Wireless Technologies in the Power Industry

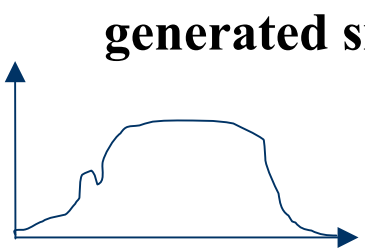
Circuit Breaker On-line Monitoring Using Wireless Communication

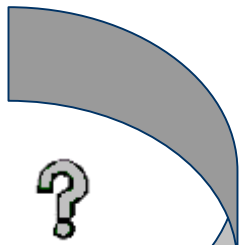
Outline

- Background
- Functional Requirements
- Design Specification
- Implementation
- Future Work

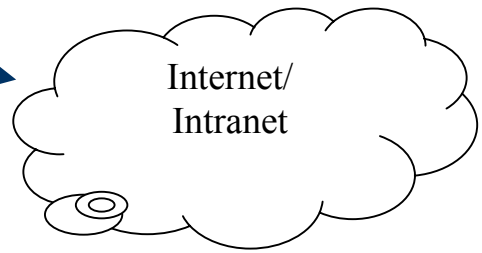
Background

Circuit breaker

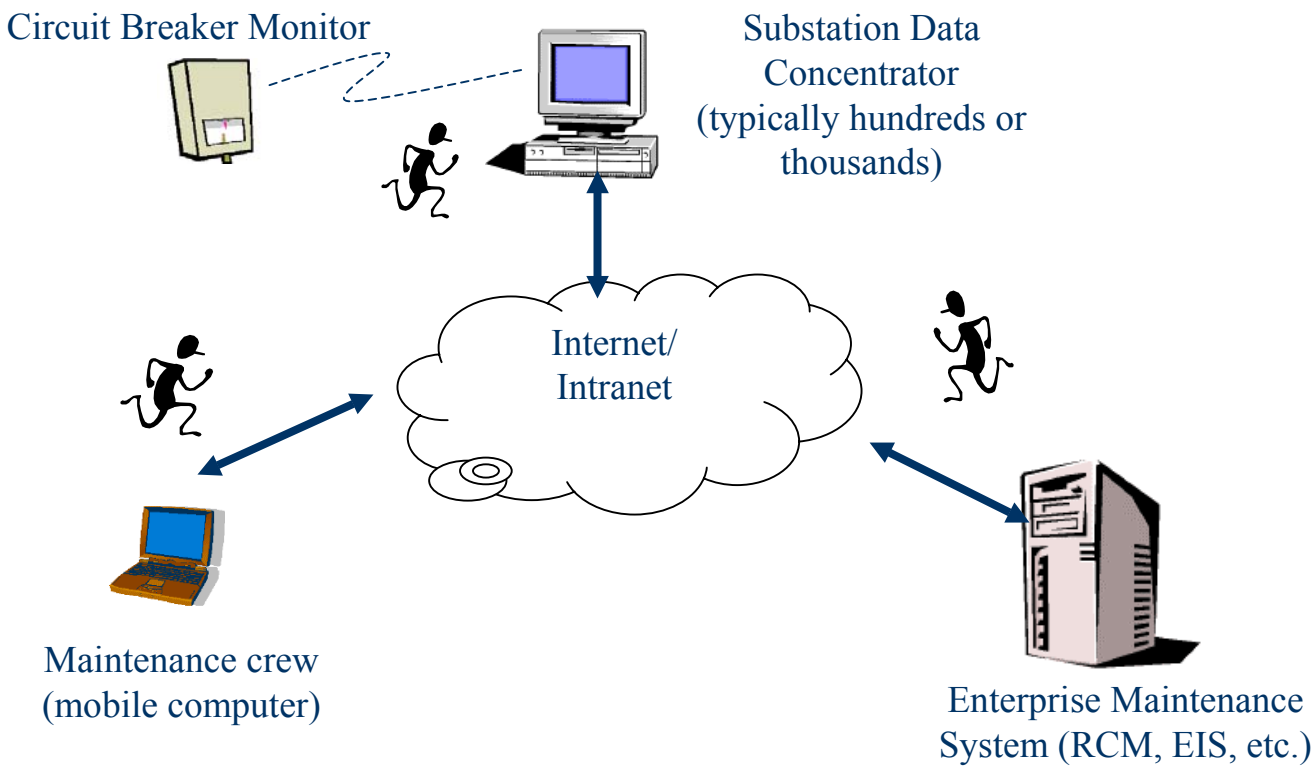




