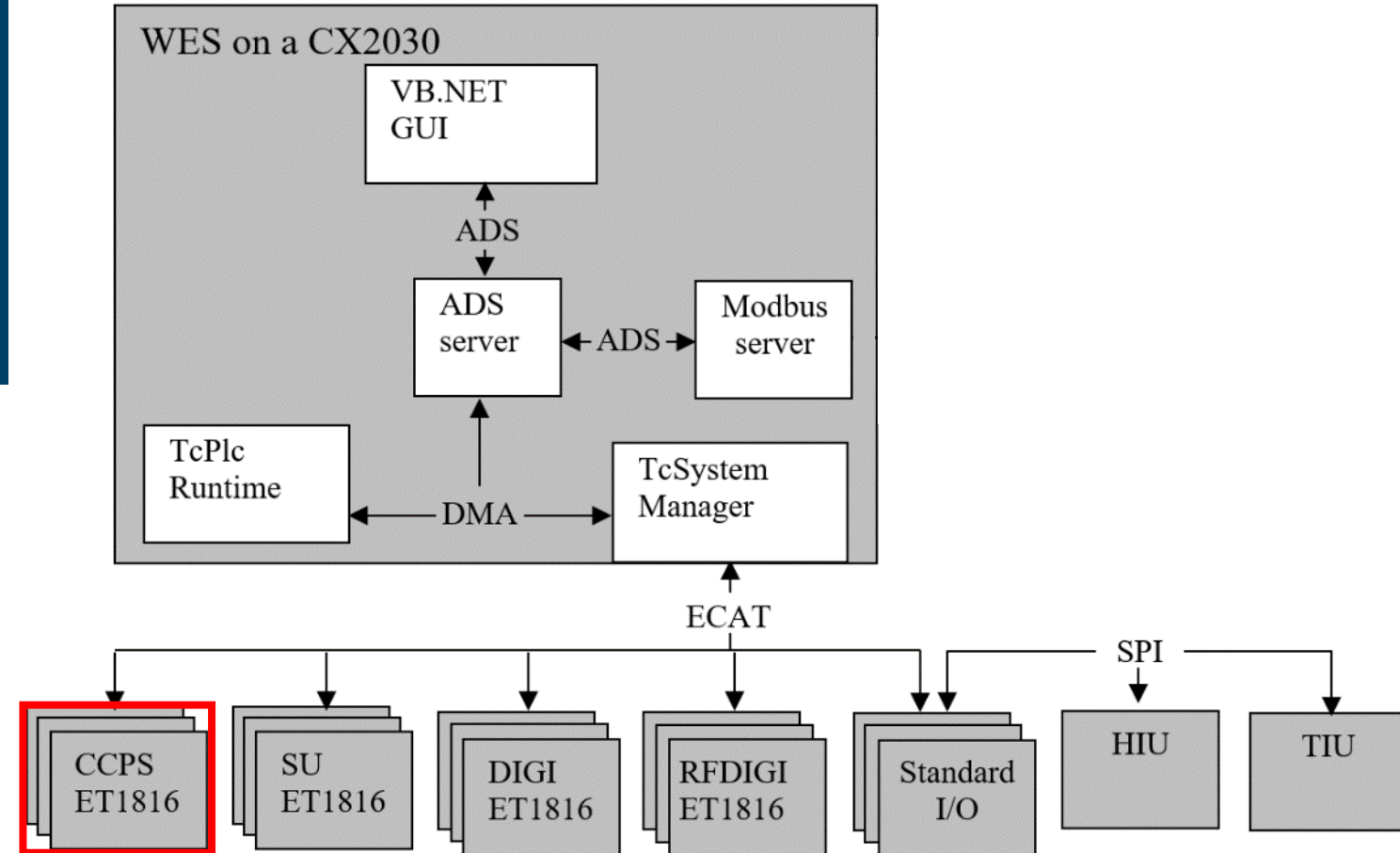
SCANDICAT SOFTWARE

- EtherCAT is fast & deterministic



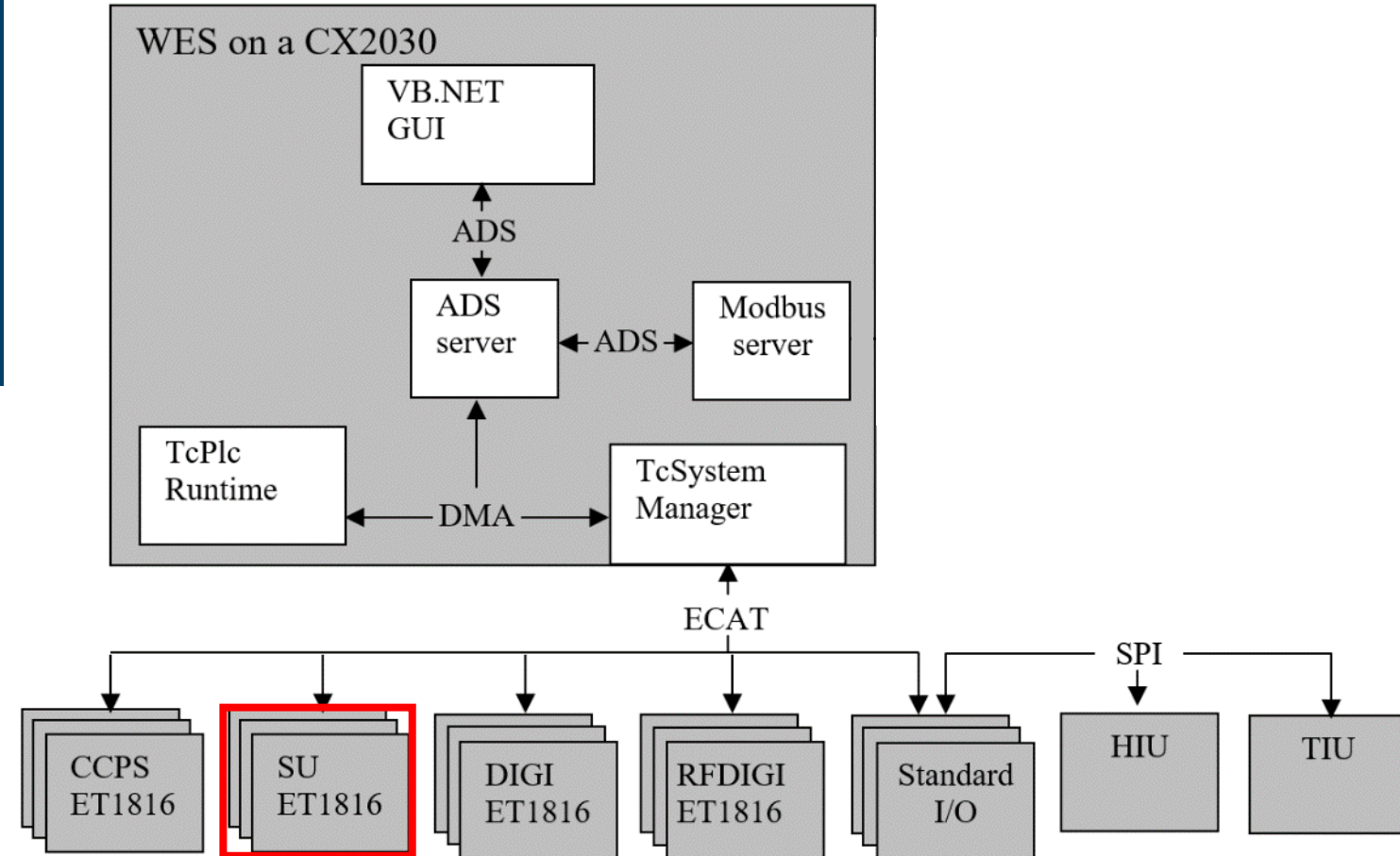
