Safety Detection Systems inside the LHC Experiments

Rui Nunes
ST-AA-AS

Presentation Organization

- Overall ST Picture
- Detection Systems
  - Overview
  - Fire, Gas & Evacuation in LEP
  - Projects for LHC
- Detection, CSAM & Safety Actions
- Time
  - 25~30 min presentation
  - Questions at the end please

Overall ST Picture (1/2)

- **ST-AA-AS Mandate**
  - **Design, procure, install & maintain all Evacuation systems, Fire, Flammable Gas and Oxygen deficiency detection systems in all CERN Sites**
- **ST-AA Responsibility**
  - **Includes Transmission of Safety Alarms (AL3) to the Fire Brigade**
- **What about ST-MO and CSAM ??**

Overall ST Picture (2/2)

- **ST Division strategy**
  - **CSAM is a close collaboration between ST-AA & ST-MO**
    - **ST-MO was "*contracted*", due to their expertise to specify, design, install and commission a Safety Alarm Monitoring system**
    - **ST-MO provides the "*tool*" for ST-AA**
    - **CSAM will be integrated in ST-AA in the future**

Detection Systems

- **What are they?**
  - **WGAL3S defined them as the AL3S**

  – **Listed in TIS IS37**

• smoke (fire) detectors	ST-AA
• flammable gas detectors	ST-AA
• oxygen concentration detectors	ST-AA
• local evacuation signals	ST-AA
• general emergency stop	ST-EL
• flooding detectors	ST-CV
• blocked lift	ST-HM
• red telephones (will disappear?)	IT/CS
• "deadman" devices	users

Detection Systems

- **Detectors**
- **May be of many types and technologies**
  - **Fire detectors**
    - Point smoke detectors (optical, ionisation)
    - Flame detectors (IR, UV)
    - Thermal detectors
    - Multi-point detectors (air sampling, sensitive cable, Optical, Laser,diffraction, etc..)
    - Linear detectors (IR, optical fibre, etc..)
  - **Gas detectors**
    - Flammable Gas (catalytic, IR, electrochemical, etc..)
    - Oxygen detectors (semiconductor, electrochemical, paramagnetic, etc..)

Detection Systems

Example of a Point Gas Detector

Detection Systems

- **Detectors are connected to Control and Indicating Equipment (CIE)**
  - **The CIE is responsible for**
    - **Analysis of the signals**
    - **Interface with Alarm transmission network**
    - **simple safety/warning actions**
    - **Maintenance interface**
    - **etc...**

Fire, Gas & Evacuation in LEP (1/2)

- **Surface & Underground**
  - **Generalised Fire Detection**
  - **Flammable Gas detection in BGs and Gas mixing areas**
  - **No Oxygen Deficiency detection**
  - **Evacuation system**
    - **General Evacuation**
    - **BIW - Beam Imminent Warning**
  - **Alarm Transmission via GSS and hardwired**

Fire, Gas & Evacuation in LEP (2/2)

- **Safety Actions in LEP**
  - **Not Always Homogeneous**
    - **Some direct safety actions** (only on surface)
    - **Some Actions via GSS** (always via GSS in underground, sometimes on the surface)
  - **What kind of actions were performed?**
    - **Flashing panels and sirens**
    - **Ventilation** (Cut or High Speed)
    - **Electrical Cuts**
    - **Gas Valve Cuts**

Projects for LHC Experiments

- **Detection in the surface buildings**
- **Detection in the Underground**
  - **Experimental Caverns**
  - **Technical Caverns**
- **Evacuation for the Underground**
- **The SNIFFER Project**
  - **Inside the experimental apparatus**