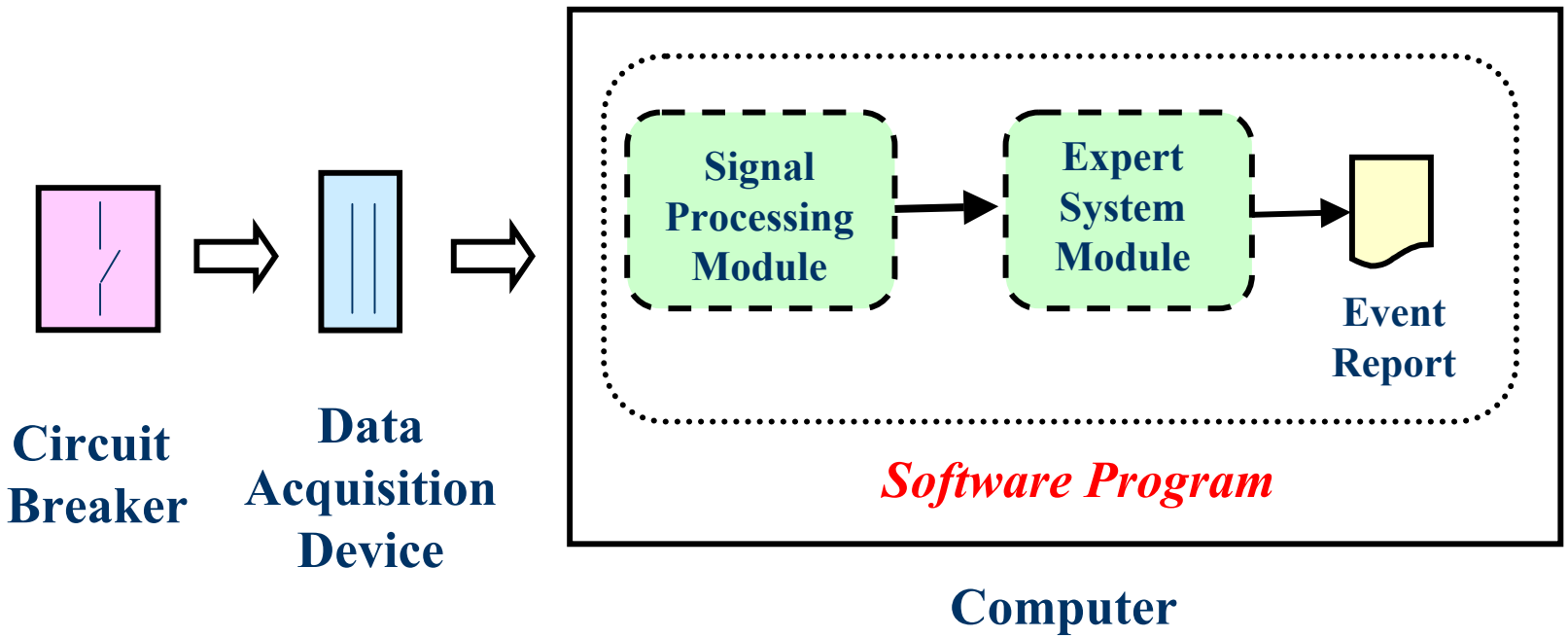
Concentrator



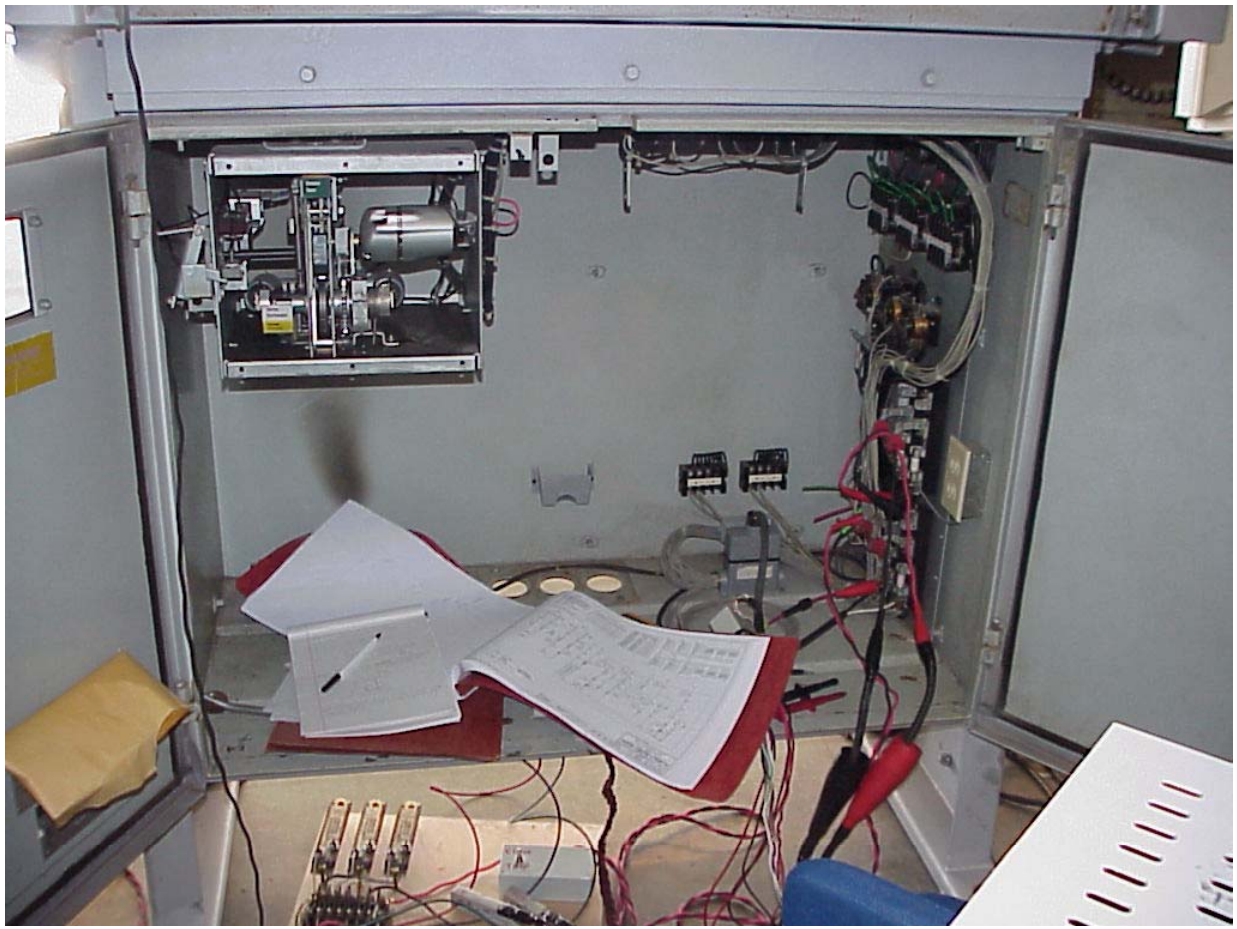
The big picture



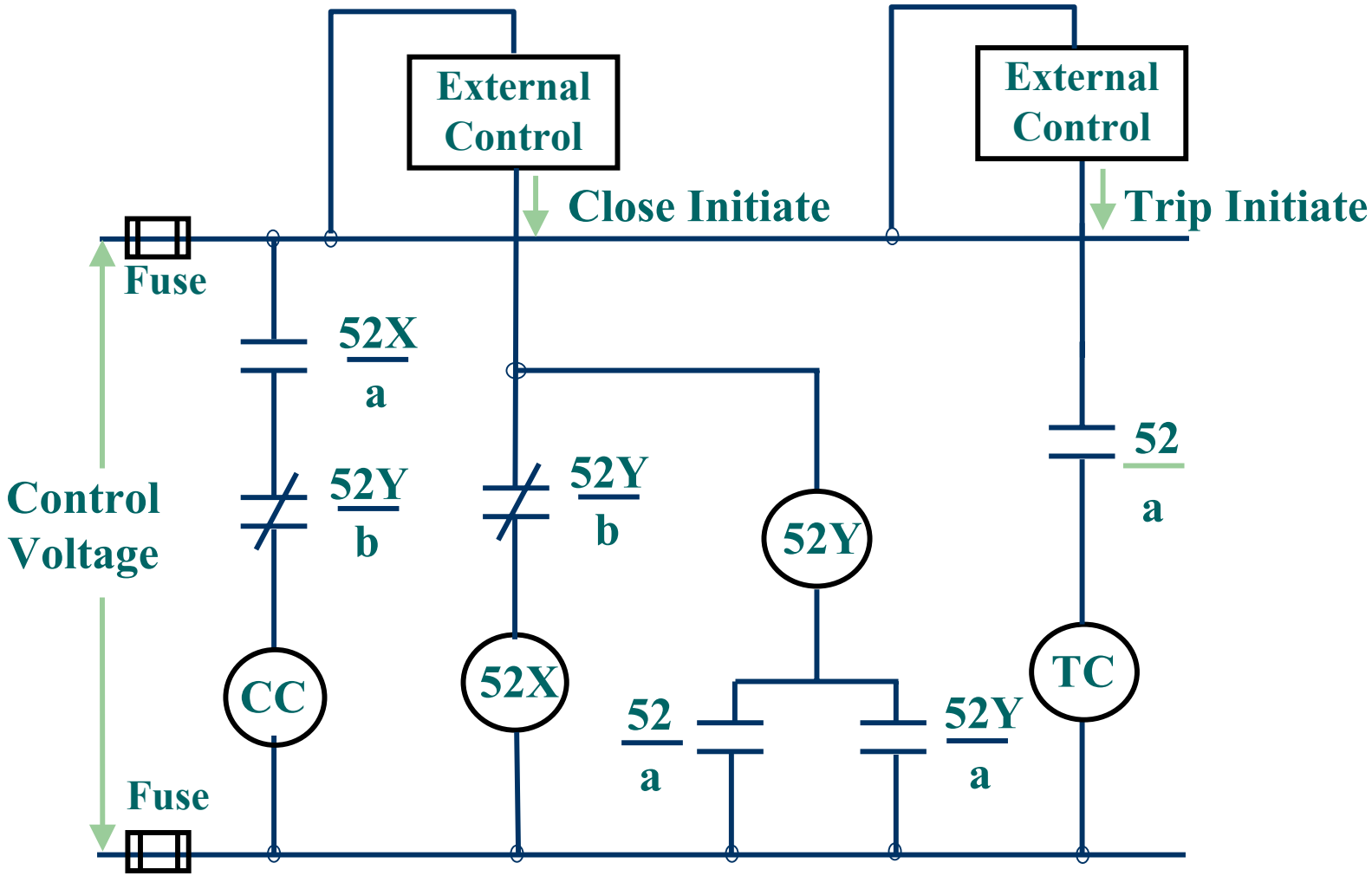
Substation set-up



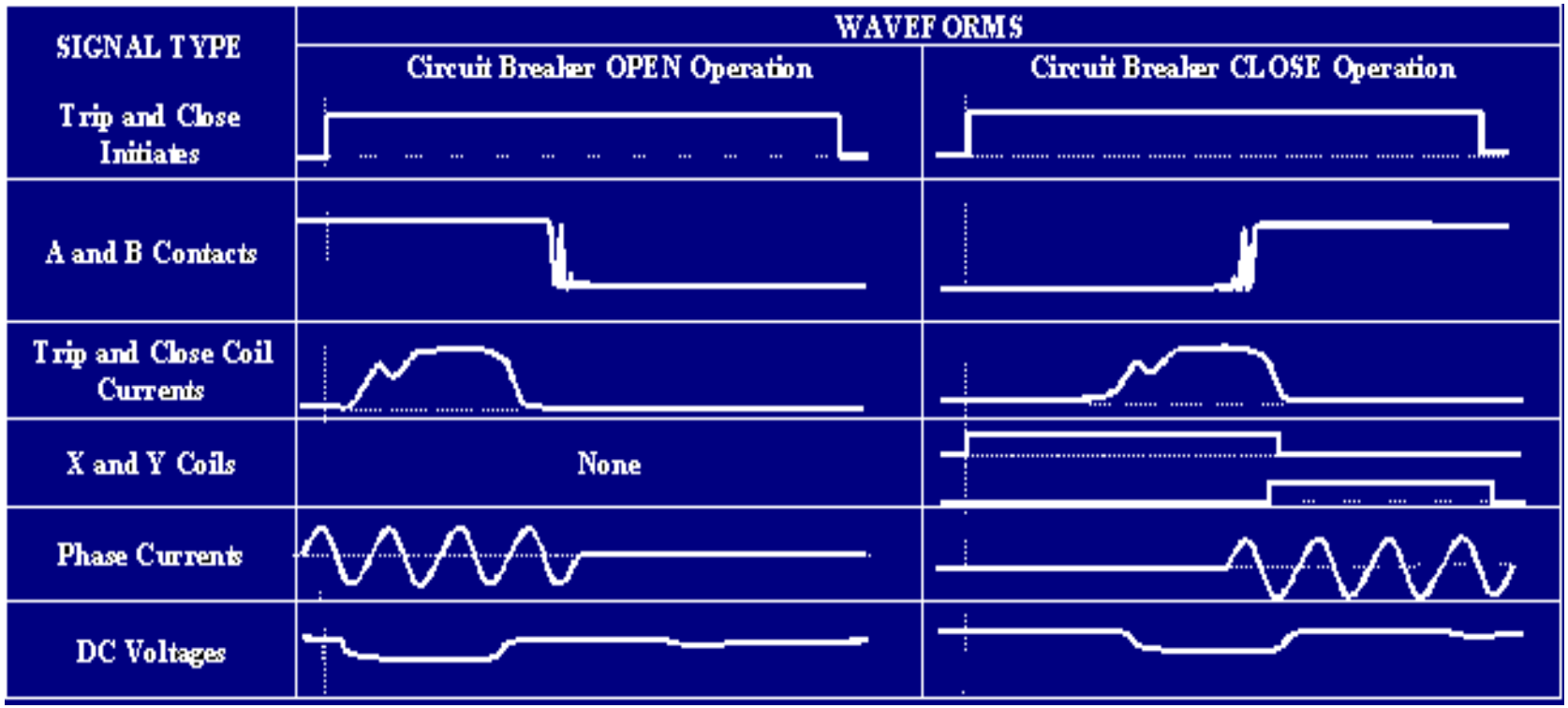
Circuit Breaker side



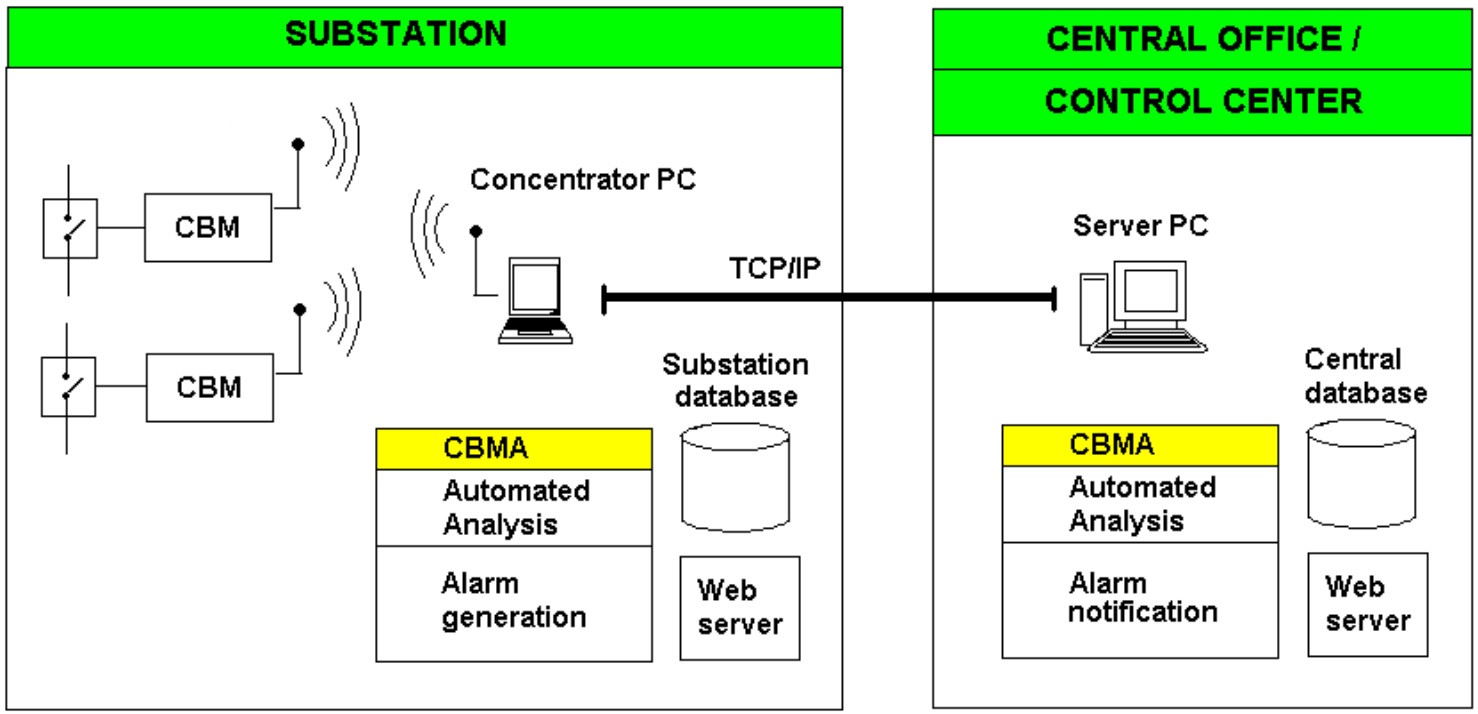
Circuit Breaker Control Circuit



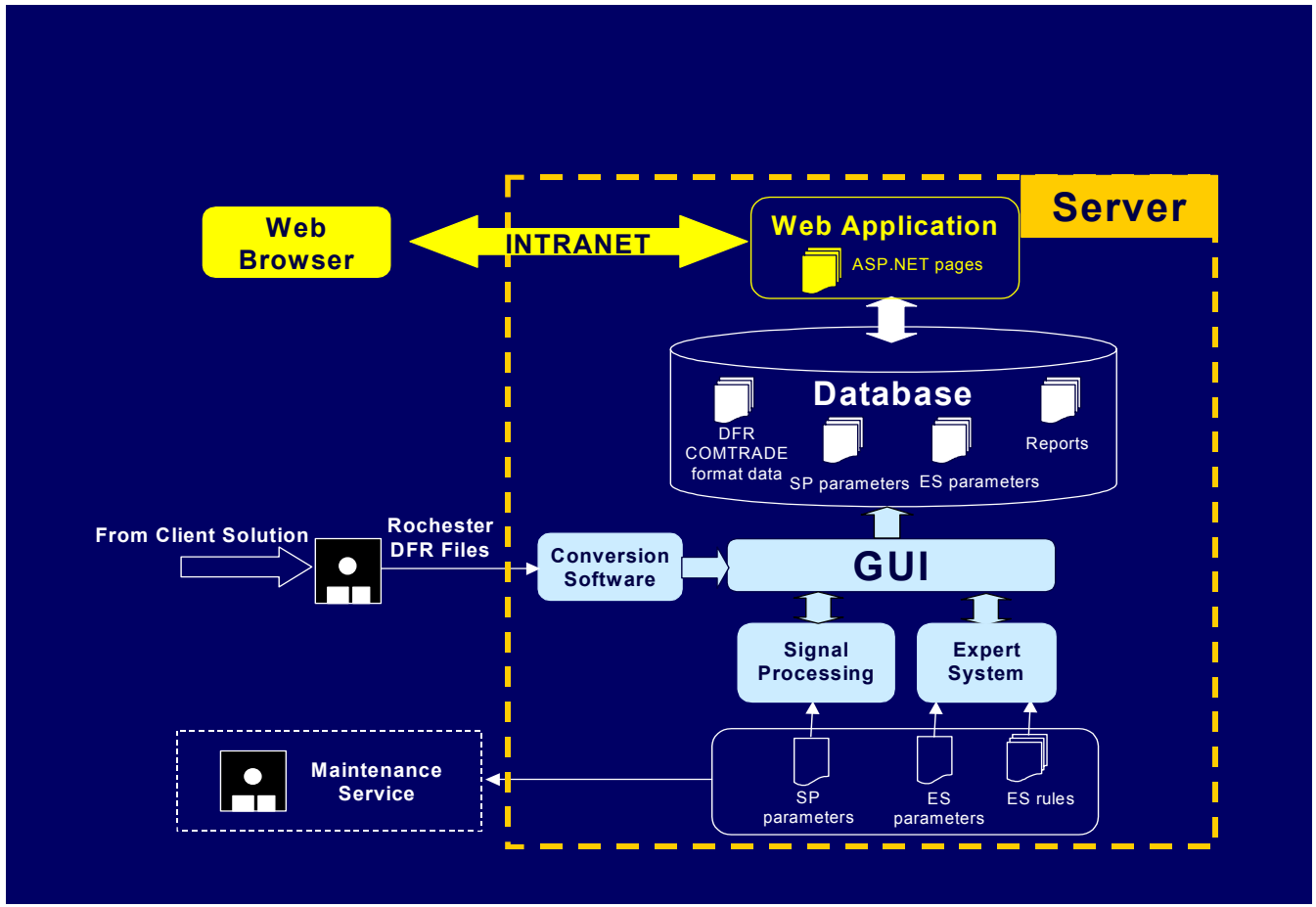
Recorded signals



