An Experiment Safety System for LHCb Ideas and Concepts

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Safety @ CERN

- Governed by several rules
  - Staff Rules and Regulations
  - SAPOCO

- Safety Rules
  - Instructions on Safety (IS)
  - Safety Codes

- Responsible
  - GLIMOS, SLIMOS
  - everyone

Alarm Levels (IS37)

- Level 1
  - Equipment or installation fault. Action by the technical service concerned.

- Level 2
  - Incorrect operation of equipment or abnormal situation. Immediate action by the technical service concerned.

- Level 3
  - Accident or serious abnormal situation, especially where people's lives are or may be in danger. Immediate action by the Fire and Rescue Group.

Safety @ LEP & LHC

- **LEP**
  - GSS
    - all alarm levels
    - common system
    - heavy
    - outside group
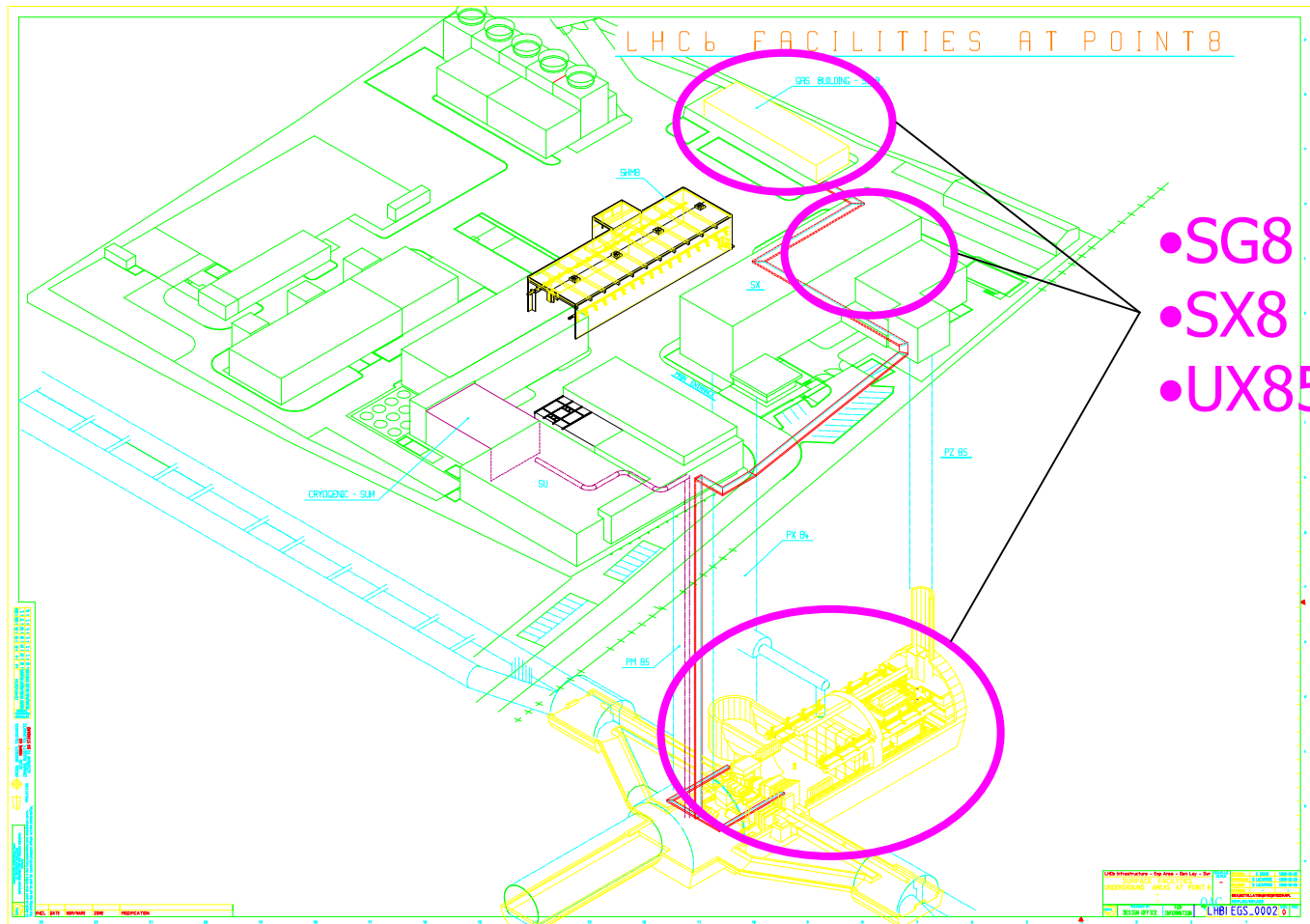- **LHC**
  - AL3WG
  - CSAM/CSE
    - only alarm level 3
    - common system
    - run by ST

