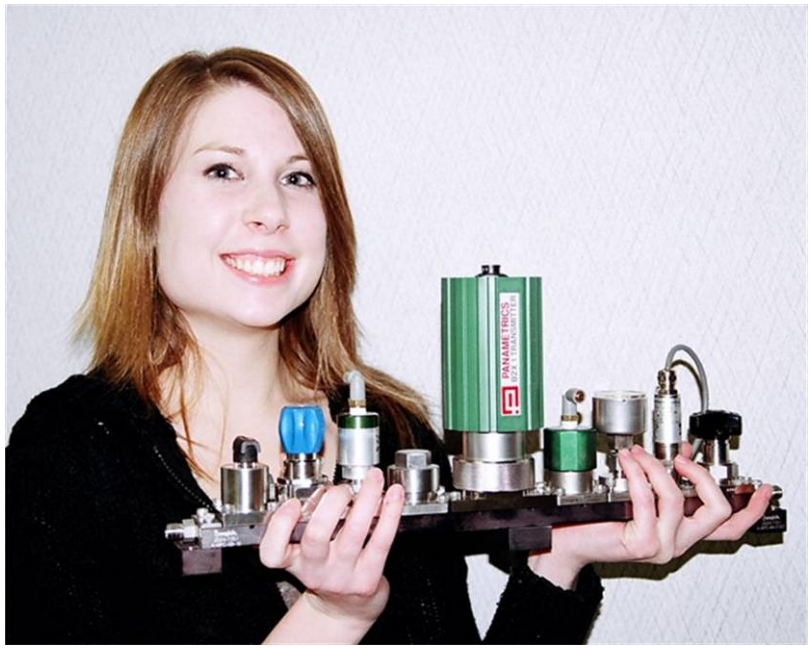
Applications for wireless in refining and petrochemical plants: Process Analytics and Sensors

- Process plants
- Analysers and sensors
- Process control



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Esso Sriracha Refinery and Aromatics Plant, Thailand

- Costs and opportunities
- Case studies

Jeff Gunnell
ExxonMobil Chemical Limited

ExxonMobil

SpeckNet EU-US Workshop on
Wirelessly Networked Embedded Systems

University of Edinburgh July 2007

Process plants

Conversion of hydrocarbon feedstocks into useful products

- Scale is huge
- Highly automated, continuous processing
- Many opportunities for optimisation using analysers and sensors

Could wireless technology reduce costs and create new opportunities?

ExxonMobil's Fife Ethylene Plant, near Cowdenbeath, Scotland

What is Process Analytics?

"Measurement of the chemical composition or intrinsic physical properties of the streams inside a processing plant"

Attributes

- Continuous analysis
  - data available to the data users in close to real time
  - updates from seconds to a few minutes
- Unattended operation
  - systems must operate for weeks or months without any kind of manual intervention

Application areas for Process Analytics

Licence to operate Safety Environmental compliance
Cost incentives Energy efficiency Process control and optimisation
Quality assurance Product certification

Combined value of incentives

- measured in millions of dollars per year per plant

Process control

- For continuous processes, desire is steady state operation
- Many external influences perturb the steady state
  - internal process variation e.g. catalyst performance
  - external variation e.g. feed quality, ambient temp.
  - maintenance activities
  - commercial constraints e.g. max production, min cost
- Rate of variation / speed of change of a process is often of the order of seconds to several minutes
- Effective process control requires a data frequency similar to the time constant of the process

What constitutes a Process Analytics system?