Client-Server solution



Centralized solution



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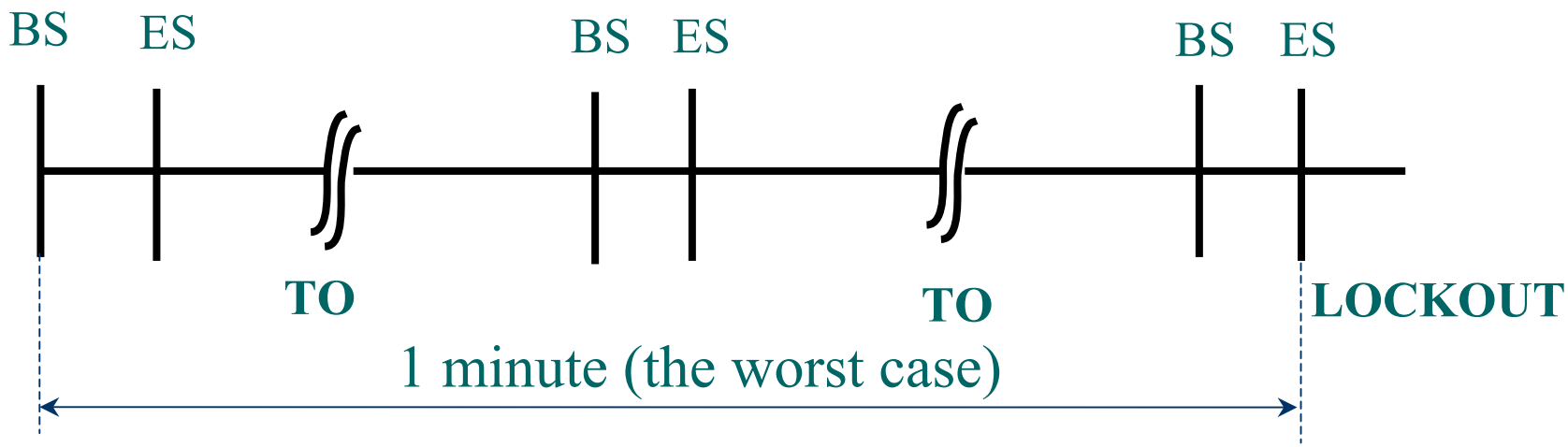
Functions

- Perform data acquisition of 15 signals (11 analog and 4 status) and record sequences of tripping and closing
- Create files of captured sequences according to COMTRADE file specification
- Wireless file transfer to concentrator

Signals Monitored by DAU