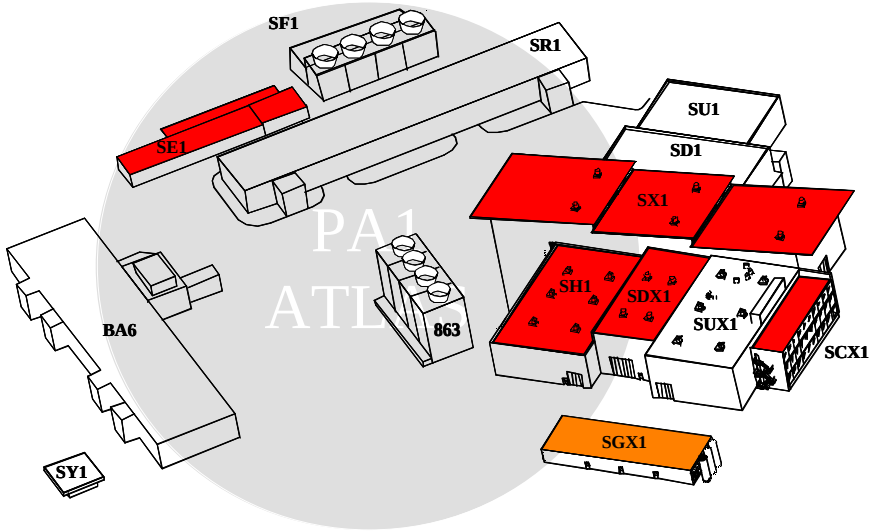
Projects for LHC Experiments

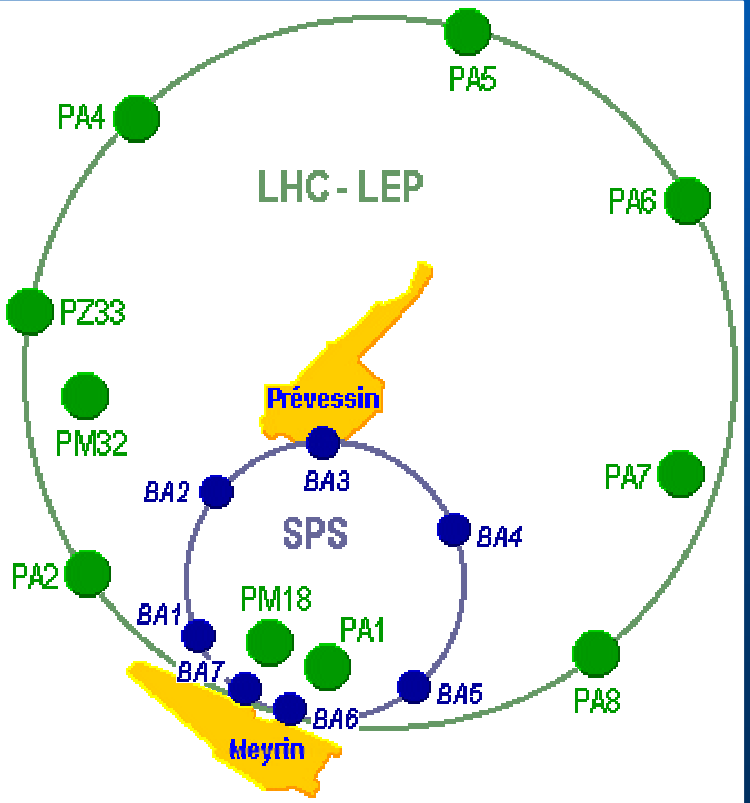
- **Projects under the guidance of TIS**
  - **Respecting Relevant Codes and Instructions**
- **In close collaboration with the users**
  (GLIMOS / DSO / FGSO / CSO / TSO)
- **To determine User Requirements**
  - **LHC Safety Co-ordination (TIS)**
  - **ATLAS - FAGIA**
  - **CMS AL3 Task Force**

LHC Surface Sites Strategy

- **CERN Sites Divided into Safety Zones**

- **1 Fire Control Panel / Zone**
- **1 Gas Control Panel / Zone**





LHC Surface Sites

- **Systematic Re-evaluation due to:**
  - **Possible change of use of buildings**
  - **New buildings**
- **Gradual Replacement of Fire & Gas Detection**
- **New O_2 deficiency detection**
- **Summary of TIS & User Requirements published**
  - *CERN-TIS-GS/TM/2000-04*