- **LHC**
  - "DSS"
    - experiment safety
    - alarm levels 1,2 (excl.)
    - alarm level 3 (add.)
    - common system
    - under development with the experiments
    - currently
      - working group set up
      - first preliminary concepts

Regional Scope @ LHCb

- SG8
- SX8
- UX85

Safety System Domains @ LHCb

- **General**
  - Supply Systems
  - DSS System

- **Gas Building**

- **Experiment Hall**
  - XCR
  - Labs
  - Hall

- **Access Shafts**
  - PZ, PX

- **Underground**
  - Counting Room Area
  - Counting Rooms
  - Detector Area
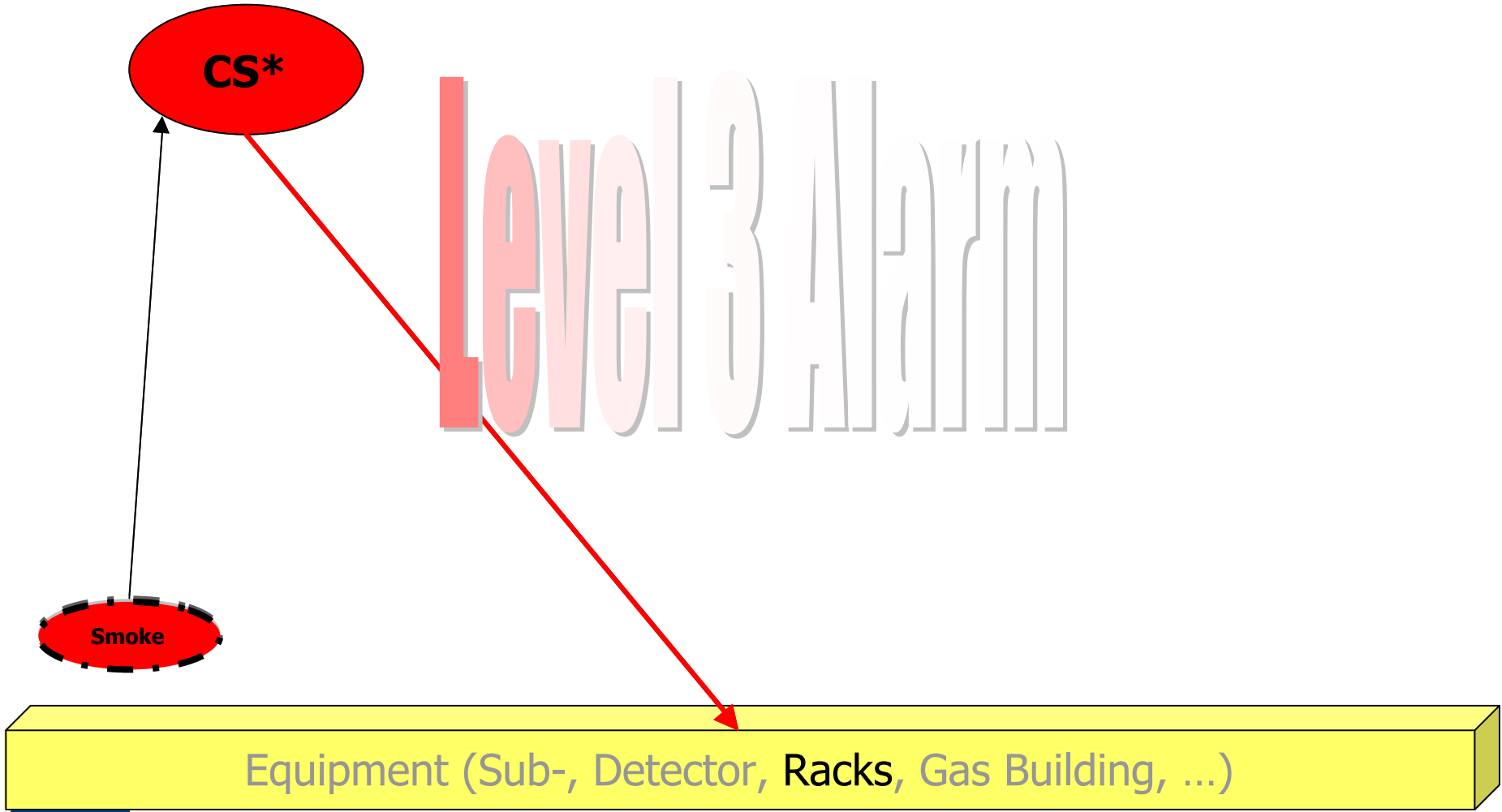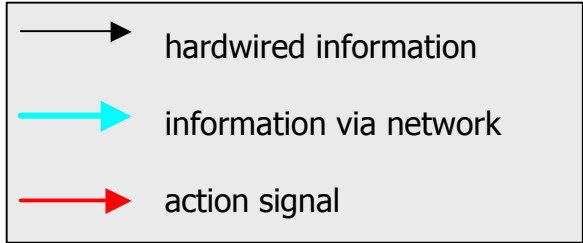 - Detector