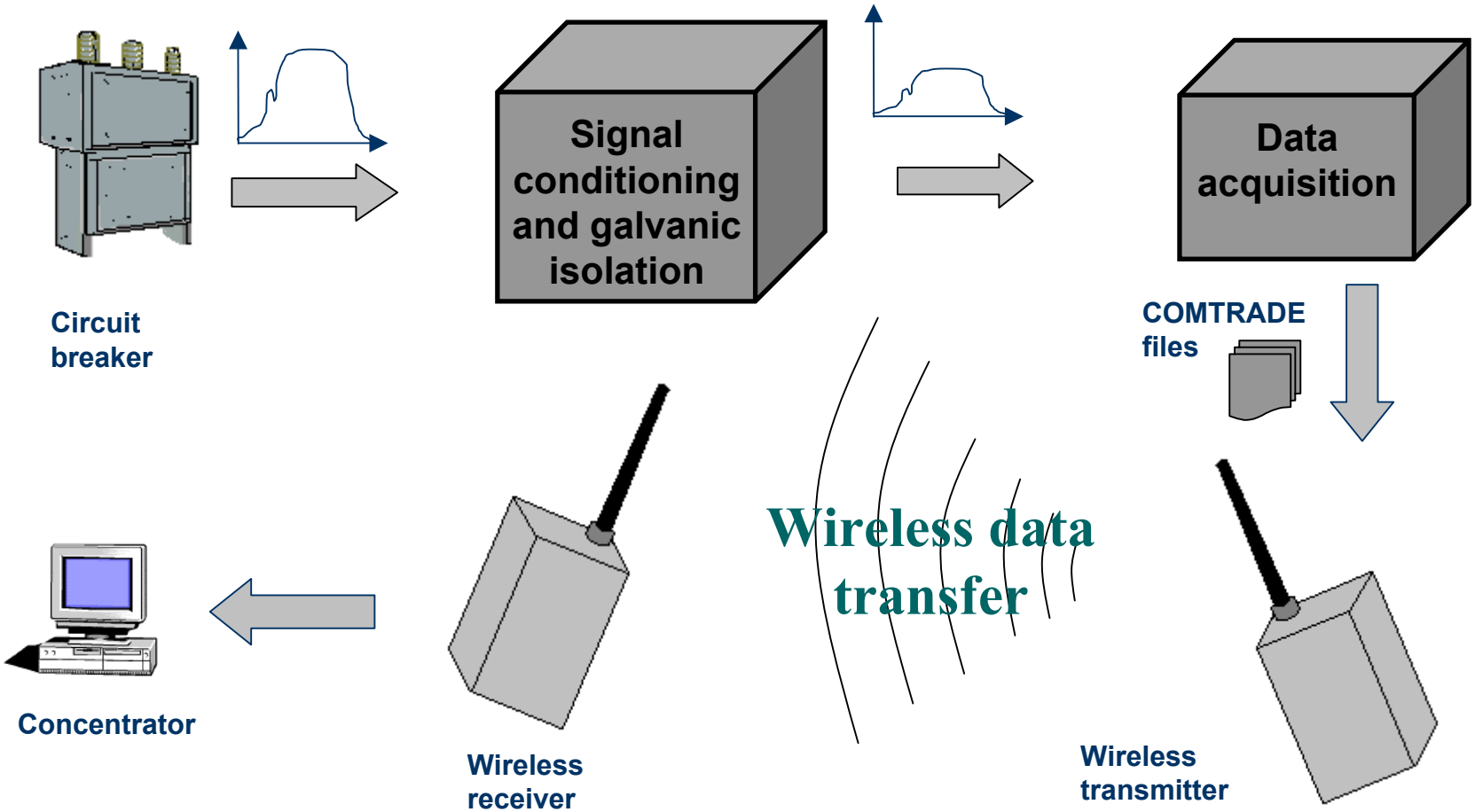
Group	Signal name
Digital signals	Trip Initiate
	Close Initiate
	X Coil signal
	Y Coil signal
Contacts	“A” Contact
	“B” Contact
DC Voltages	Control DC Voltage
	Yard DC Voltage
	Light Wire
Coil Currents	Trip Coil (TC) Current 1
	Trip Coil (TC) Current 2
	Closing Coil (CC) Current
Phase Currents	Phase Current A
	Phase Current B
	Phase Current C

