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CHIC
Chopper Integration Controller

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Presentation Overview

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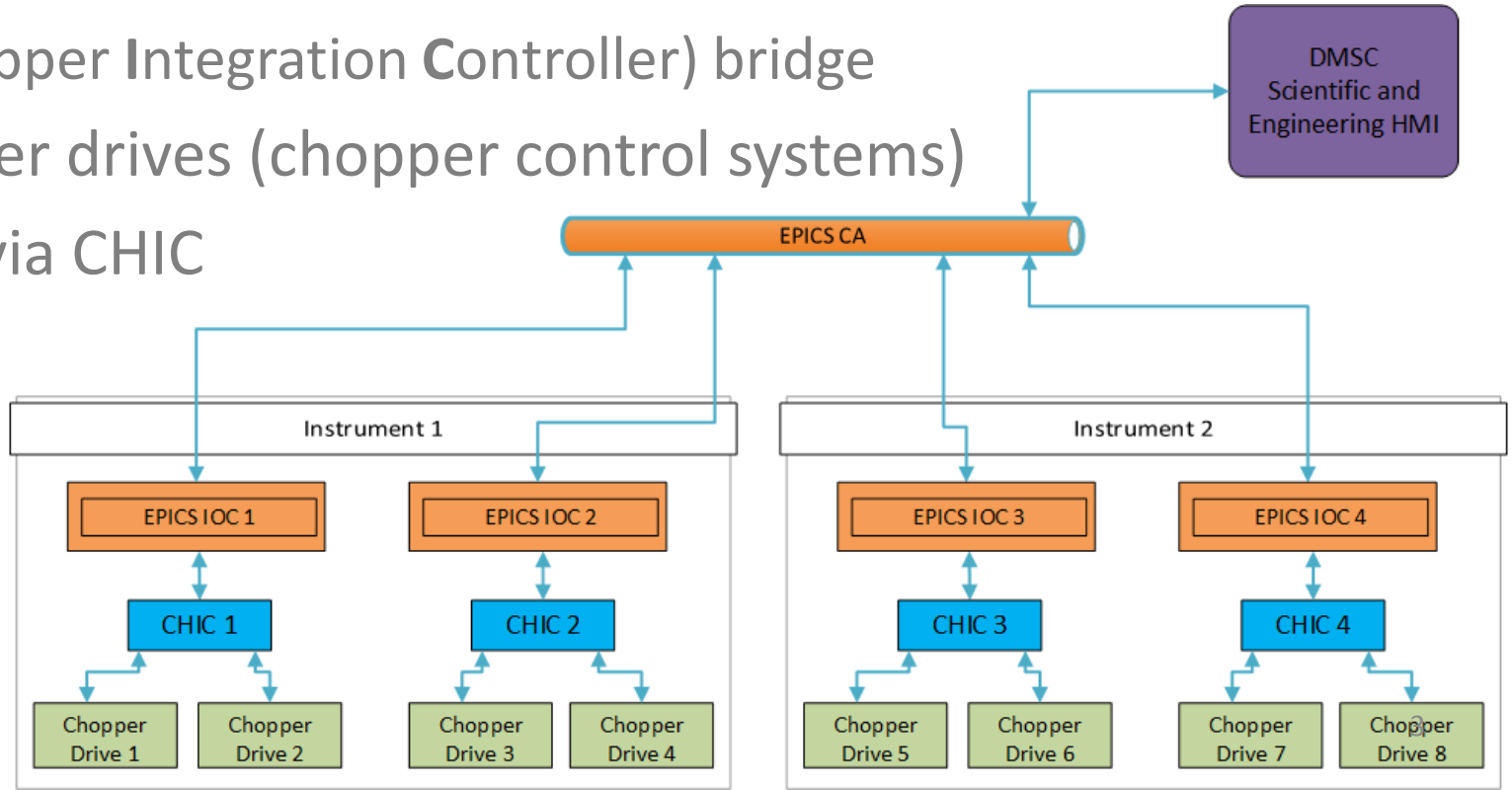
- Background of CHIC
- Interfaces
- Timing system
- Control rack
- CHIC concept
- Time line

Why a Chopper integration controller?