Support and Maintenance

Process Control

Sample preparation

Measurement

Data Transmission

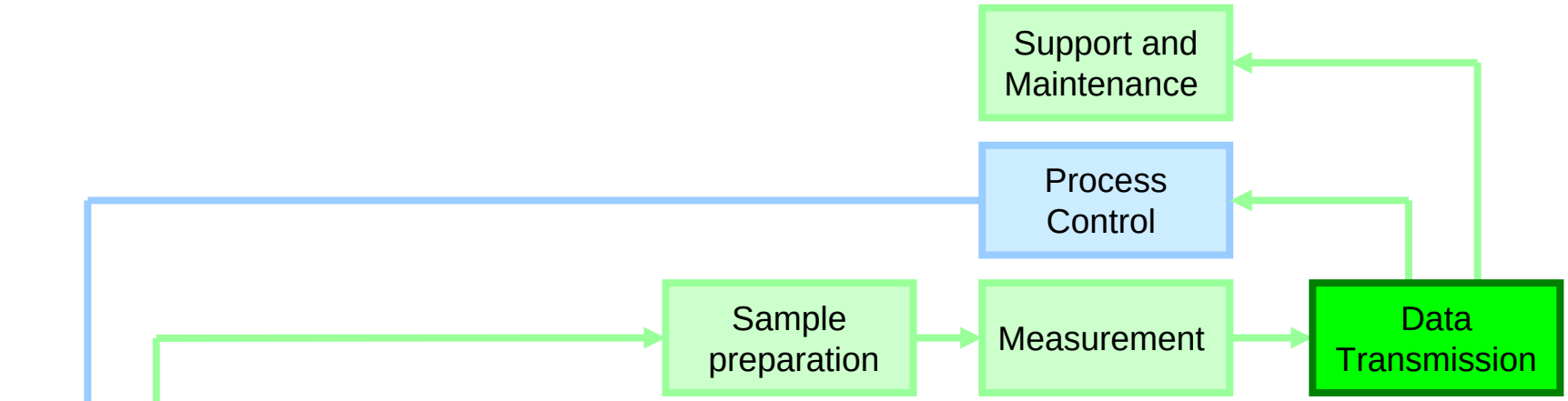
Samp. return
Validation
Calibration

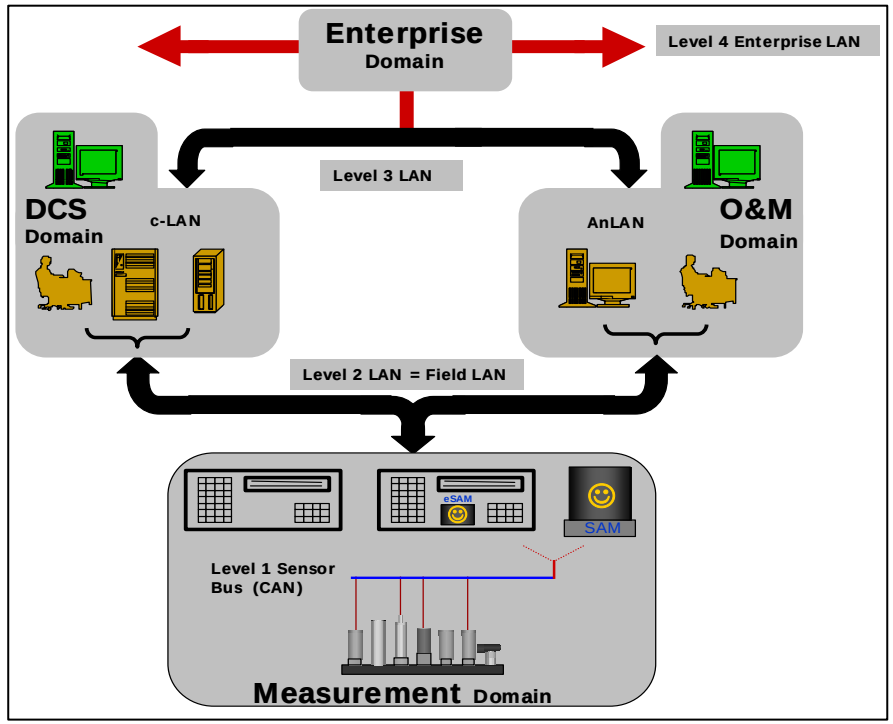
Shelter
Safety
Utilities
Services

Maintenance aids
Performance mon.

Infrastructure and support systems

What constitutes a Process Analytics system?





Site installations and costs

Infrastructure cost is high

- climate control
- safety considerations
  - hazardous area certn.

New technologies promise by-line instead of remote analysers

- Could wireless technologies contribute to reducing the cost of systems?

Case study: gas detectors

Many sensors located throughout plants to detect hydrocarbons leaks

Cost to build

• Sensing element		50 USD
• Packaged system		700 – 1200 USD (tech. dependent)
• Installed gas detector		
– engineering	4 hours @ 100 USD/hour	400 USD
– install cabling	100 m @ 40 USD/m	4000 USD
TOTAL		~5000 USD per detector
TOTAL for 100 detectors		**~500000 USD**