Tripping and closing sequences



- BS -- beginning of sequence
- ES – end of sequence
- TO – time out

DAU – Functional block diagram



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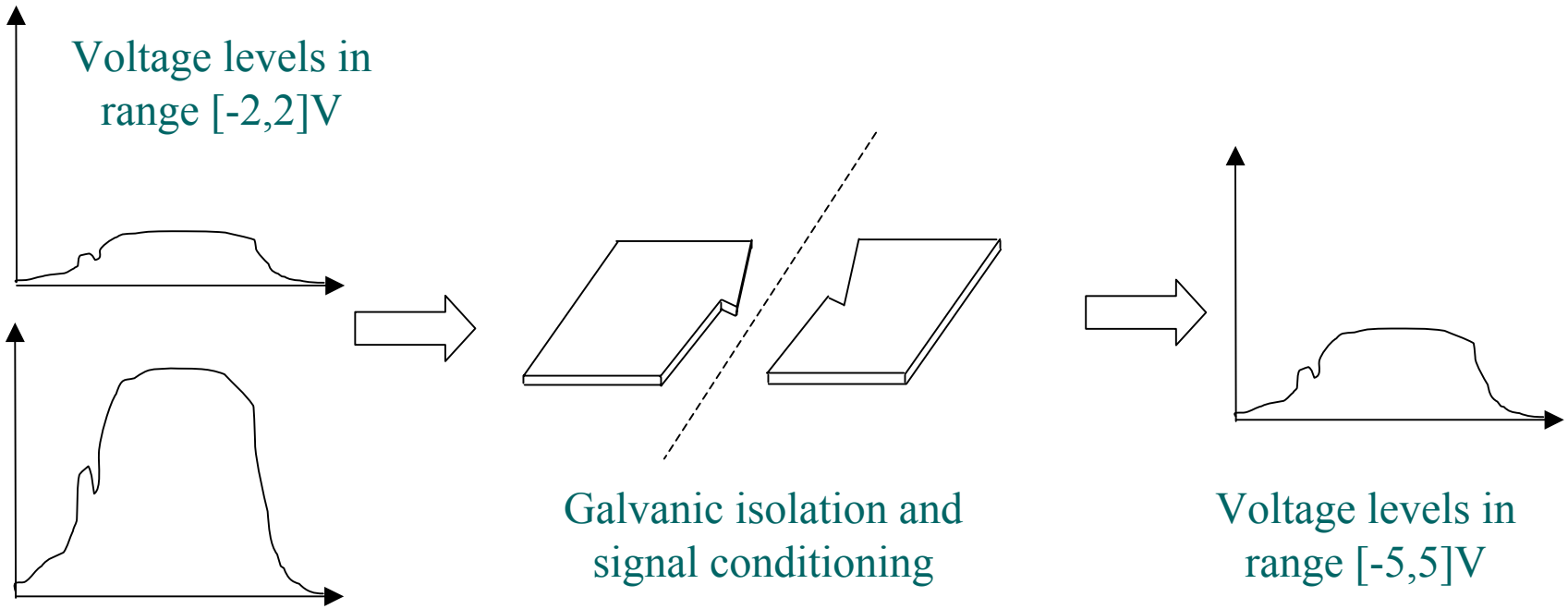
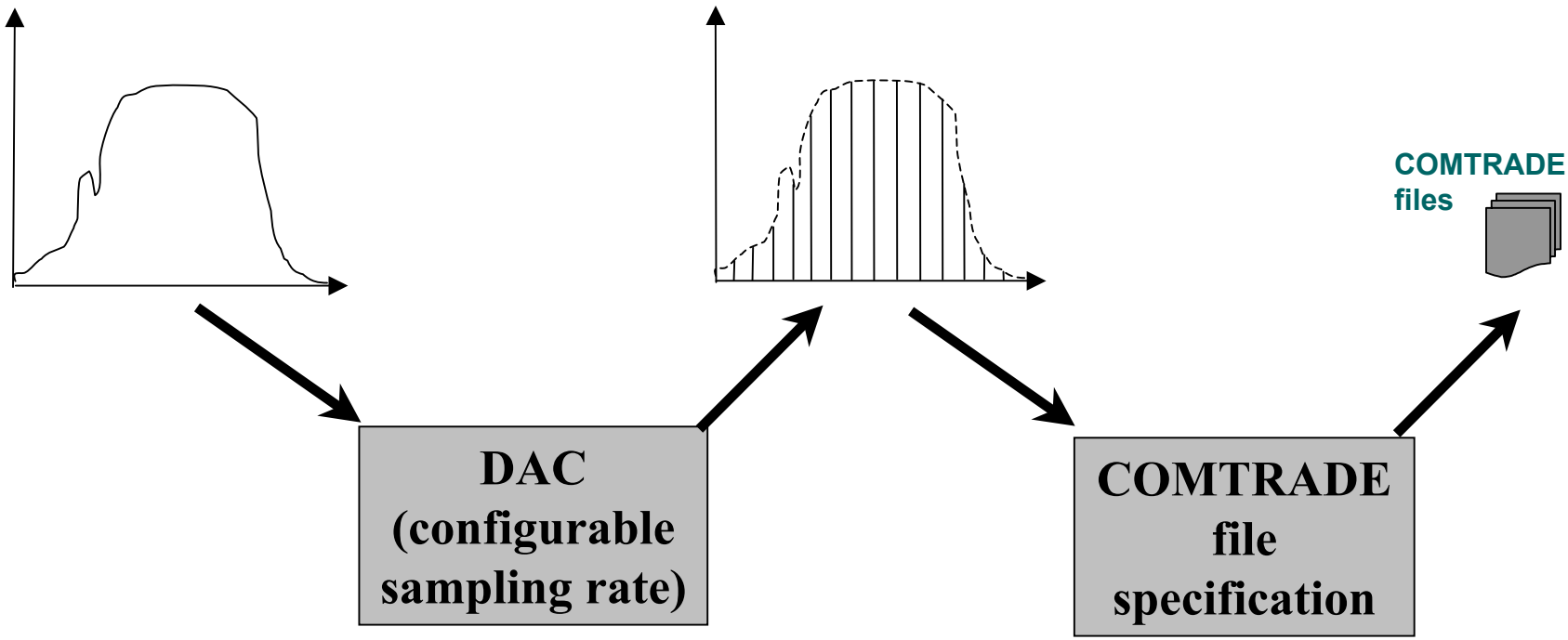
Design Specification

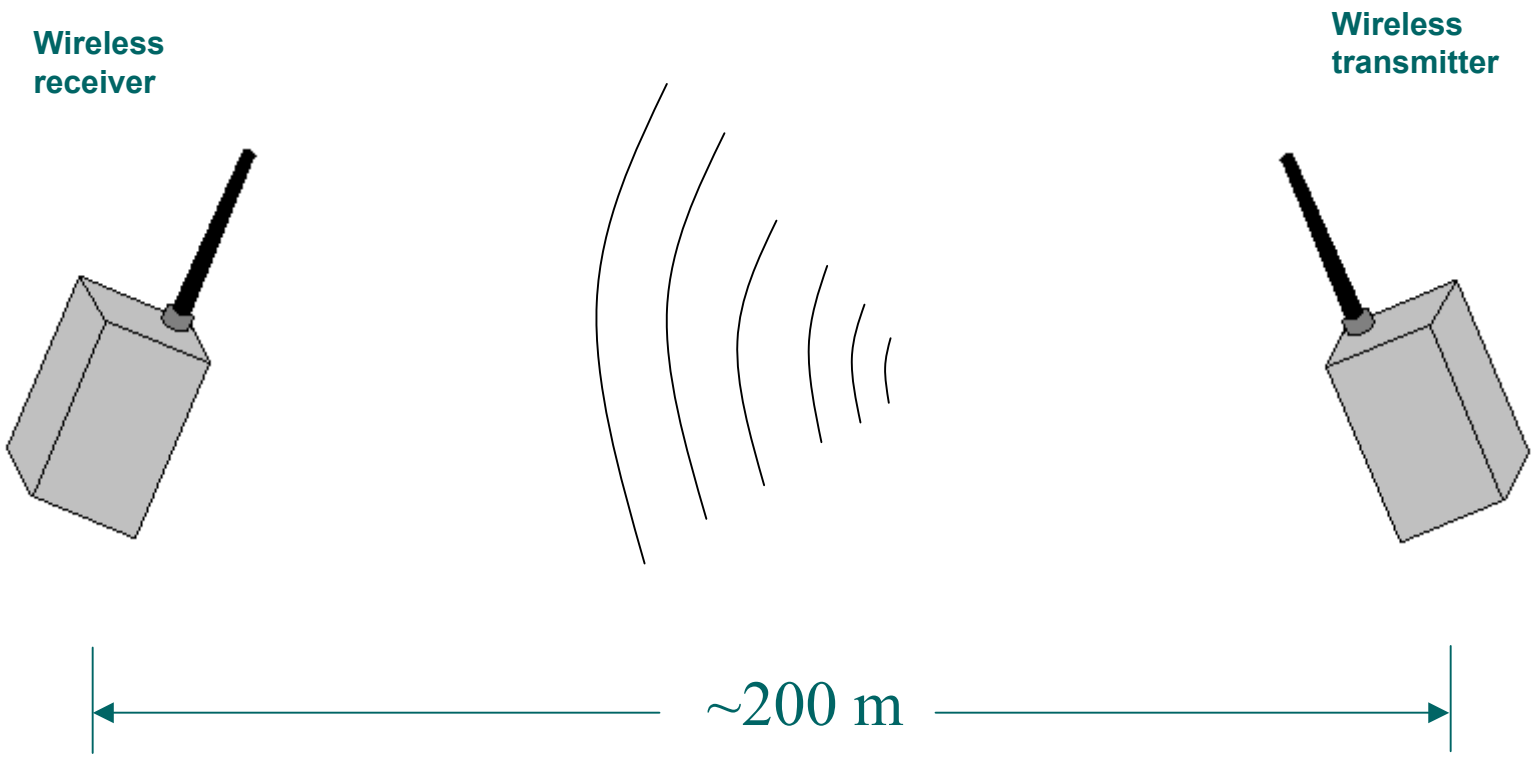
- Board for signal conditioning and galvanic isolation