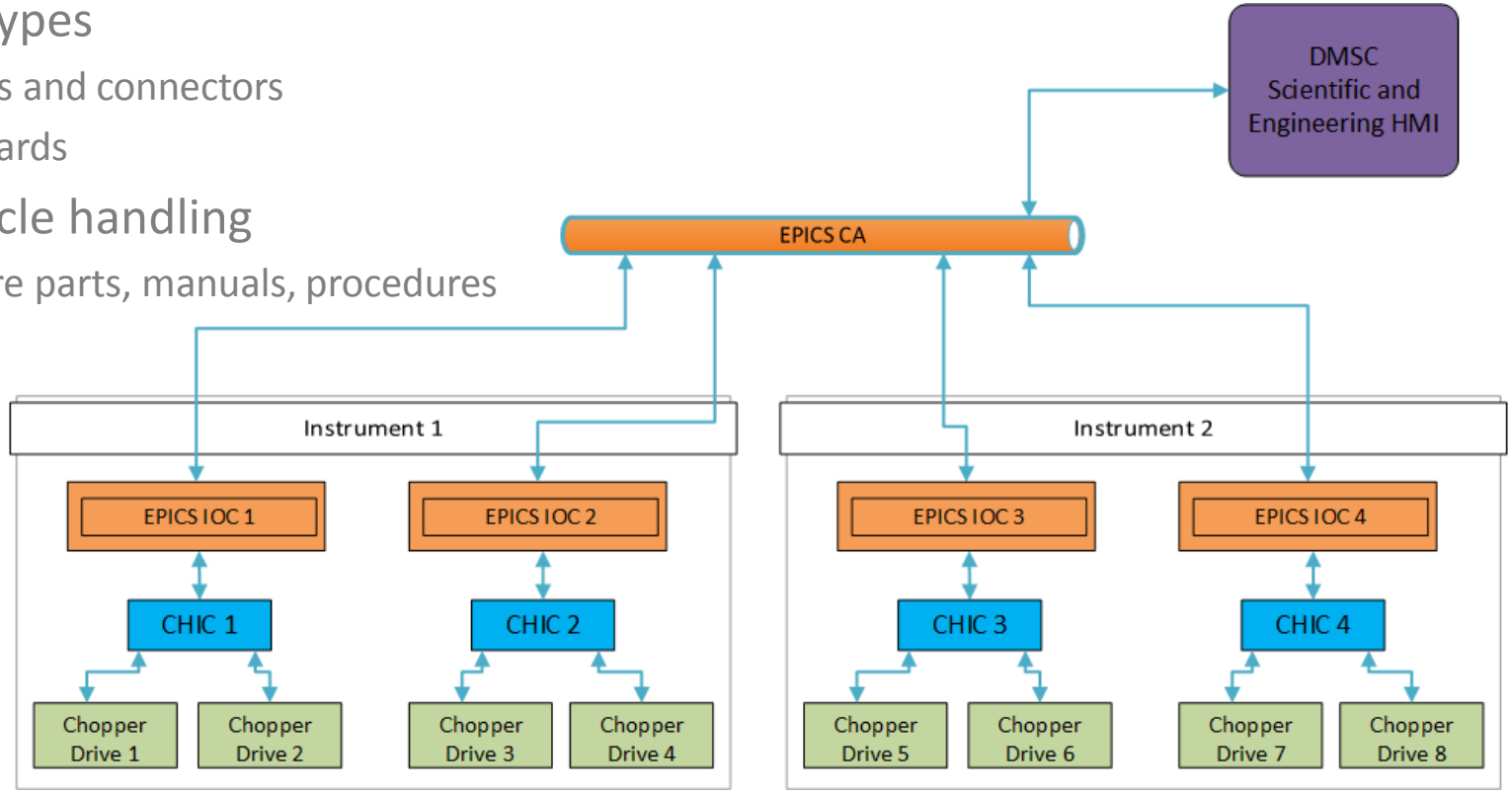
- Central user interface, DMSC (Data Management and Software Center)
- Centralized control system, ICS (Integrated Control System)
  - **Experimental Physics and Industrial Control System (EPICS)**
  - EPICS is the central communication network and control system
- CHIC (**Ch**opper **I**ntegration **C**ontroller) bridge
- All chopper drives (chopper control systems) connect via CHIC



How to develop a standardized solution?

Needs standardized interfaces to effectively integrate 150 neutron choppers

- Simplify compatibility
  - Common electrical and software interfaces
- Fewer part types
  - Cable types and connectors
  - Interface cards
- Easier life cycle handling
  - Fewer spare parts, manuals, procedures

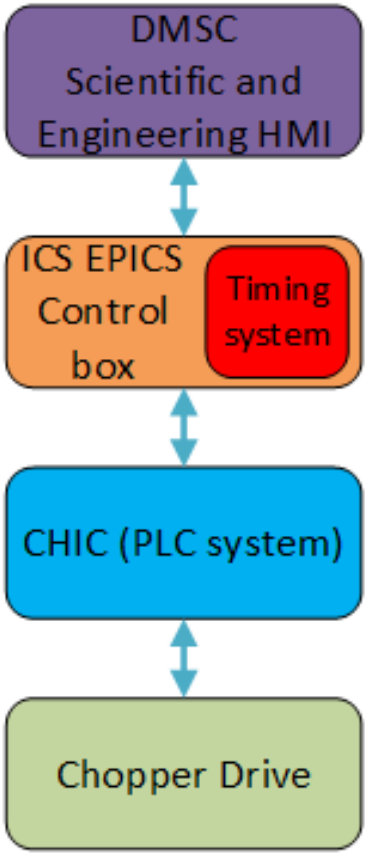


ESS high level system principles

- DMSC handles user interfaces and calculations
  - Scientist HMI
  - Engineering HMI
  - Instrument – Device parameters calculations
- EPICS - communication DMSC and CHIC
- Timing system
  - Timestamping
  - Reference pulses

Design restrictions

- CHIC - communication EPICS and chopper drive
  - Parameters, commands, alarms, time stamped data
- All chopper drives handled as stand alone
  - No direct connection between two drives