LHC Experiments Underground

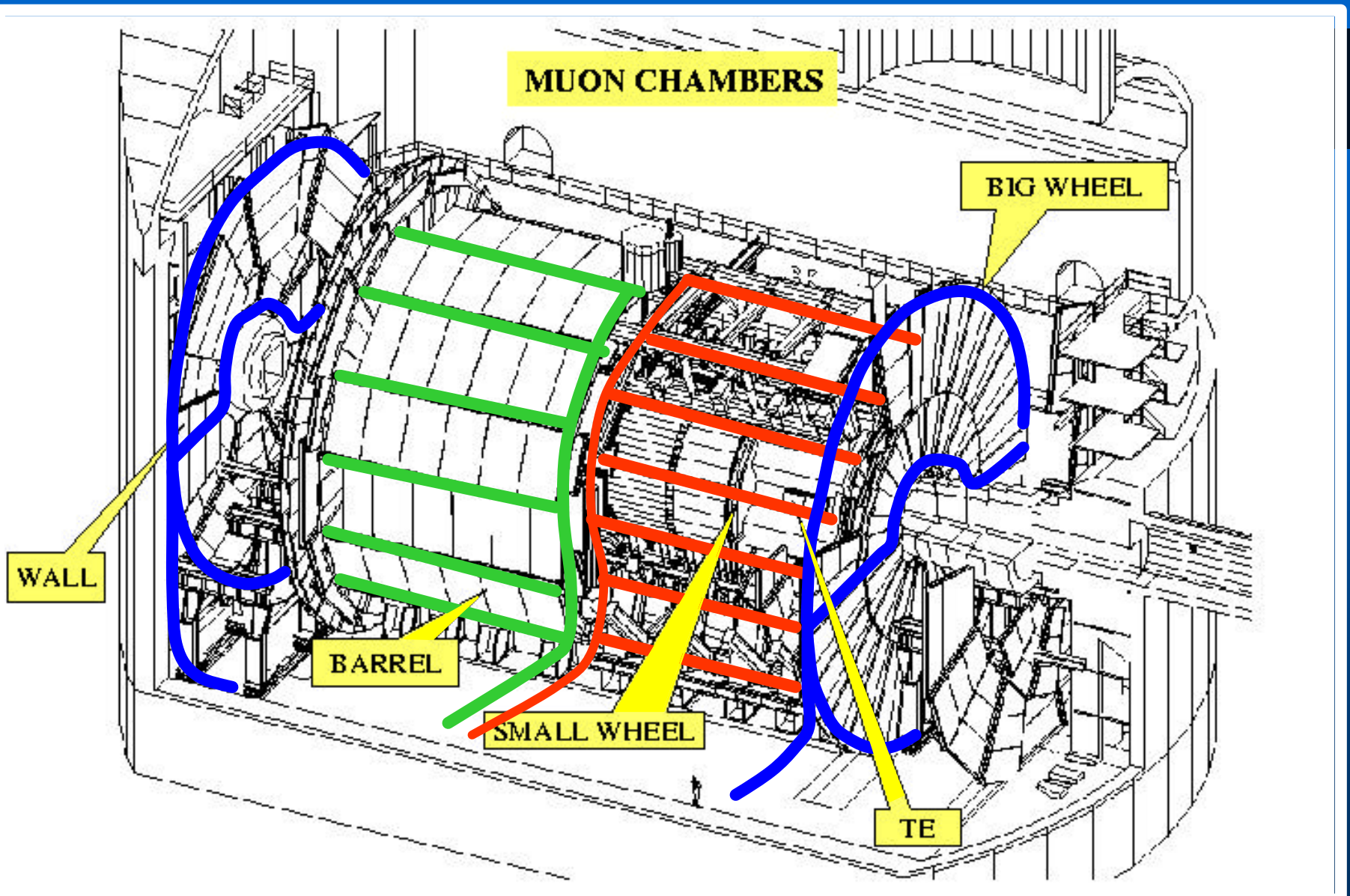
- **Generalised Detection systems**
  - **User Requirements Gathering phase**
    - **ATLAS**
      - **the most advanced (FAGIA, GLIMOS)**
      - **but incomplete**
    - **CMS**
      - **Some information available,**
      - **very incomplete**
    - **ALICE, LHCb**
      - **No info available**