SCANDICAT SOFTWARE

- CCPS (Capacitor Charging Power Supply)
- FPGA based



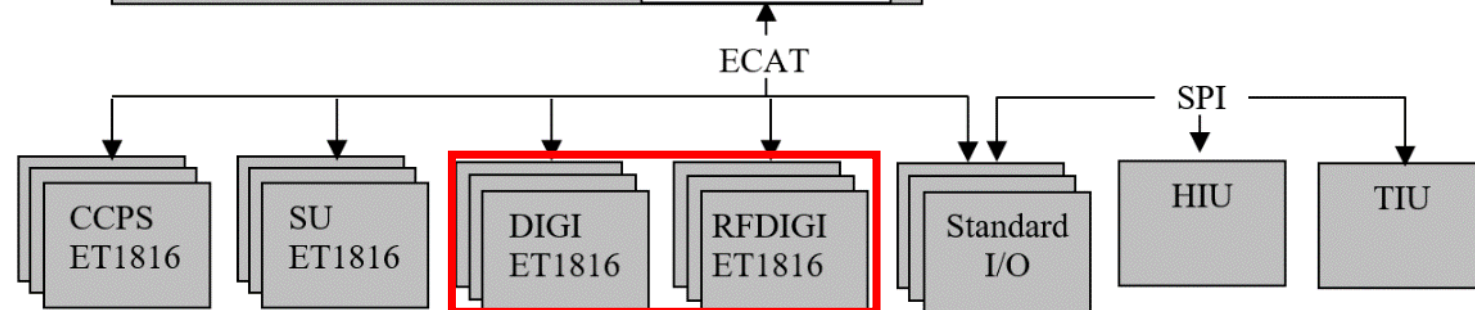
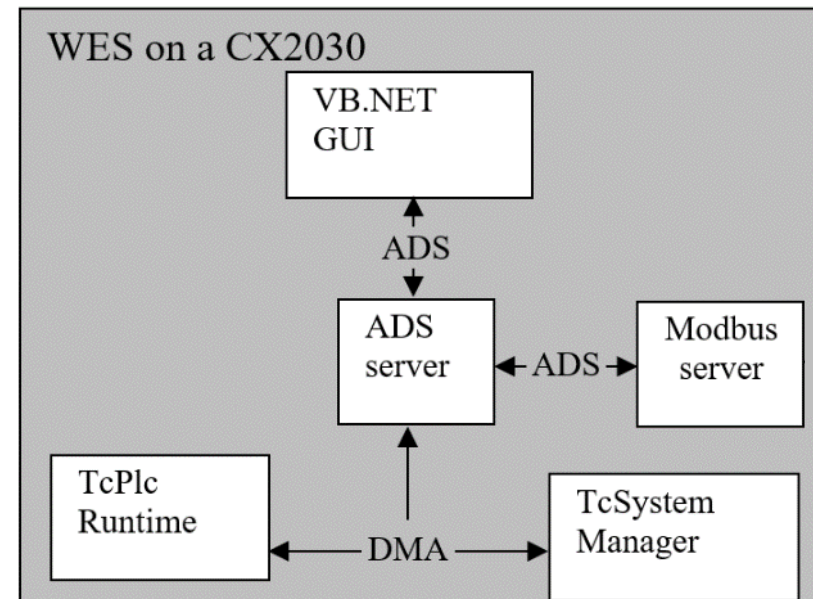
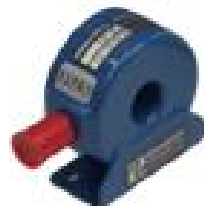
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- SU (IGBT Switch Unit)