CHIC - Chopper drive Interface

Assumptions

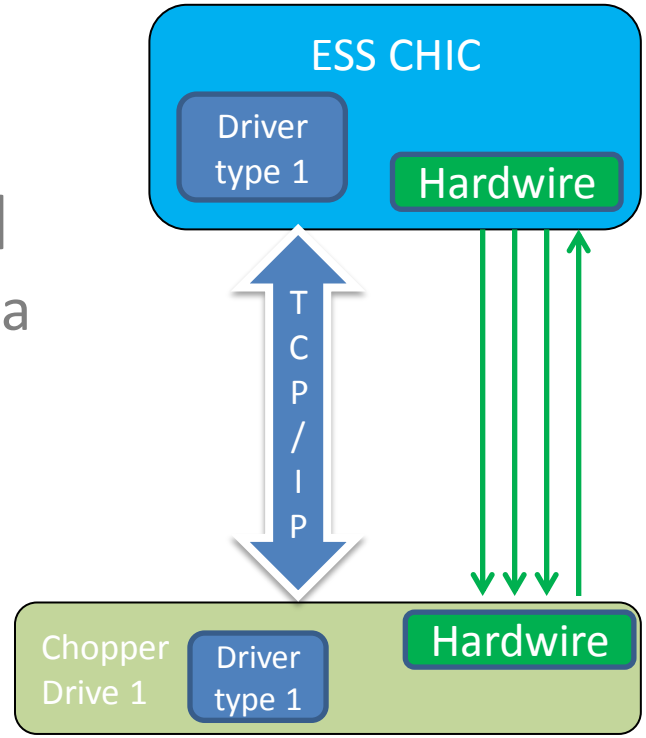
- Chopper drives support remote control
- Field bus used as much as possible
- Veto evaluation done at higher level

Communication bus - non time critical

- Commands, alarm handling, parameters, data logging, interlock signals
- Watch dog

Hardwire - time critical signals

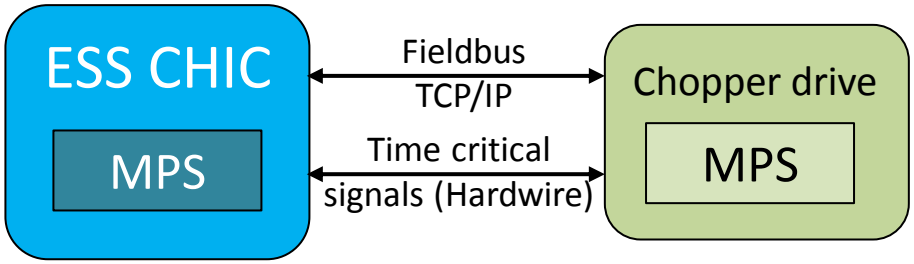
- Input chopper drive (5VDC)
  - Master Pulse Synchronization (14Hz)
  - MPS stop signal
- Output chopper drive (5VDC)
  - Top Dead Centre sensor, << 1 µs jitter, known delay



Machine Protection system (MPS)

MPS is a split function between CHIC and chopper drive

- CHIC responsibility
  - Interlock signals
    - Cooling, vacuum, UPS
  - Instrument MPS

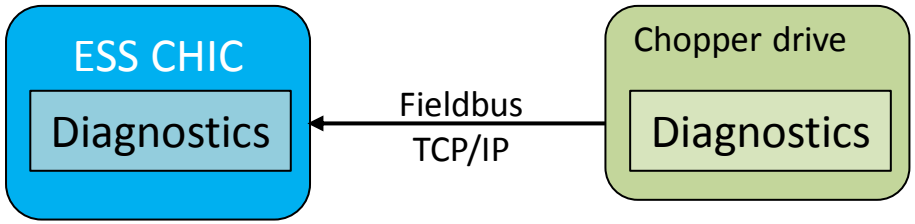


- Chopper drive responsibility (if applicable)
  - Motor MPS
    - Temperature, current, power consumption, position error
  - Bearings MPS
    - Orbits, currents
  - Supplying data and alarms to CHIC