Areas of opportunity: costs

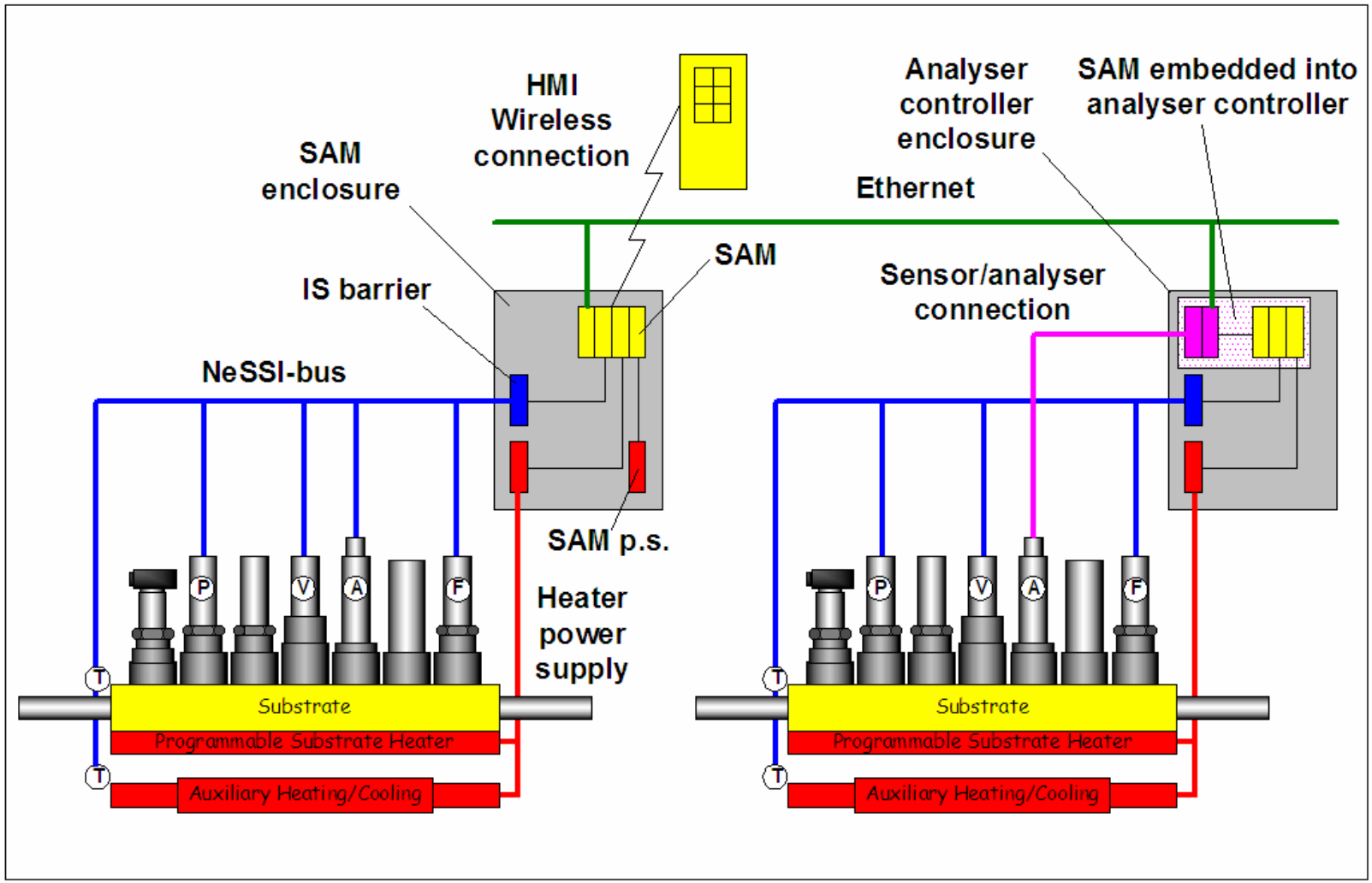
☑ Eliminate engineering cost
☑ Eliminate installation cost

Desire: black box installation: pick location, stick it to a piece of equipment

☑ self contained power
☑ self assembling wireless network
☑ self configuring user interface

Case study: NeSSI

- A new approach to designing analyser systems
  - provides much more sensing and control of sample systems



Challenges for wireless

- What makes it hard?
  - Hazardous areas requirements and certification
  - Security of communication /control system
  - Extreme operating conditions
  - Mobile and stationary metal equipment
  - Power requirements
  - Choice of communications protocol
  - Band-width for complex data transmission
  - Fast moving technology: obsolescence horizon is short
- Promising technologies
  - Development of wireless architecture standards
  - “Smart Dust” / Mote technology for sensor networks
  - Technology to scavenge power from the environment