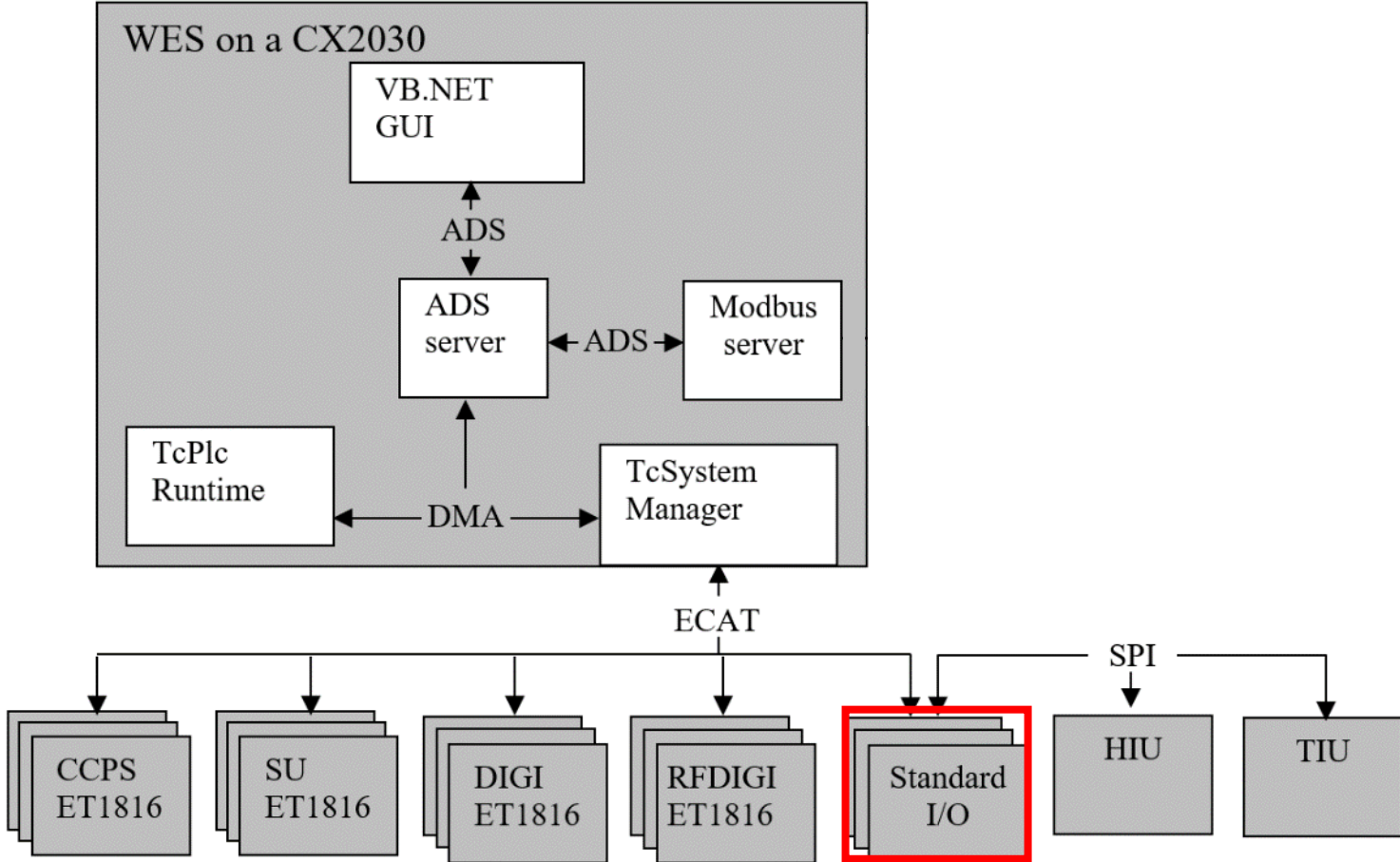
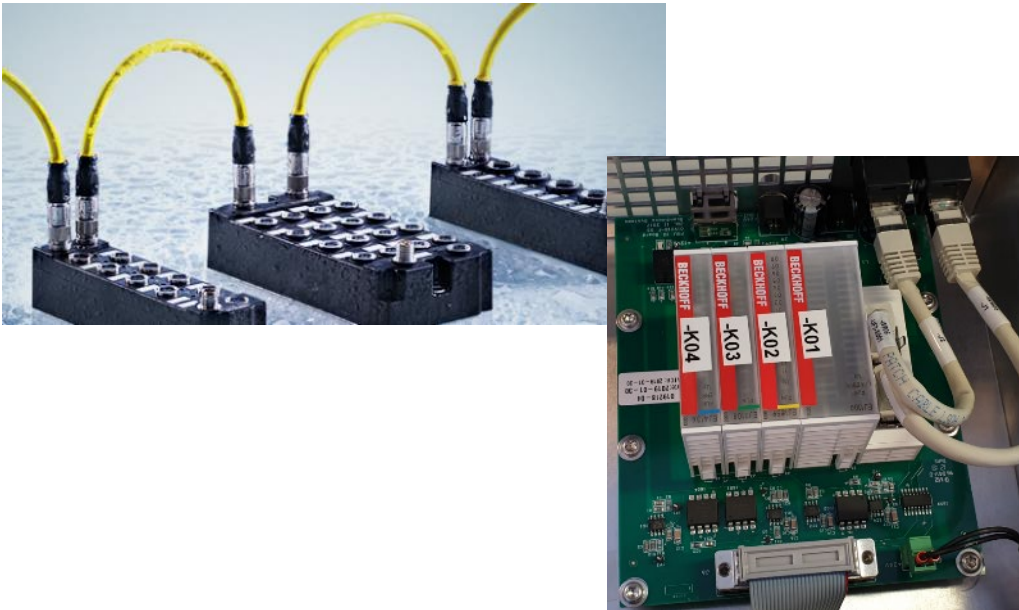
SCANDICAT SOFTWARE