Diagnostics

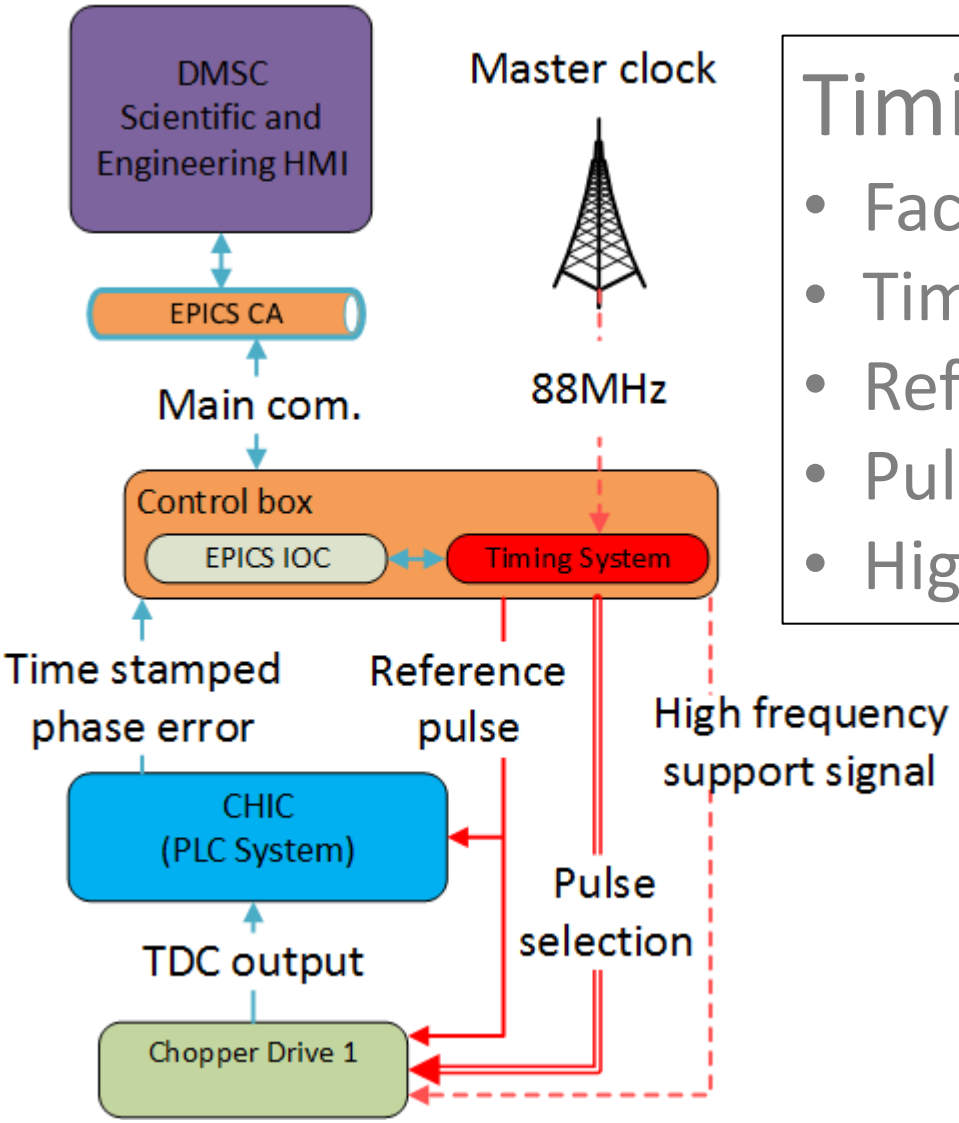
Diagnostics is a split function between CHIC and chopper drive

- CHIC responsibility
  - Hardware installed by NCG group
    - Vibrations, rotor temperature
  - Software developed by NCG group
    - Predictive maintenance, not preventive maintenance
    - Condition monitoring



- Chopper drive responsibility (if applicable)
  - Motor diagnostics
    - Temperature, currents, power consumption, position error
  - Bearing diagnostics
    - Orbits, currents, positions
  - Supplying data and warnings to CHIC

Global Timing System



Timing system

- Facility wide absolute time
- Time stamping - Sync. clocks
- Reference pulse
- Pulse selection
- High frequency support signal

Electrical specification

- Interface type: LVTTL
- Vhigh= 3.3V (min: 2.4V)
- Vlow= 0V (max: 0.4V)
- Termination: 50Ω
- Jitter ±2ns

Time stamping

Time stamping important to move veto evaluation up at DMSC level
Time stamping not fast enough in EPICS IOC, must be done at a lower level.

Two options:

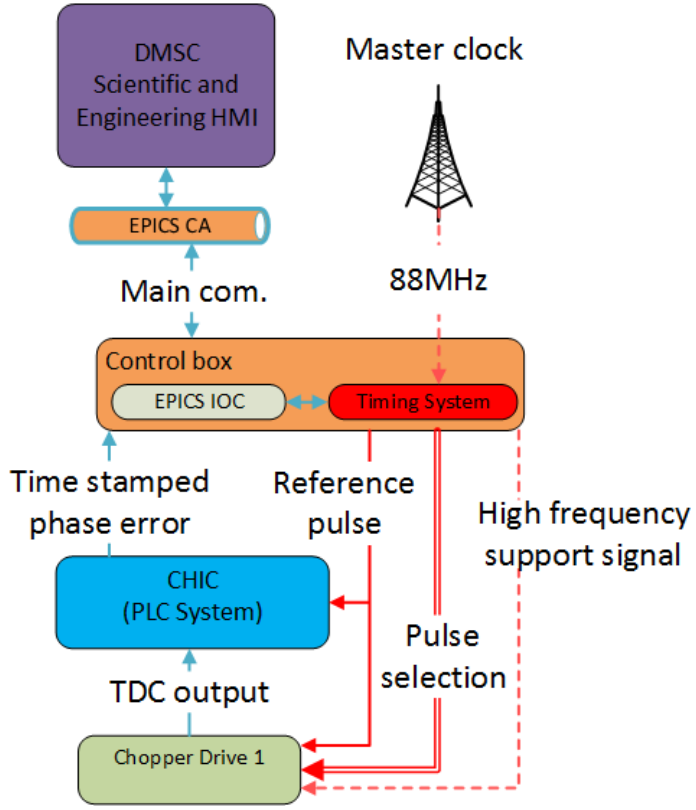
A. Data is time stamped in CHIC

+ Simple interface (TDC sensor output)
- Limited data with timestamp

B. Data is time stamped in chopper drive

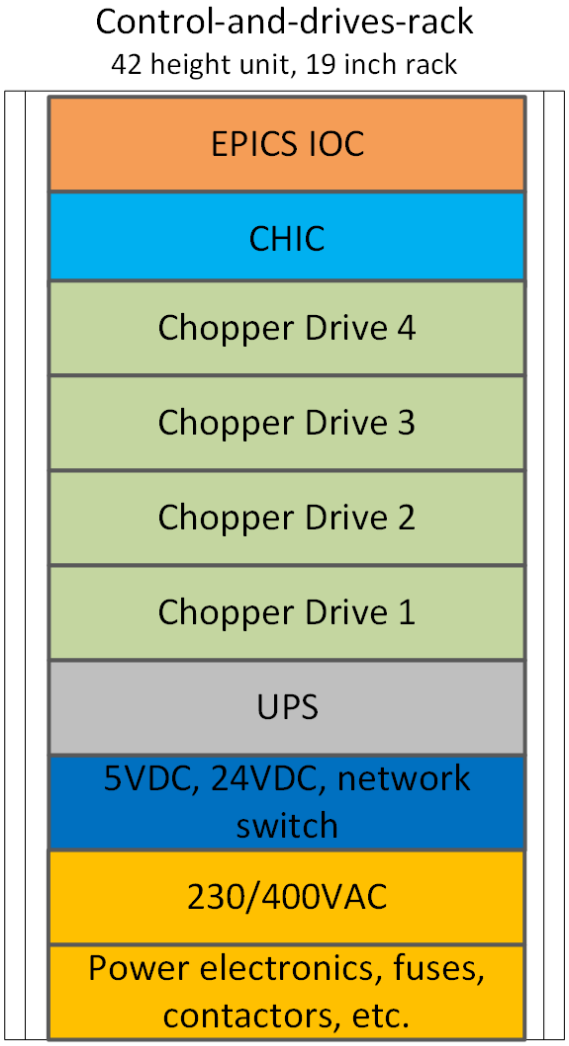
+ Chopper drive has access to more data
+ Less delay, better time stamp precision

- Develop clock sync function
- Develop time stamping, needs more CPU power
- Develop data buffering, needs more memory