A Sample Domain

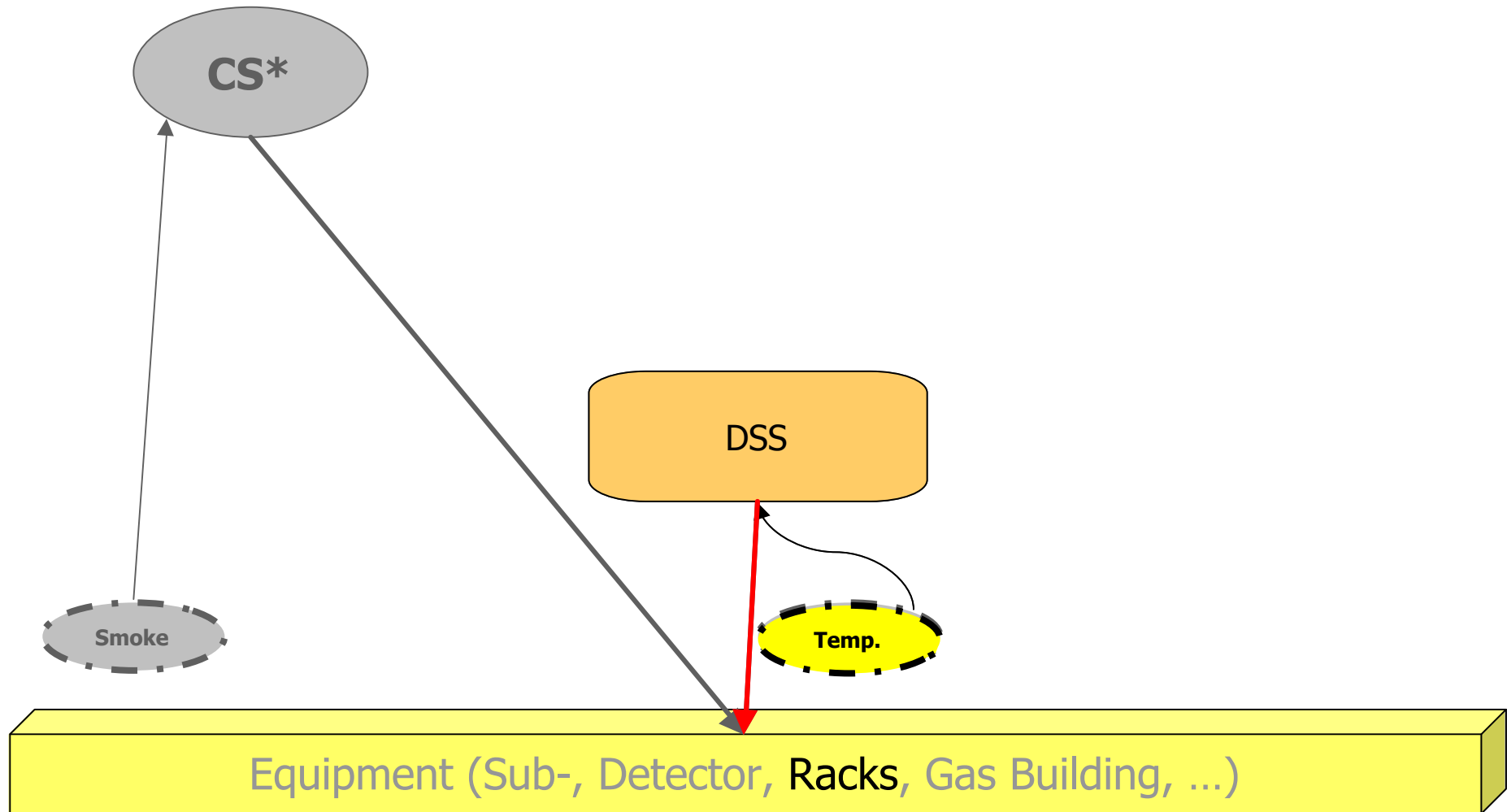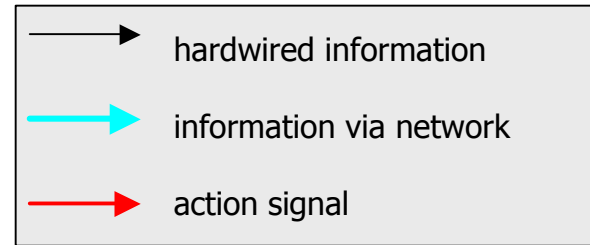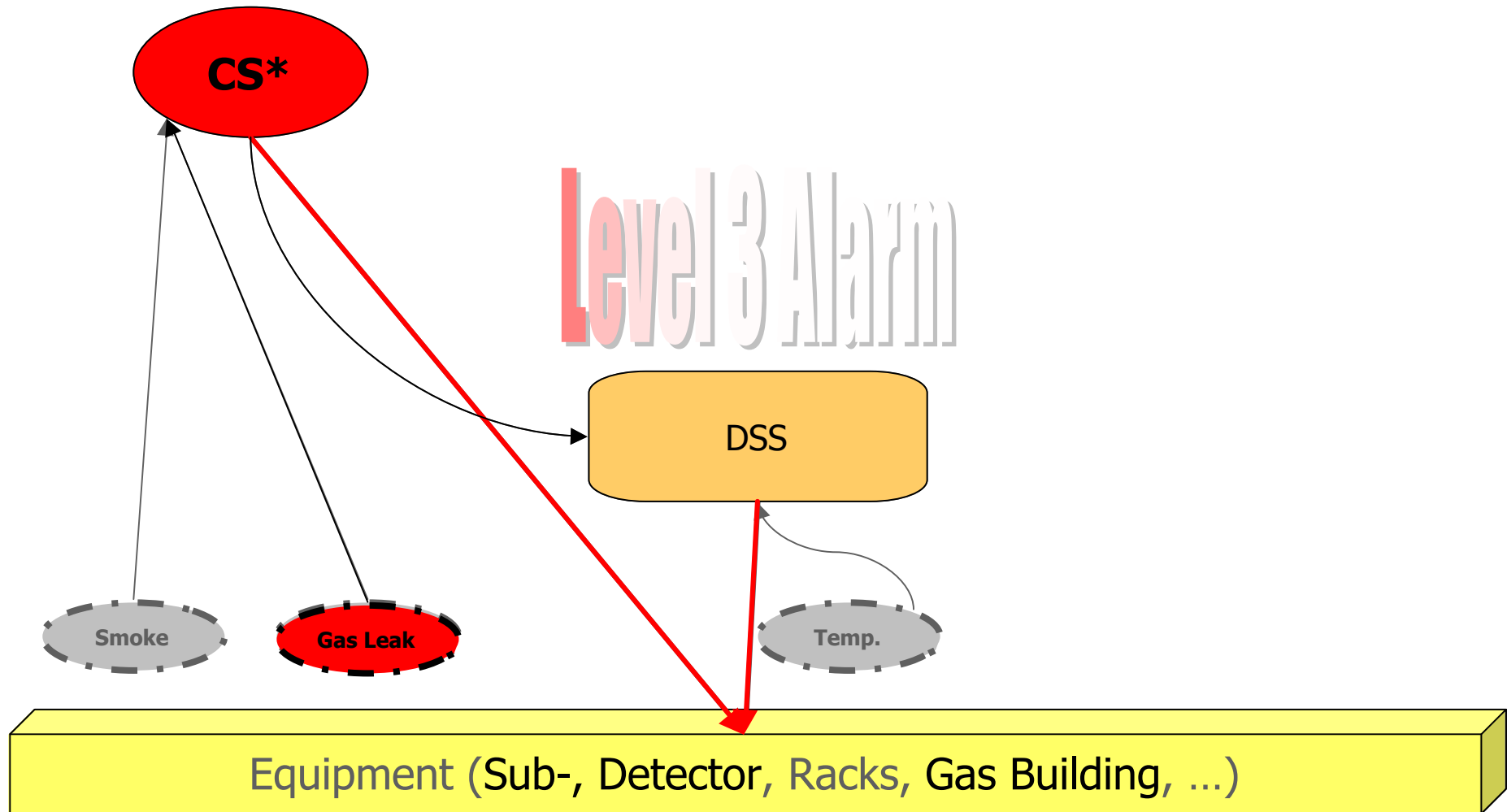| Location	Item	Level	Detection	Destination	Action
UX85 Counting Room Area					
	Smoke	1,2	ST/AA	CSAM, TCR, XCR	CSAM, TCR
		3	ST/AA	CSAM, TCR, XCR	CSAM, TCR
	Power - 48V - 230V	1,2	ST/EL	TCR, XCR	TCR
	Ventilation	1,2	ST/CV	CSAM, TCR, XCR	TCR, XCR
	Temperature	1,2	LHCb	XCR	XCR
	Humidity	1,2	ST/CV	TCR, XCR	TCR
	Radiation	1,2	TIS/RP	TCR, XCR	TIS/RP
		3	TIS/RP	CSAM, TCR, XCR	CSAM
	Water Flood (PZ)	1,2	ST/CV	TCR, XCR	TCR
		3	ST/CV	CSAM, TCR, XCR	CSAM
	Water Pumps (PZ)	1,2	ST/CV	TCR, XCR	TCR
	Water Flood	1,2	ST/CV	TCR, XCR	TCR
Counting Rooms					
	Smoke	1,2	ST/AA	CSAM, TCR, XCR	CSAM, TCR
		3	ST/AA	CSAM, TCR, XCR	CSAM, TCR
	Power - 48V - 230V	1,2	ST/EL	TCR, XCR	TCR
	Ventilation	1,2	ST/CV	CSAM, TCR, XCR	TCR, XCR
	Temperature	1,2	LHCb	XCR	XCR
	Air Conditioner	1,2	ST/CV	TCR, XCR	TCR
	UPS	1,2	ST/EL	TCR, XCR	TCR
	AUL	2	ST/EL?, LHCb?	TCR, XCR	XCR
	Racks - cooling agent - temperature - ventilation - power	1,2	EP/ESS	TCR, XCR	TCR, XCR