- Data acquisition



- Wireless data transfer



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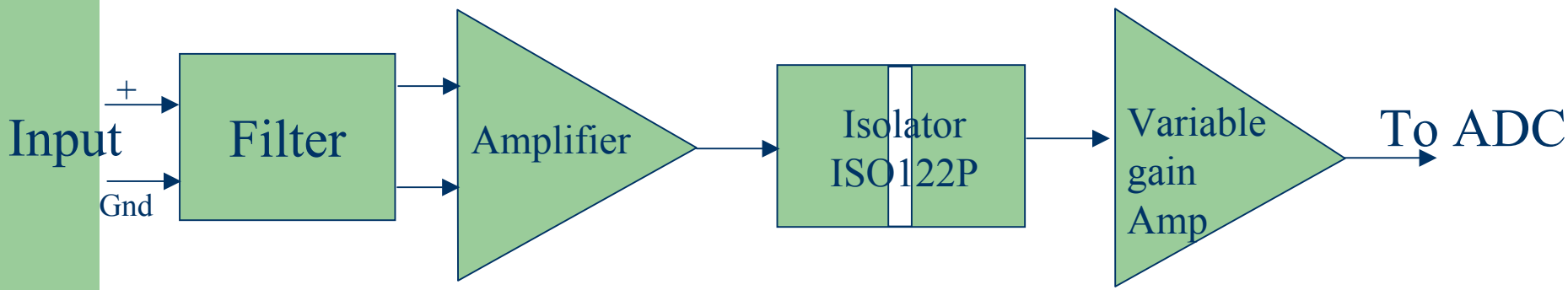
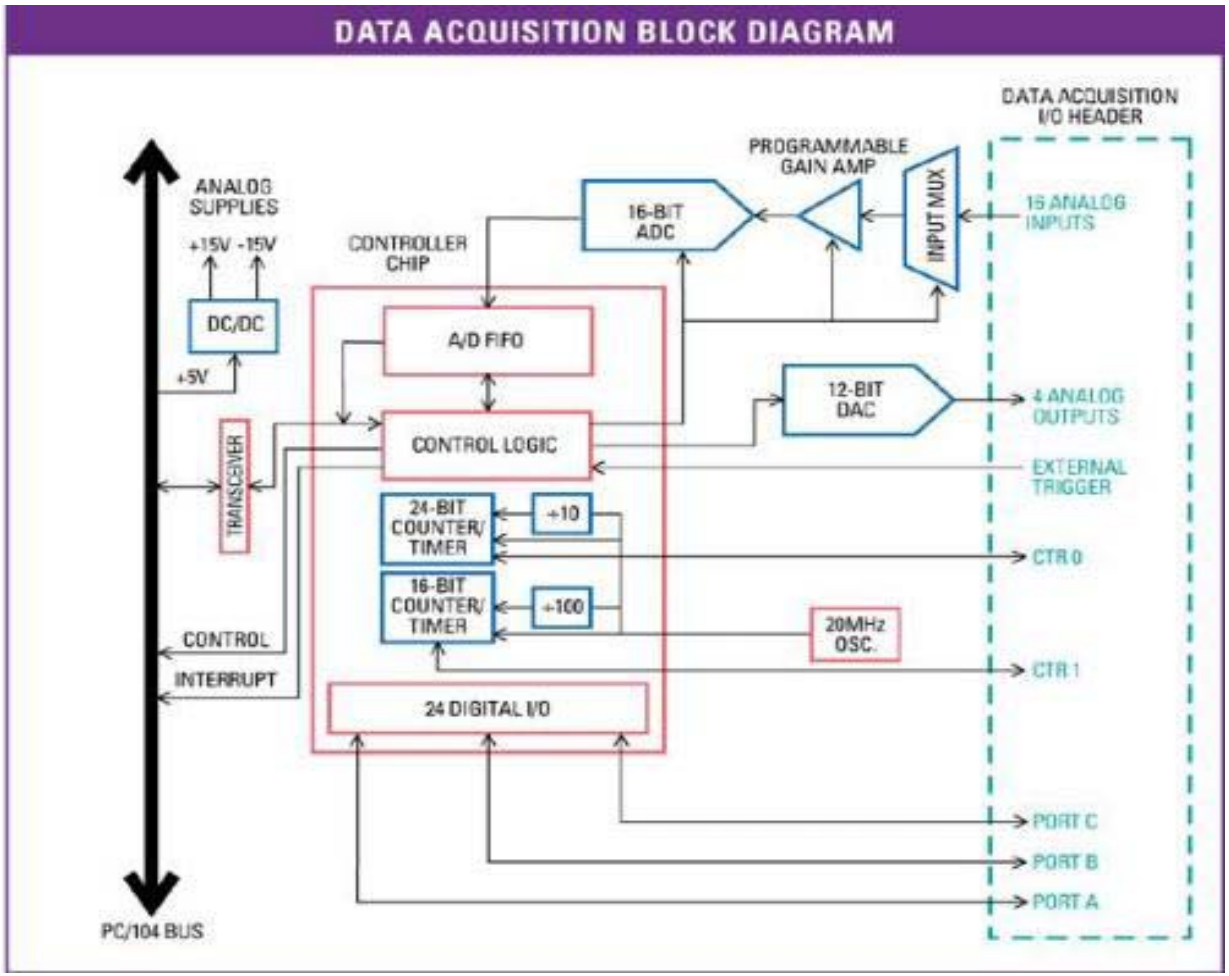
Implementation