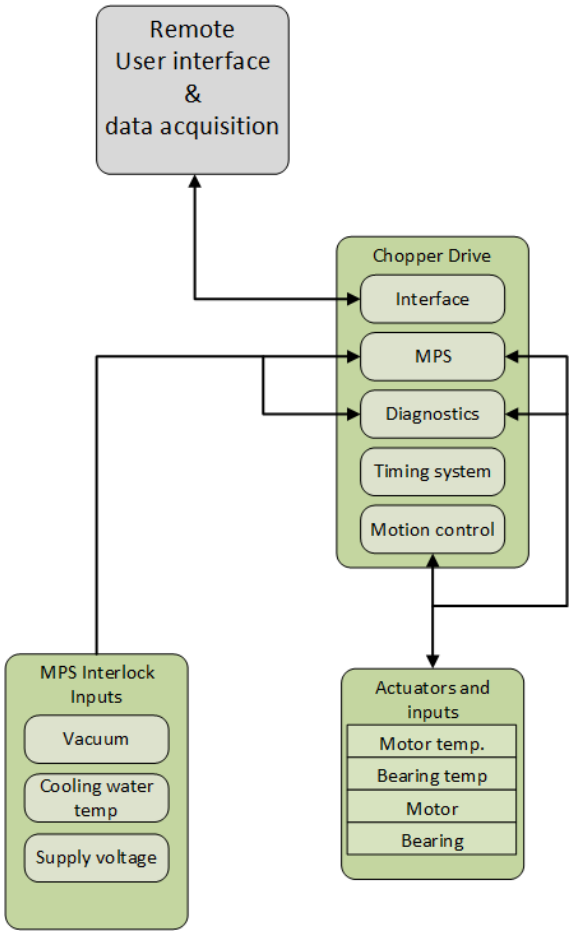


Control Racks

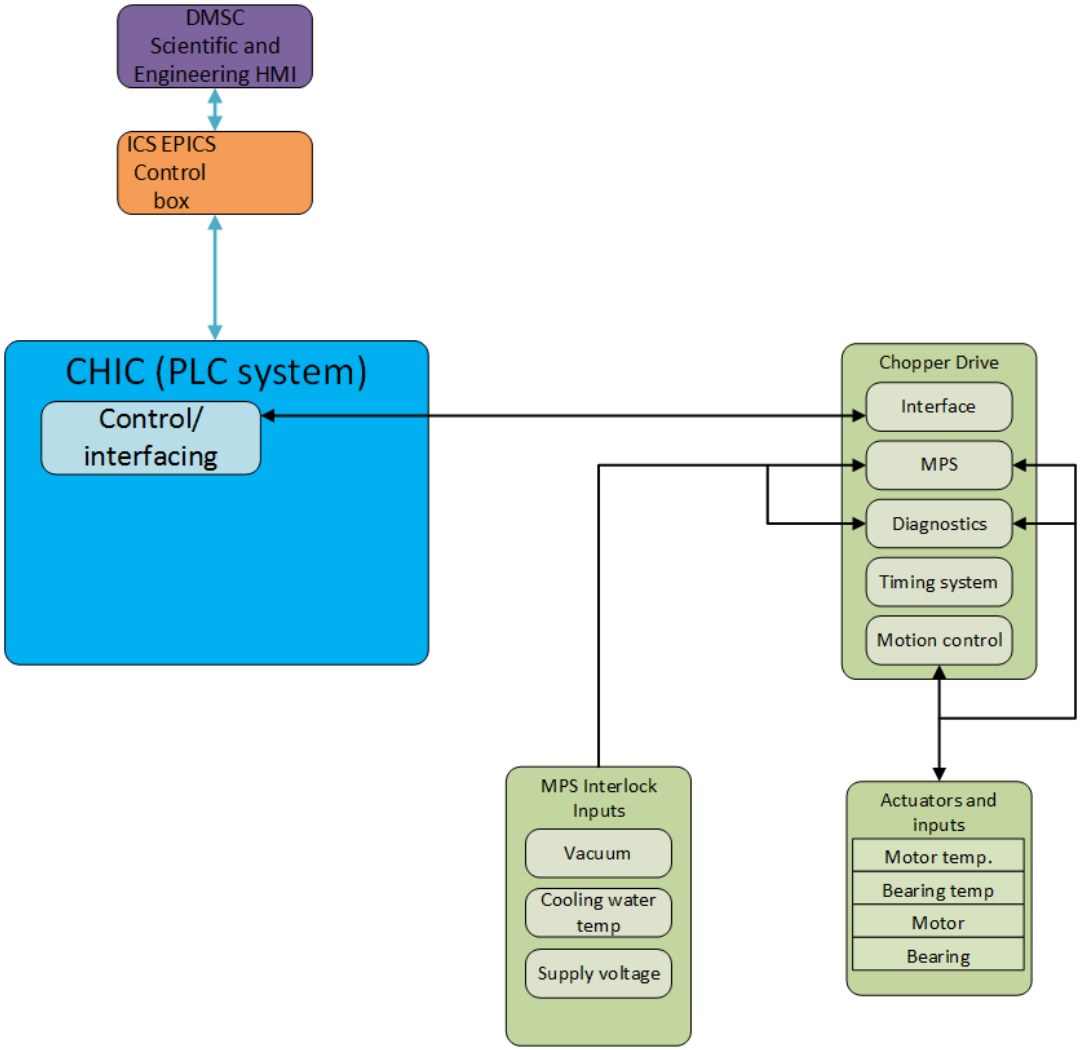
- 19 inch for factor
- One standard control rack
- Variants
  - Different drive sizes
  - No EPCIS IOC or CHIC
- No of Racks in an instruments
  - Number of choppers
  - Distribution of choppers
  - Cable length limitations
  - Space in rack
  - CHIC CPU capabilities