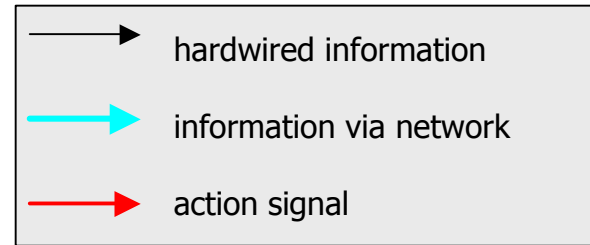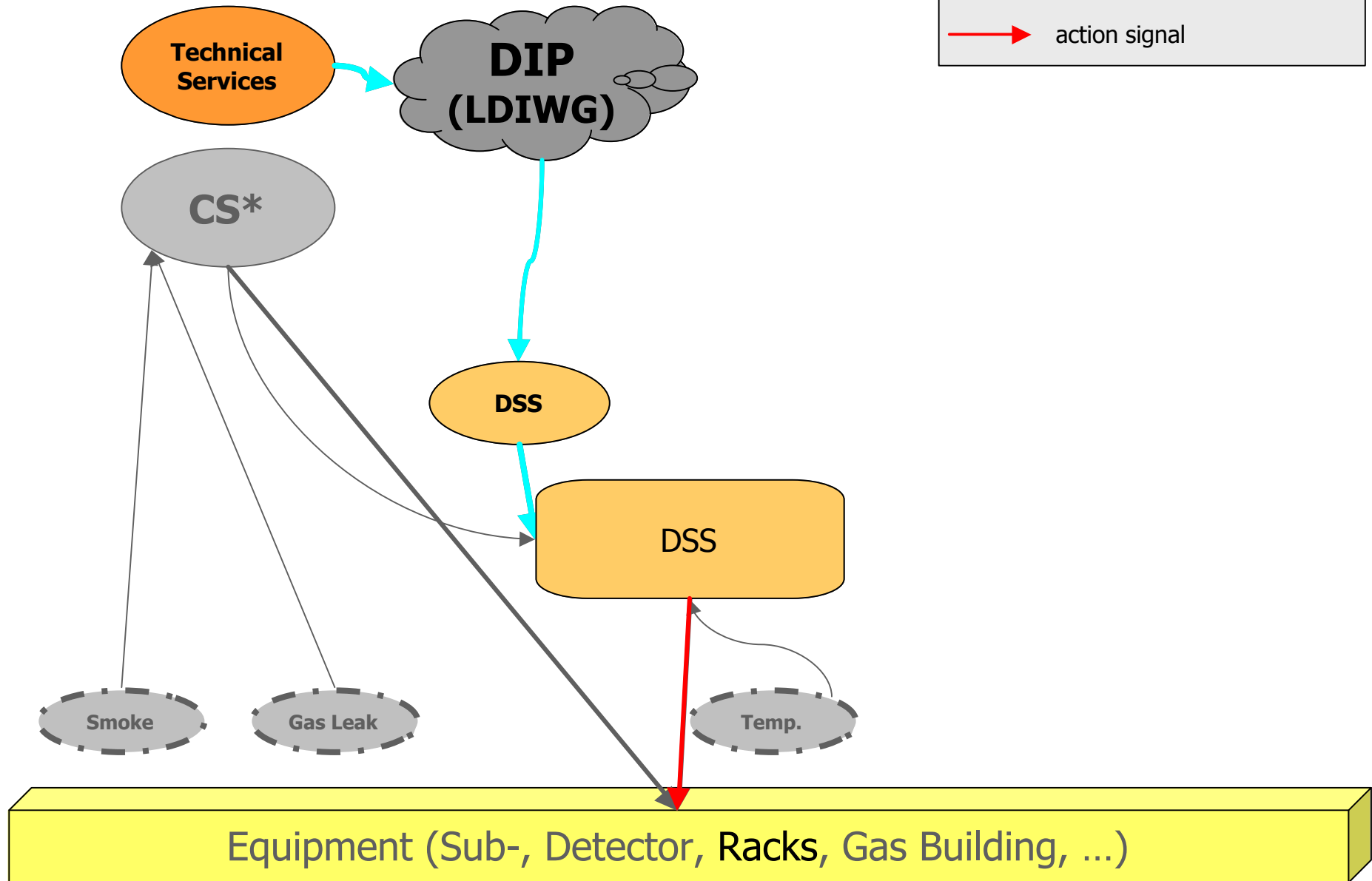# Aims of a Detector Safety System for LHC Experiments