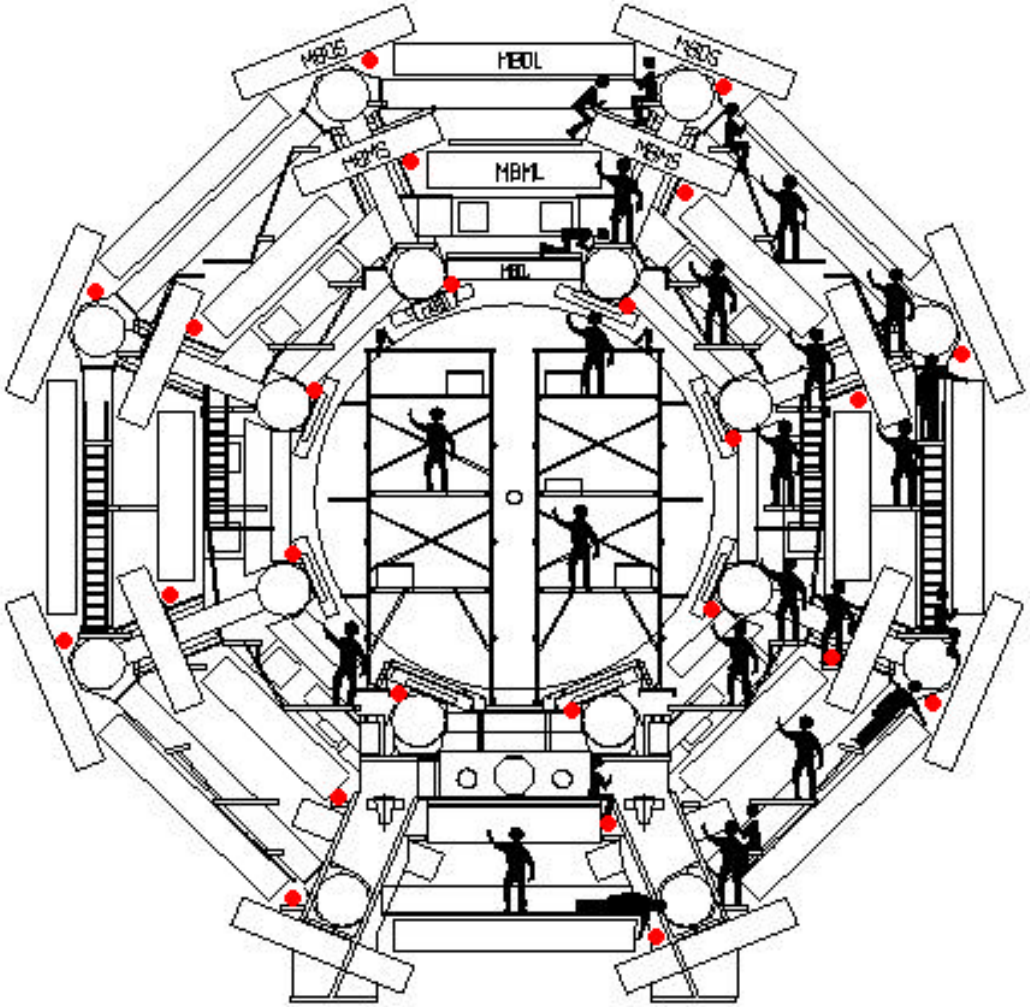
LHC Experiments Underground

- **Evacuation system**
  - **Separate Safety Equipment from detection**
    - **Consisting of**
      - **Manual Call Points** (break glass type)
      - **Sirens or Public Address** (do be defined by Experiments)
      - **Control and Indicating Equipment (CIE)**
    - **Functions** (to be confirmed by Experiments)
      - **General Evacuation**
      - **Beam Imminent Warning**

The SNIFFER Project

- **For the protection of**
  - **People**
  - **Property**
- **Early Detection of**
  - **Fire**
  - **Flammable Gas Leak**
  - **Oxygen Deficiency**
- **INSIDE Experimental Apparatus**