- DIGItizers
- One for CT&CVD
- One for RF (can have many)



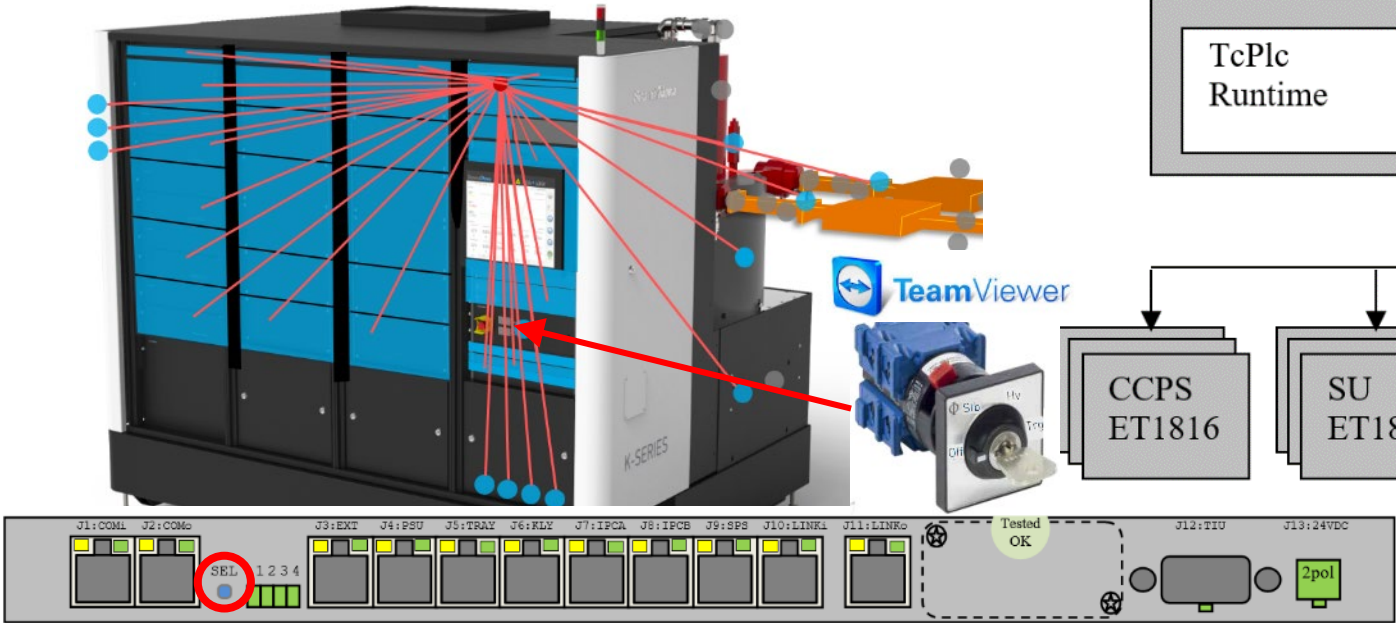
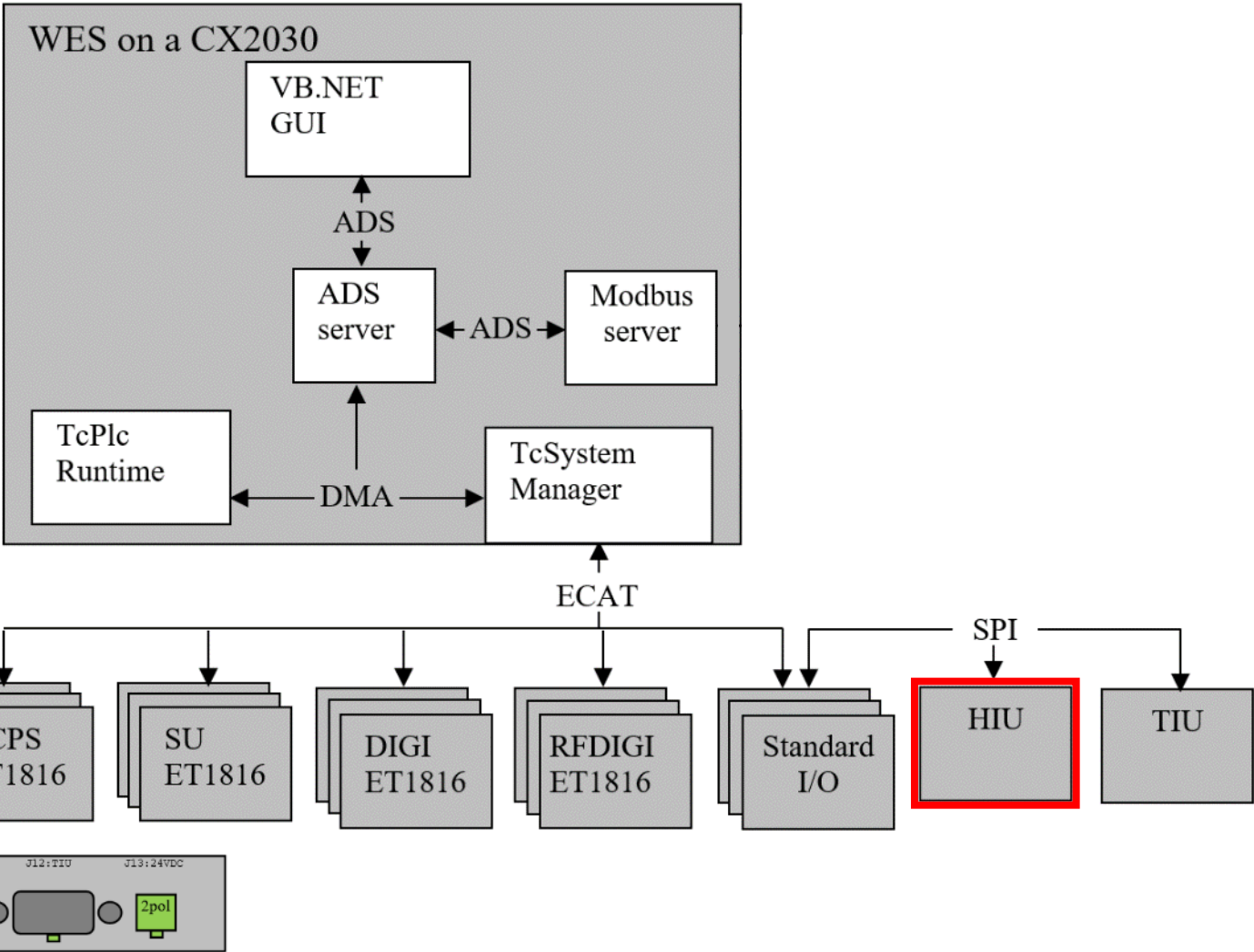
SCANDICAT SOFTWARE