- The main aims of DSS are
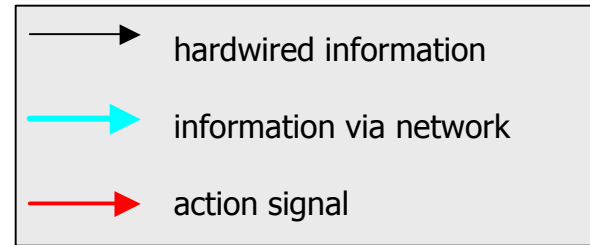 - to protect the equipment
  - to prevent situations leading to Level 3 Alarms.

- DSS should therefore deal with alarm levels 1&2 as defined in IS37.
  - Nevertheless, the DSS may also take additional actions in case of a Level 3 Alarm.

Legend:
- → hardwired information
- → information via network
- → action signal

CS*

Level 3 Alarm

Smoke

Equipment (Sub-, Detector, **Racks**, Gas Building, …)

hardwired information

information via network

action signal

CS*

DSS

Smoke

Temp.

Equipment (Sub-, Detector, **Racks**, Gas Building, …)

Legend:
- → hardwired information
- → information via network
- → action signal

CS*

Level 3 Alarm

DSS

Smoke

Gas Leak

Temp.

Equipment (Sub-, Detector, Racks, Gas Building, …)

Legend:
- hardwired information
- information via network
- action signal

Technical Services → DIP (LDIWG) → DSS → DSS

CS*

Smoke   Gas Leak   Temp.

Equipment (Sub-, Detector, Racks, Gas Building, …)

Legend:
- hardwired information
- information via network
- action signal

Technical Services

DIP (LDIWG)

CS*

DSS

DSS

Smoke

Gas Leak

Temp.

Equipment (Sub-, Detector, Racks, Gas Building, …)

Legend:
- hardwired information
- information via network
- action signal

Technical Services

DIP (LDIWG)

CS*

DSS

DSS

Smoke

Gas Leak

Temp.

Status

Equipment (Sub-, Detector, Racks, Gas Building, …)

Technical Services

DIP (LDIWG)

CS*

ECS

DSS

DAQ

...

DCS

DSS

hardwired information

information via network

action signal

Smoke

Gas Leak

Temp.