MUON CHAMBERS
BIG WHEEL
WALL
BARREL
SMALL WHEEL
TE

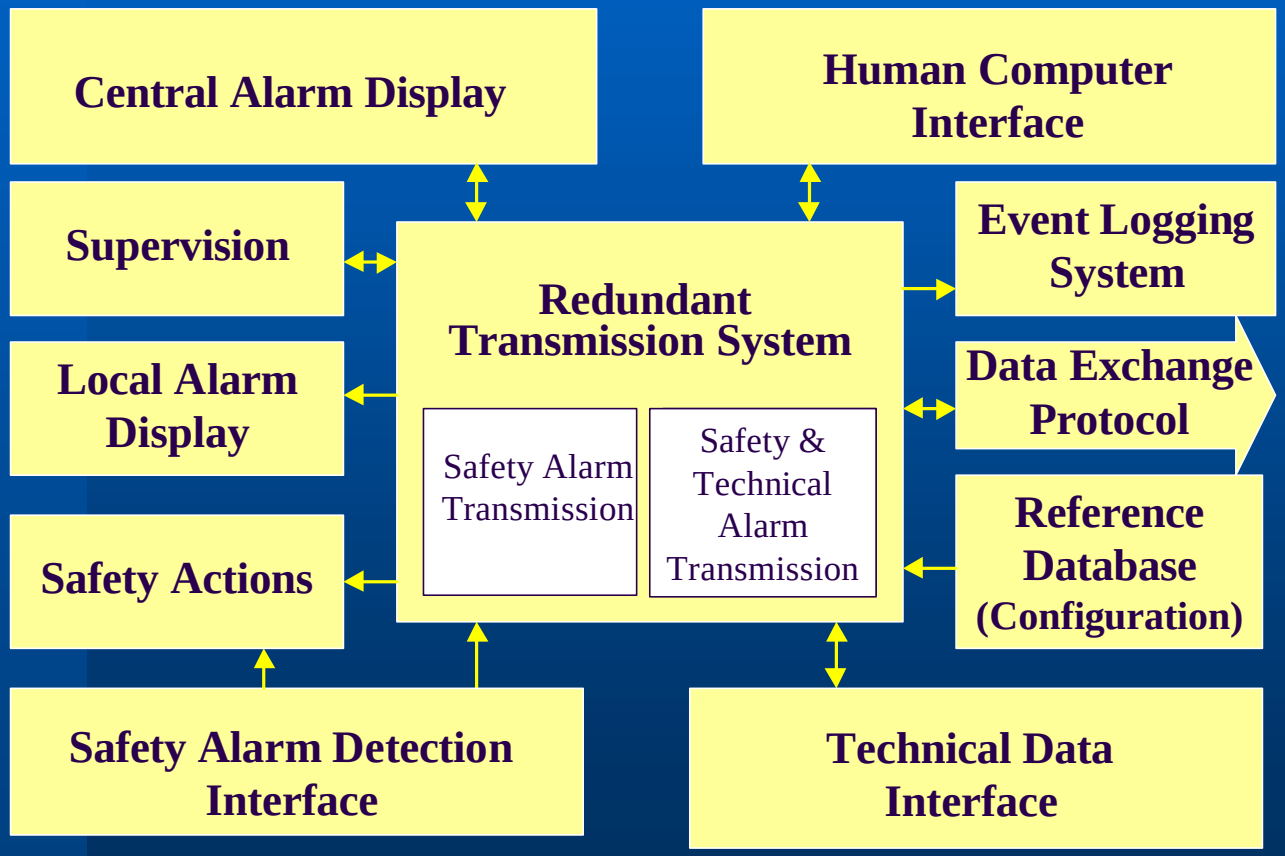

MB0L
MB1L

The SNIFFER Project

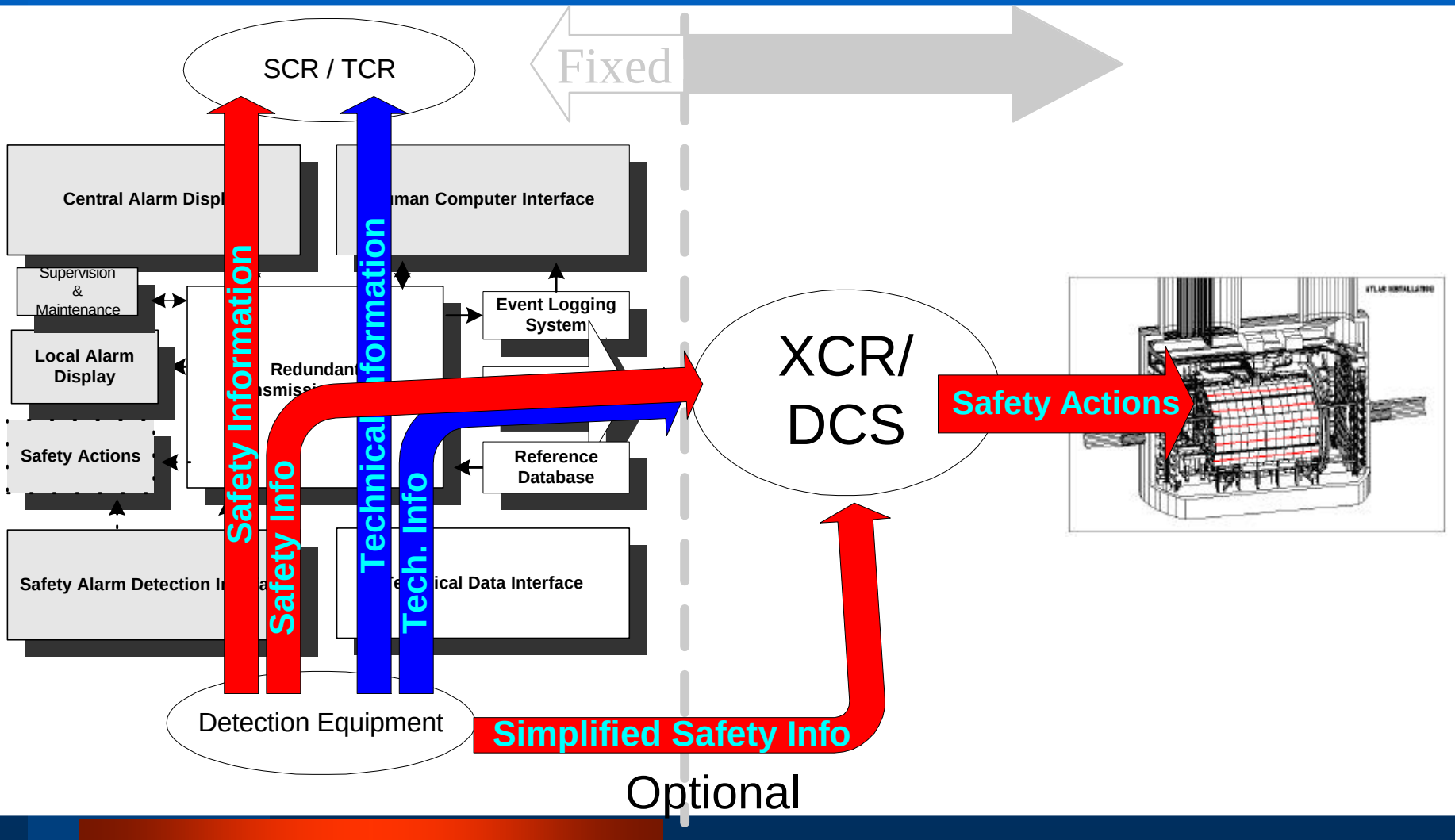
- **Prototyping needed**
  - **to validate physical principle**
  - **to assure performances**
  - **to define best architecture**
- **Status report**
  - **Prototyping phase started**
  - **Expected Completion early next year**
  - **Invitation to Tender will go out during 2002**