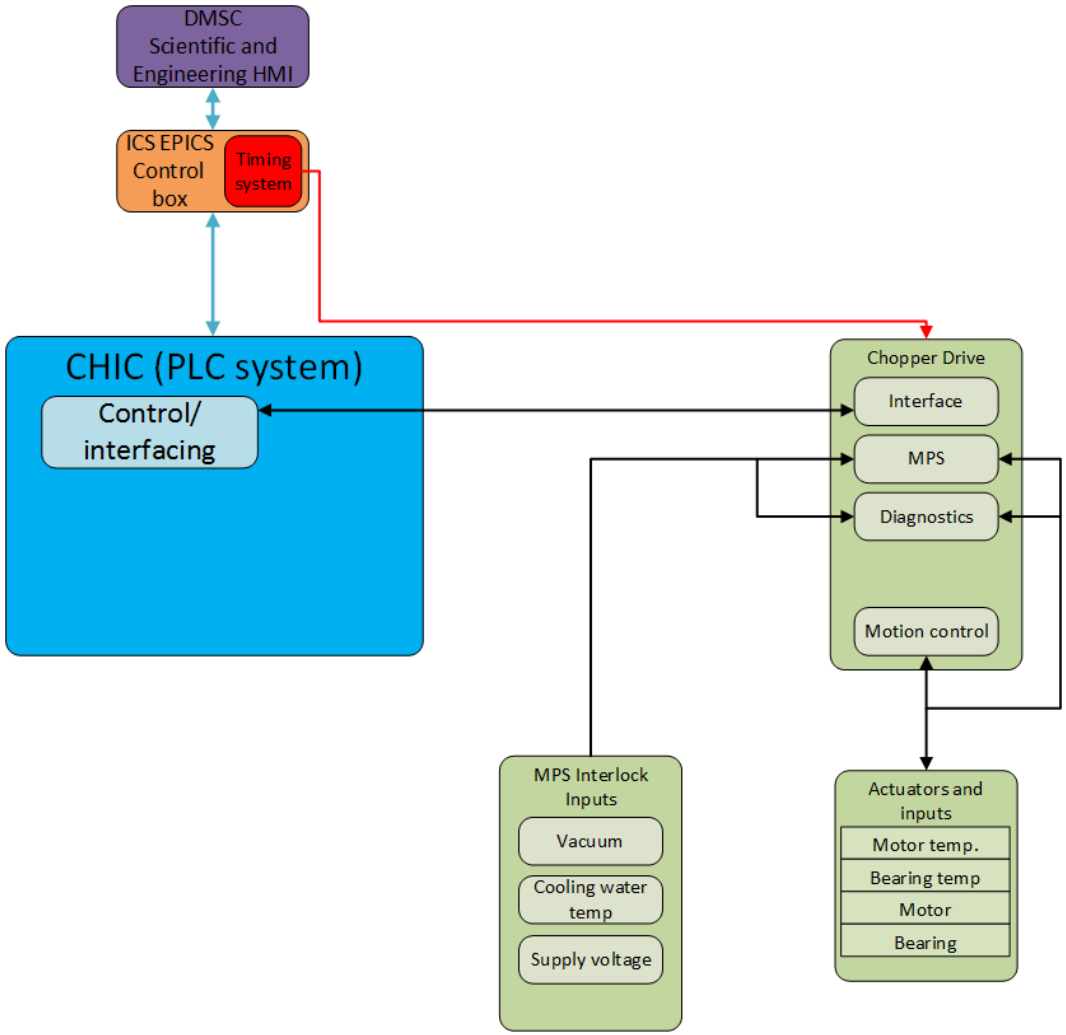
Stand alone Chopper Control System



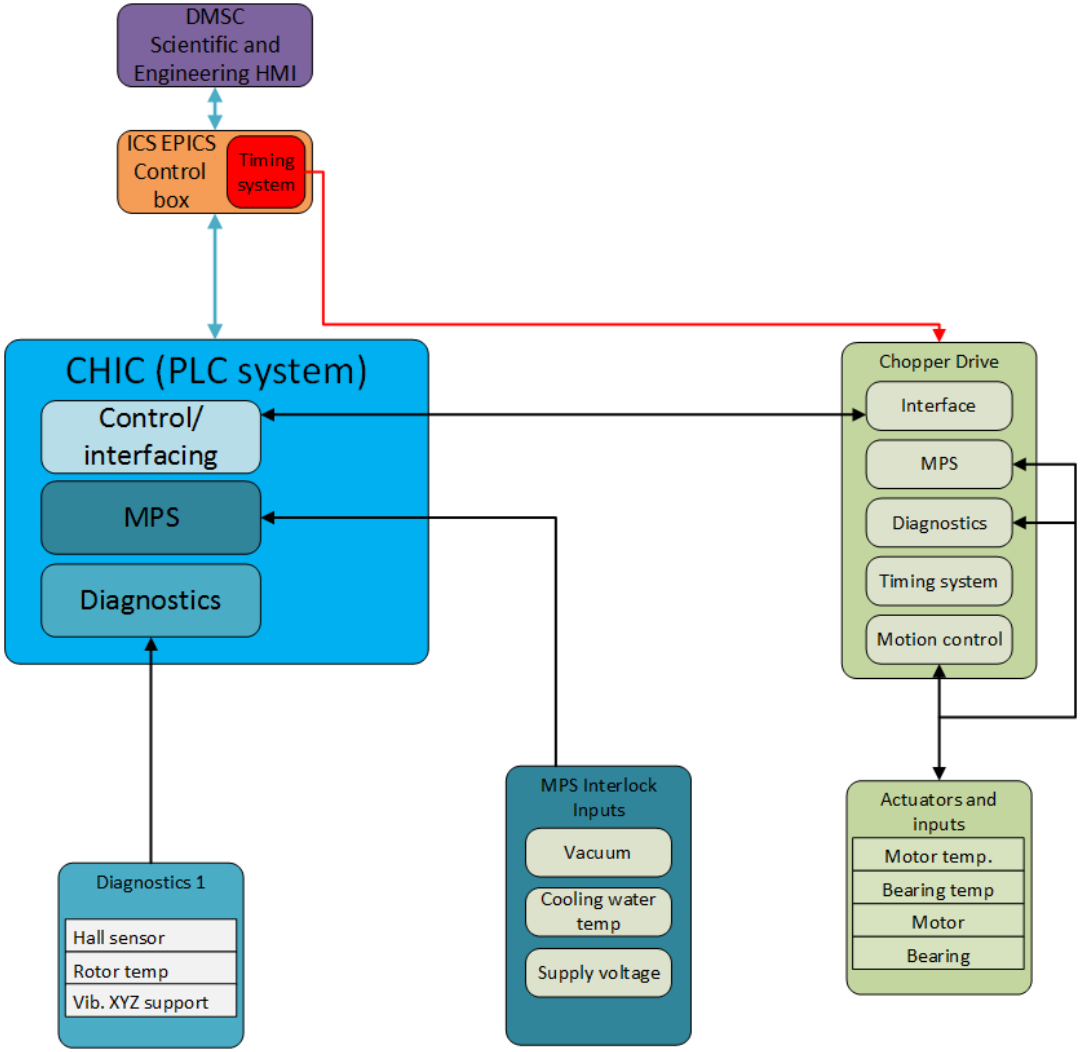
ESS Chopper Control System
Remote control & Data Acquisition