Humidity

Status

Equipment (Sub-, Detector, Racks, Gas Building, ...)
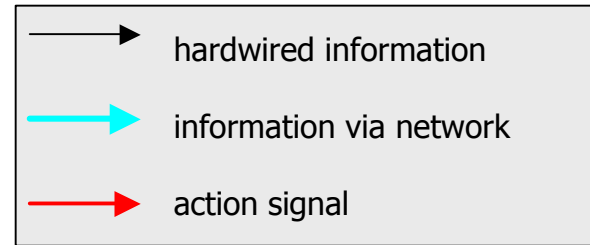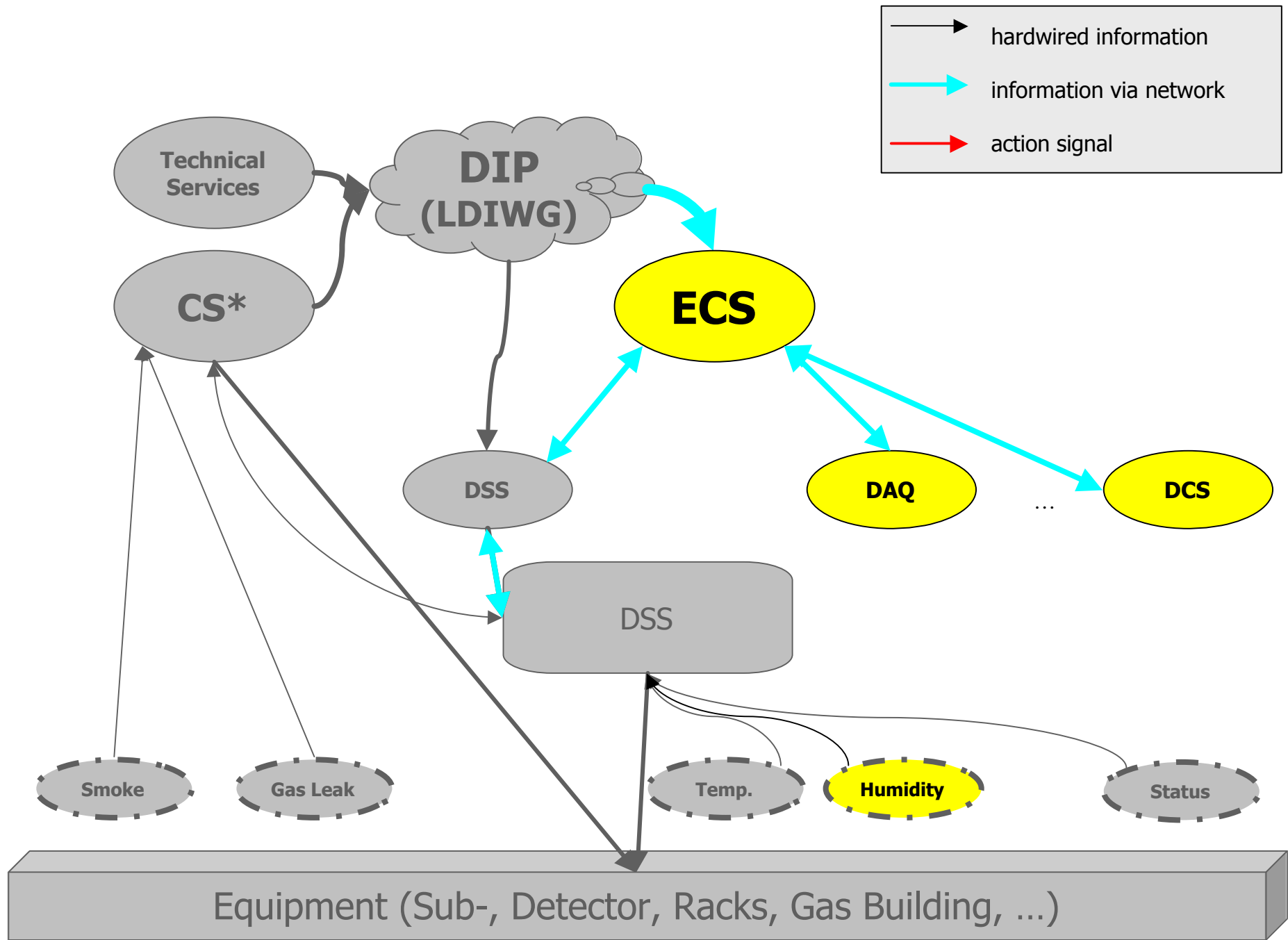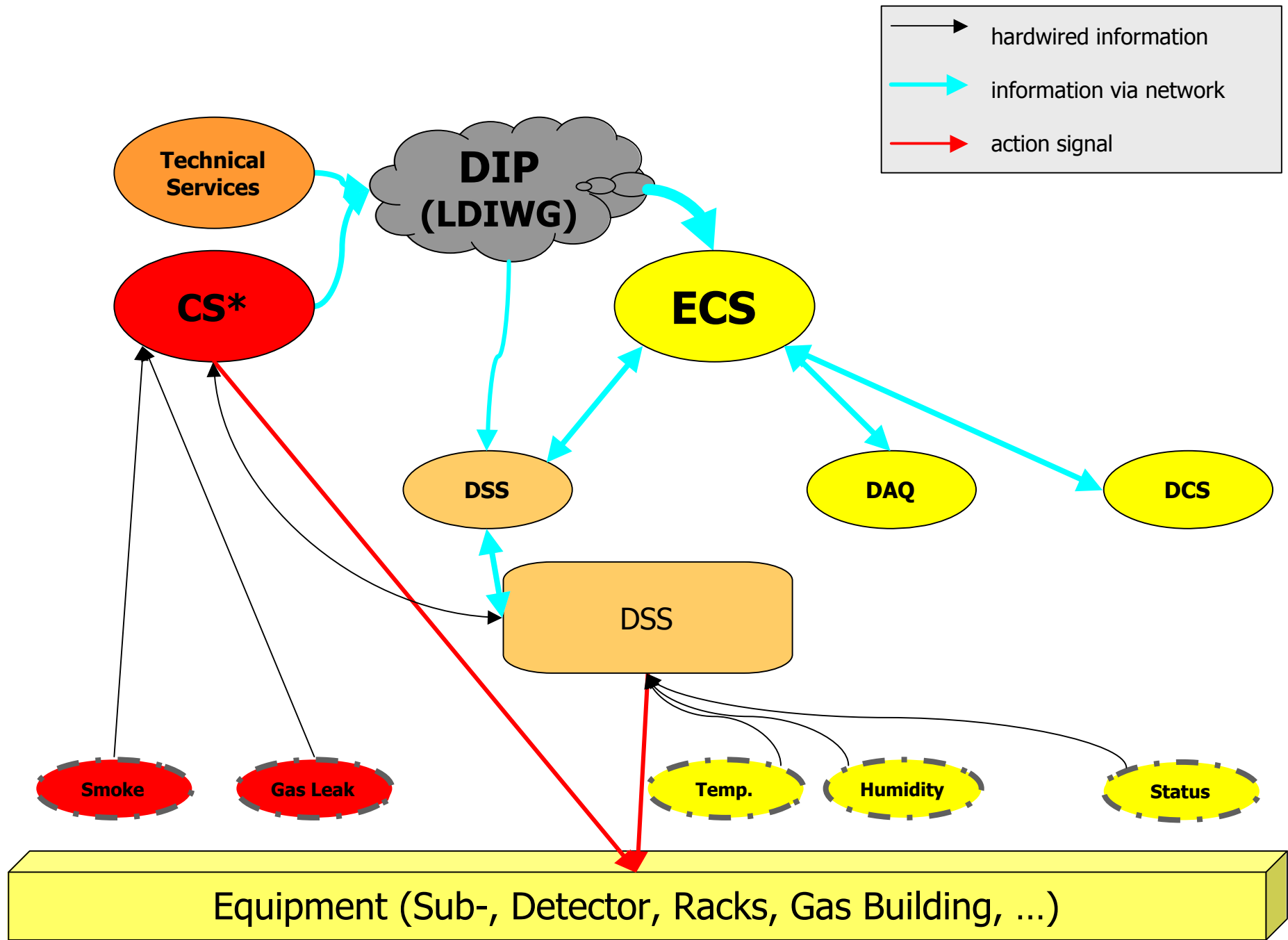
Basic Concepts and Requirements

- **System**
  - independent of the ECS
  - reliable
  - scalable
  - operational permanently
    - from 2004
    - to the end of LHCb
- **Modes**
  - shutdown
  - maintenance
  - data-taking
- **Tasks and Actions**
  - monitor parameters
  - preventive actions
  - emergency actions

- **Use of ECS (SCADA)**
  - same look&feel
    - panels with required actions, e. g.
      - acknowledgement,
      - help for shifters, …
  - common infrastructure
    - tools for post-mortem analysis
  - remote interfaces for experts on-call
  - persistent and permanent logging and presenting

Outlook and Questions

- A DSS will be a set of tools to implement a highly reliable safety logic.

- The logic itself has to be defined by the GLIMOS together with the SD experts.

- Open questions exist (Questionaire for SD will come soon!)
  - What does the GLIMOS want from the DSS?
  - What do the subdetectors expect to be taken care of by a DSS?

- How to keep track of developments and details?
  - http://cern.ch/lhcb-comp/DSS
  - http://itcowww.cern.ch/DSS/welcome.htm