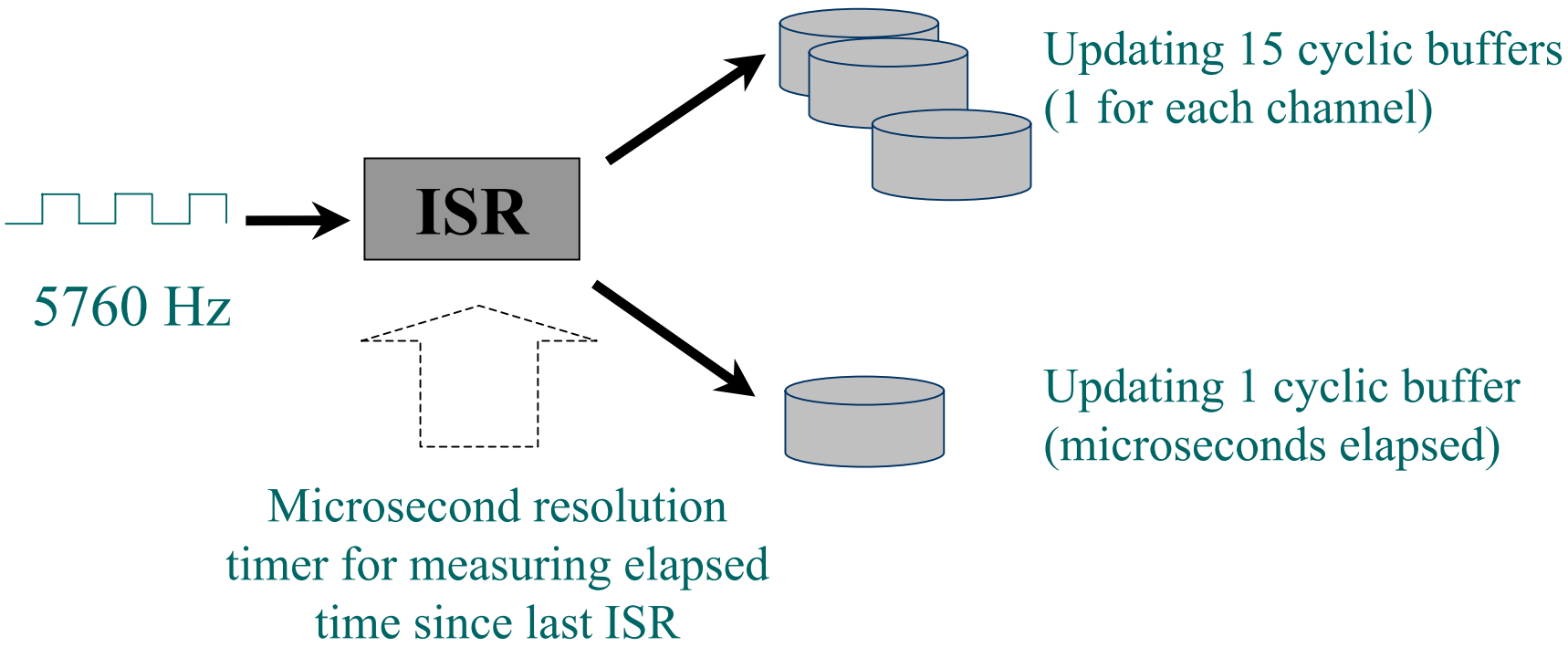
Signal Conditioning board – 15 channels



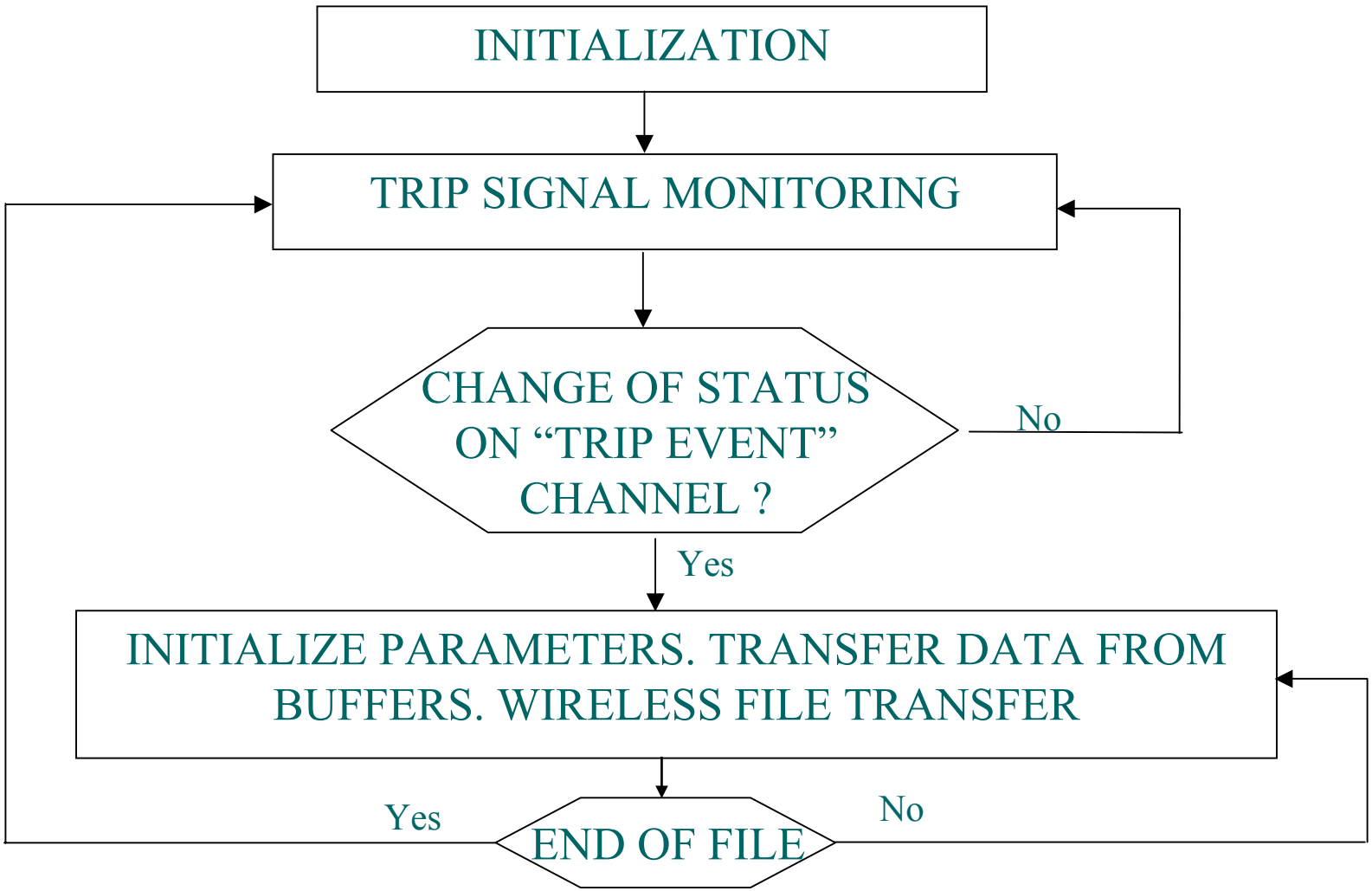
ADC module


DATA ACQUISITION BLOCK DIAGRAM
DATA ACQUISITION I/O HEADER
PROGRAMMABLE GAIN AMP
ANALOG SUPPLIES
+15V -15V
CONTROLLER CHIP
16-BIT ADC
INPUT MUX
16 ANALOG INPUTS
DC/DC
A/D FIFO
+5V
12-BIT DAC
4 ANALOG OUTPUTS
TRANSCEIVER
CONTROL LOGIC
EXTERNAL TRIGGER
24-BIT COUNTER/ TIMER
÷10
CTR 0
16-BIT COUNTER/ TIMER
÷100
20MHz OSC.
CONTROL
INTERRUPT
CTR 1
24 DIGITAL I/O
PORT C
PORT B
PORT A
PC/104 BUS