- Distributed Beckhoff modules are used for periferal I/O



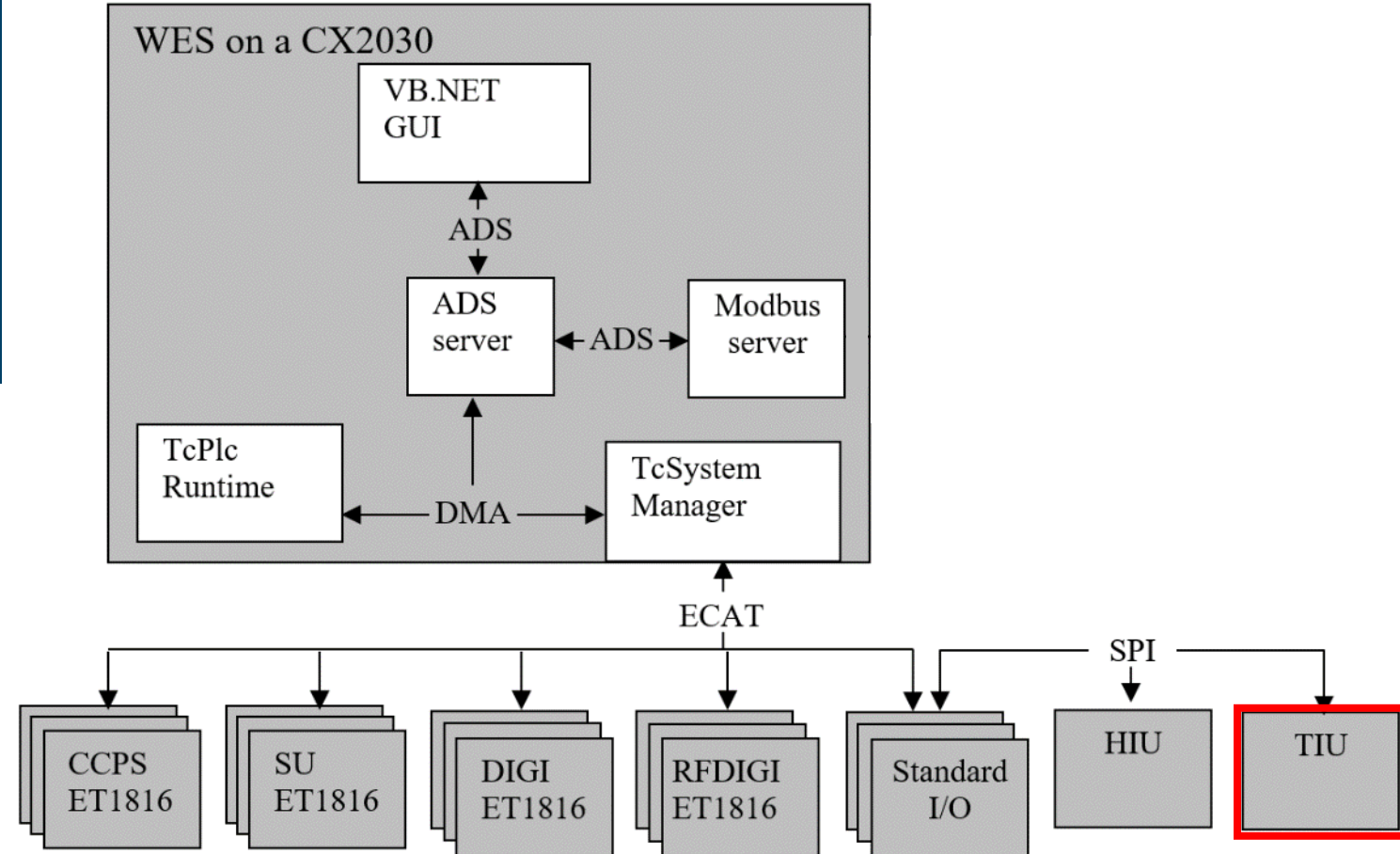
SCANDICAT SOFTWARE

- HIU (Hard-wired Interlock Unit)
- Non-software logic
- CPLD-based monitoring
- Protecting the Klystron
- "SEL" cycles through I/O status using LED's
- Optional



SCANDICAT SOFTWARE

- TIU (Trig & Interlock Unit)
- <ns RMS jitter
- ~1μs to interlock pulse
- CPLD-based (hard-coded)
- 8 Green LED's=OK, 1 flashing Blue = Trig



-
- TIU1
- TIU2
- TIU3
- TIU4 (master)
- K-SERIES





THANK YOU!