CSAM Functional Diagram

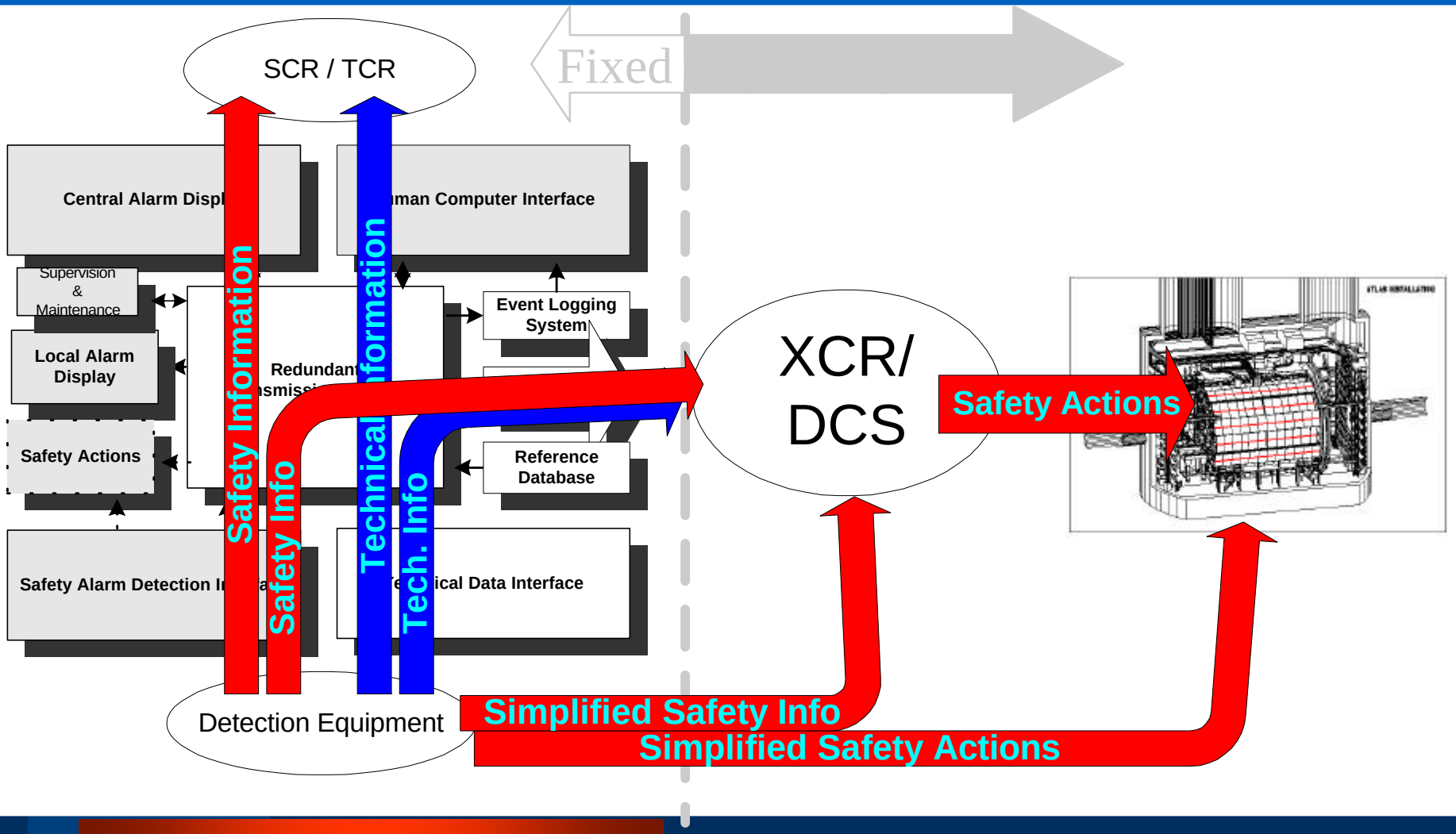
(Already Presented by L. Scibile)



CSAM & Environment



CSAM & Environment



Detection Safety Actions

- **What are the capabilities for Safety Actions?**
  - **Few Hardwired contacts only (one per zone)**
- **Simple safety actions**
  - **General Electrical cuts, ventilation, and gas valves**
  - **Only a few simple actions are reasonably possible**
- **Complex Shutdown Operations**
  - **Impossible**

Safety Actions

- **Functional point of view**
  - **Three different functions can be identified:**
    - **Detection**
    - **Transmission**
    - **Safety Actions** "*Mise en securité*"
      - Requires specific knowledge of the Experiment
  - **There should be one "entity" for each of these functions**

Summary (1/2)

- **Overall ST Picture**
  - **ST-AA responsible for the whole chain**
  - **ST-MO provides the “tool” CSAM**
- **Detection Systems**
  - **User Requirements needed for**
    - **generalised detection in the LHC Experiments**
    - **evacuation system**
    - **SNIFFER Project**
  - **ST-AA-AS shall provide the equipment according to user requirements and approved by TIS, CSAM shall transmit to the Fire Brigade and XCR**

Summary (2/2)

- **Safety Actions**
  - **Technically**
    - **Only very simple safety actions can be performed by the detection equipment**
  - **Practically**
    - **For reasons such as:**
      - **simplicity** (the simpler the better)
      - **shutdown operations**
      - **treatment of other signals than AL3**

Þ **Safety Actions should be done by an entity with overall view and control of the experiment**

Thank You for your Attention

For more info

Rui.Nunes@cern.ch