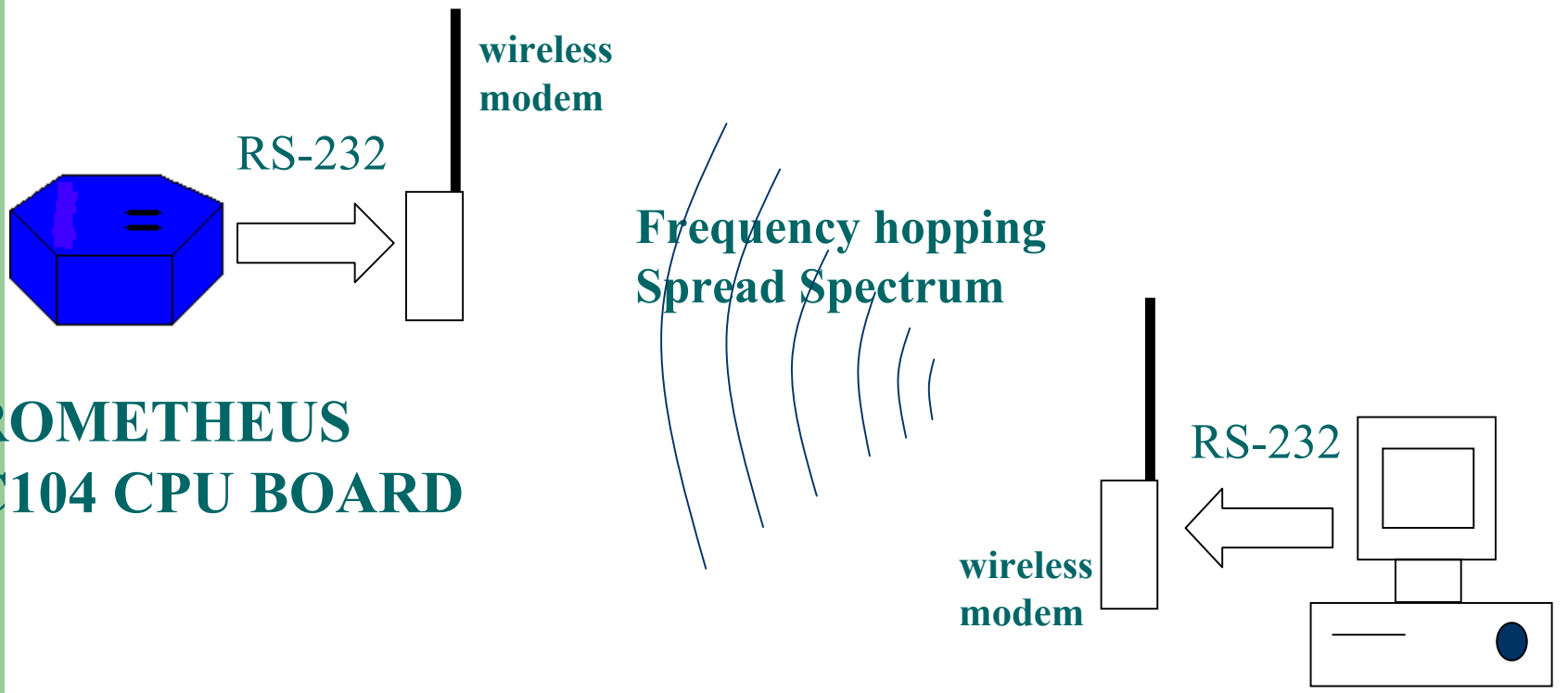
A/D conversion algorithm



Main program flow diagram



Wireless file transfer



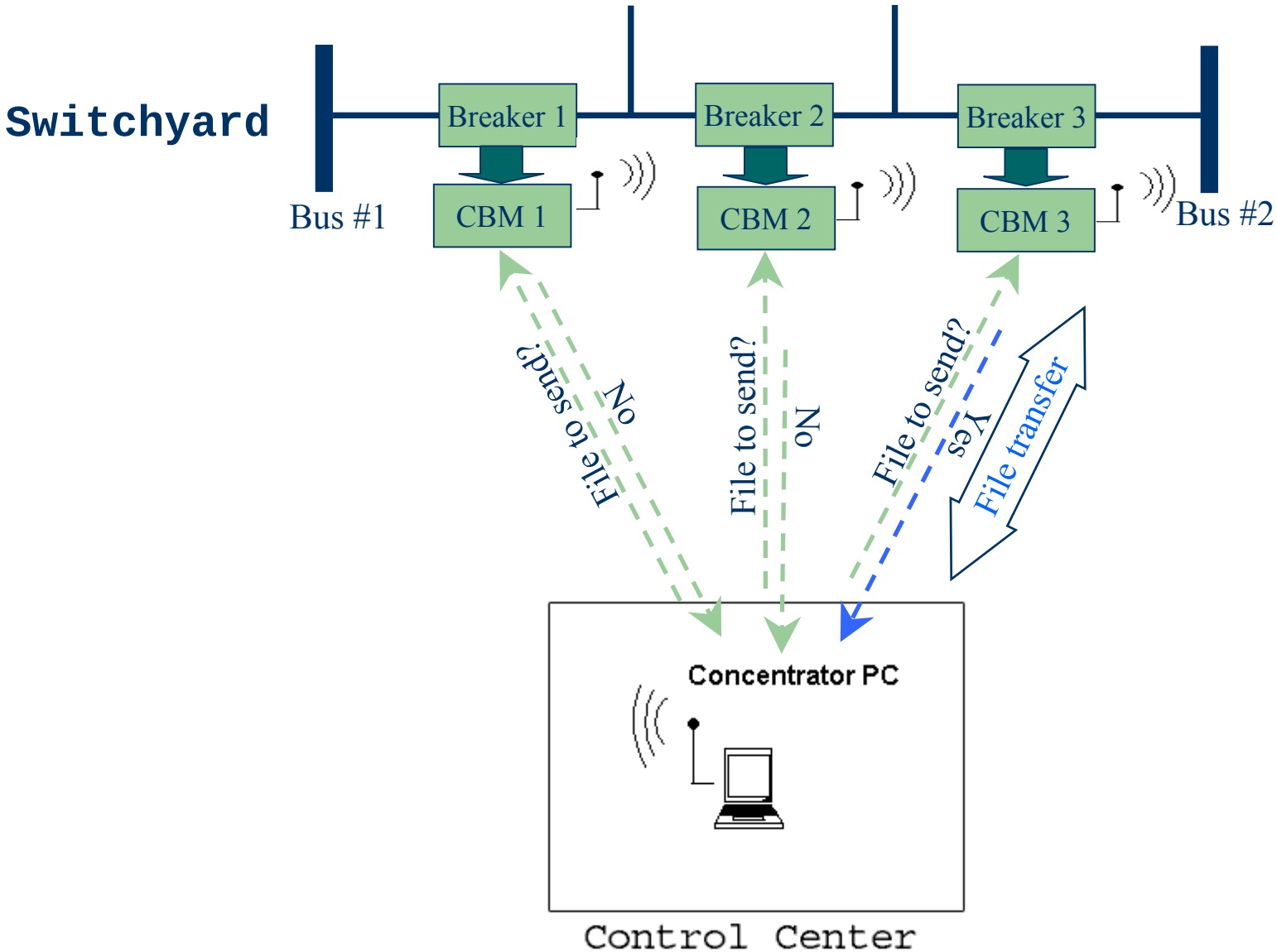
PROMETHEUS
PC104 CPU BOARD

CONCENTRATOR

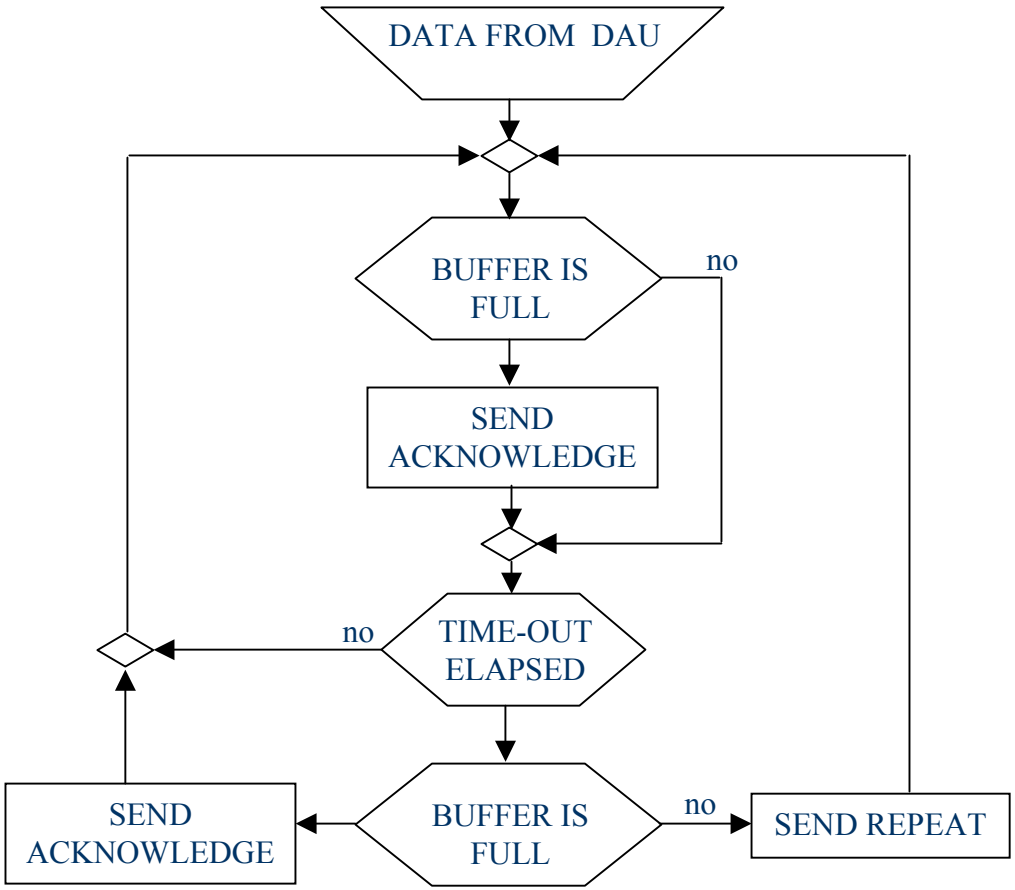
Transmission properties

- Point-to-multipoint communication system
- Frequency Hopping Spread Spectrum technology
- Pre-scheduled polling for availiable files
- End of file determined by pre-specified code

Concentrator polling



Communication protocol



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Future Work

- Robust communication protocol for error detection and elimination
- Real time monitoring at high sampling rates – interleaving data from different CBMs
- Wireless configuration of remote device

Acknowledgements

- Earlier work related to development of the automated software for CBMA was funded by CenterPoint Energy
- The work of the CB data acquisition unit was coordinated by the Consortium for Electric Reliability Technology Solutions, and funded by the Office of Electric Transmission and Distribution, Transmission Reliability Program of the U.S. Department of Energy under Interagency Agreement No.DE-AI-99EE35075 with the National Science Foundation.