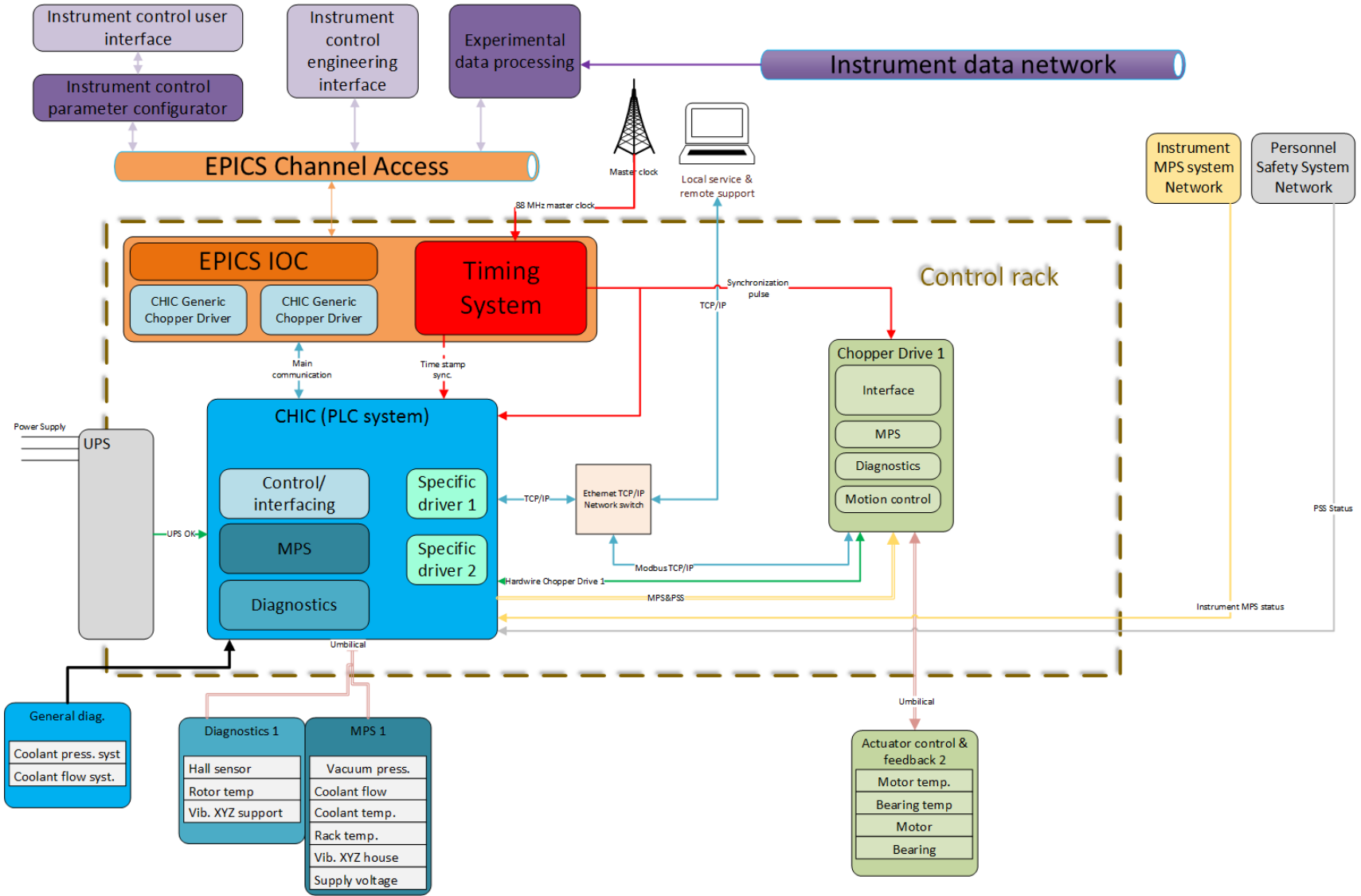
ESS Chopper Control System
Timing system



ESS Chopper Control System
MPS and diagnostics

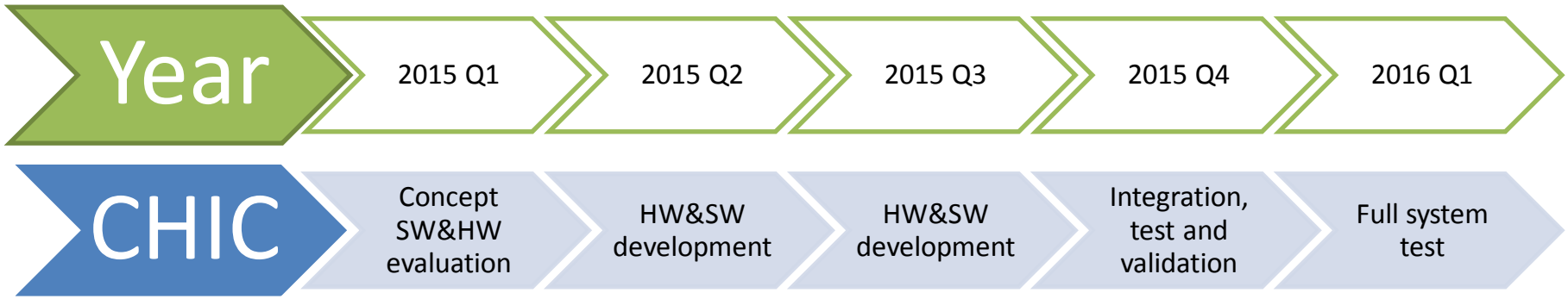


ESS System networks



Time line

- Q1 2015 – Concept decision
- Q2 2015 – Hardware and software development
- Q3 2015 – Architecture agreement
- Q4 2015 – Compatibility verification & validation
- Q1 2016 – Full system test run



Thank you

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Questions?