PERVASIVE DATA MANAGEMENT

EMBEDDED DATABASES

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EMBEDDED DATABASE

FULL-FEATURED DATABASE THAT IS:

INTEGRATED DIRECTLY INTO

OR

PACKAGED WITH AN APPLICATION

EMBEDDED DATABASE APPLICATIONS

- **PROCESS CONTROL (SOFT OR HARD RT)**
  - ✈ MANUFACTURING AUTOMATION
  - ✈ AVIONICS
  - ✈ TELECOMMUNICATIONS
  - ✈ ……..

- **INFORMATION MANAGEMENT (NON RT OR SOFT RT)**
  - 🚲 ENTERPRISE APPLICATIONS ON MOBILE POCKET OR HANDHELD PC AND CELL PHONES
  - 🚲 SMART CARD INFORMATION SYSTEMS
  - 🚲 SALESMAN ORDER ACQUISITION AND PROCESSING
  - 🚲 INTERNET APPLICATIONS (LOCATION DEPENDENT QUERIES, ON LINE CHOICE OF QoS, …)

EMBEDDED DATABASE APPLICATIONS

MANUFACTURING AUTOMATION

✈DEVICES

- PROGRAMMABLE LOGICAL CONTROLLERS (PLC)
- REMOTE TELEMETRY UNITS, WIRELESS SENSOR NETWORKS
- RFID (RADIO FREQUENCY IDENTIFICATION)

✈FEATURES

- HISTORICAL AND STATE INFORMATION MANAGEMENT UNDER TIMING CONSTRAINTS
- SMALL/MEDIUM DATA VOLUMES
- HIGH RESPONSIVENESS

EMBEDDED DATABASE APPLICATIONS

ON BOARD AVIONICS SYSTEMS

KEEP TRACK OF 3000 OBJECTS

- ✈ TEMPORAL COHERENCE WITH THE ACTUAL SITUATION WITHIN 200 msec
- ✈ ACCEPTABLE READ/WRITE RESPONSE TIME: 1 msec

EMBEDDED DATABASE APPLICATIONS

AIR TRAFFIC CONTROL

- ✈KEEP TRACK OF 20000 OBJECTS
- ✈TEMPORAL COHERENCE WITH THE ACTUAL SITUATION WITHIN 3÷6 sec
- ✈ACCEPTABLE READ/WRITE RESPONSE TIME: 5 msec

EMBEDDED DATABASE APPLICATIONS

TELECOMMUNICATIONS

- 800-NUMBERS TRANSLATION REQUIRES LESS THAN 50 msec TURNAROUND TIME
- AVAILABILITY REQUIRED: LESS THAN 1 CALL IN 10^6 MAY BE LOST
- KEEPING INFORMATION IN MAIN MEMORY CAN REDUCE ACCESS TIME AS LOW AS 10 msec
- LOGGING OVERHEAD MUST STAY LOW

REQUIREMENTS FOR A CONTROL SYSTEM

- FROM THE ARCHITECTURE POINT OF VIEW:
  - AD HOC ARCHITECTURES FOR PROCESS CONTROL
  - AD HOC COMPONENTS FOR PROCESS CONTROL
  - INTEGRATING PROCESS CONTROL WITHIN A WIDER INFORMATION SYSTEM

- MAIN HARDWARE COMPONENTS OF CONTROL SYSTEMS
  - INDUSTRIAL REGULATION DEVICES
  - APPROPRIATE HARDWARE FOR ACQUISITION, CONDITIONING, TRASMISSION, ACTUATION
  - PLC (PROGRAMMABLE LOGIC CONTROLLERS)
  - “SOFT” COMPONENTS, I.E. USE FO INDUSTRIAL PC WHICH EMULATE SPECIFIC HARDWARE COMPONENTS

AD HOC ARCHITECTURES OF CONTROL SYSTEMS

MUST PROVIDE AND MANAGE:

- **TEMPORAL DETERMINISM**
- **FAULT TOLERANCE (FOR BOTH HW AND SW FAULTS)**
- **LARGE AMOUNTS OF TEMPORAL DATA, TO BE MANAGED WITH**
  - **DIFFERENT TIME GRANULARITIES,**
  - **DIFFERENT IMPORTANCE LEVELS, AND**
  - **DIFFERENT CRITICITY**

AD HOC ARCHITECTURES OF CONTROL SYSTEMS

- **USER ADAPTABLE OPERATOR INTERFACE (DIFFERENT CULTURES AND TRAINING LEVELS)**
- **(RE)CONFIGURABILITY : RECONFIGURING A CONTROL SYSTEM DURING ITS LIFE MAY BE VERY CRITICAL**
- **HIERARCHICAL ORGANIZATION AND MANAGEMENT OF ALL SYSTEM COMPONENTS (MUCH MORE MAINTENABLE)**

AD HOC COMPONENTS OF CONTROL SYSTEMS

- **COMPONENTS FOR “PHISICAL WORLD INTERFACES”, FOR MEASURING, SENSING, ACTUATING ETEROGENEOUS QUANTITIES.**
- **WHILE SIGNAL TRANSMISSION IS BASED ON STANDARD TECNHNIQUES, THESE SAME SIGNALS ARE**
  - **COLLECTED FROM DIFFERENT SOURCES**
  - **DIFFERENT IN NATURE**
  - **TO BE TREATED IN DIFFERENT WAYS.**
- **THE OPERATING ENVIRONMENT MAY BE VERY DIFFERENT, THUS COMPONENTS MUST BE ABLE TO WORK IN DIFFERENT ENVIRONMENTAL CONDITIONS.**
- **NONETHELESS, COMPONENTS MUST INTEROPERATE, EVEN IF THEY COME FROM DÌIFFERENT MANUFACTURERS**

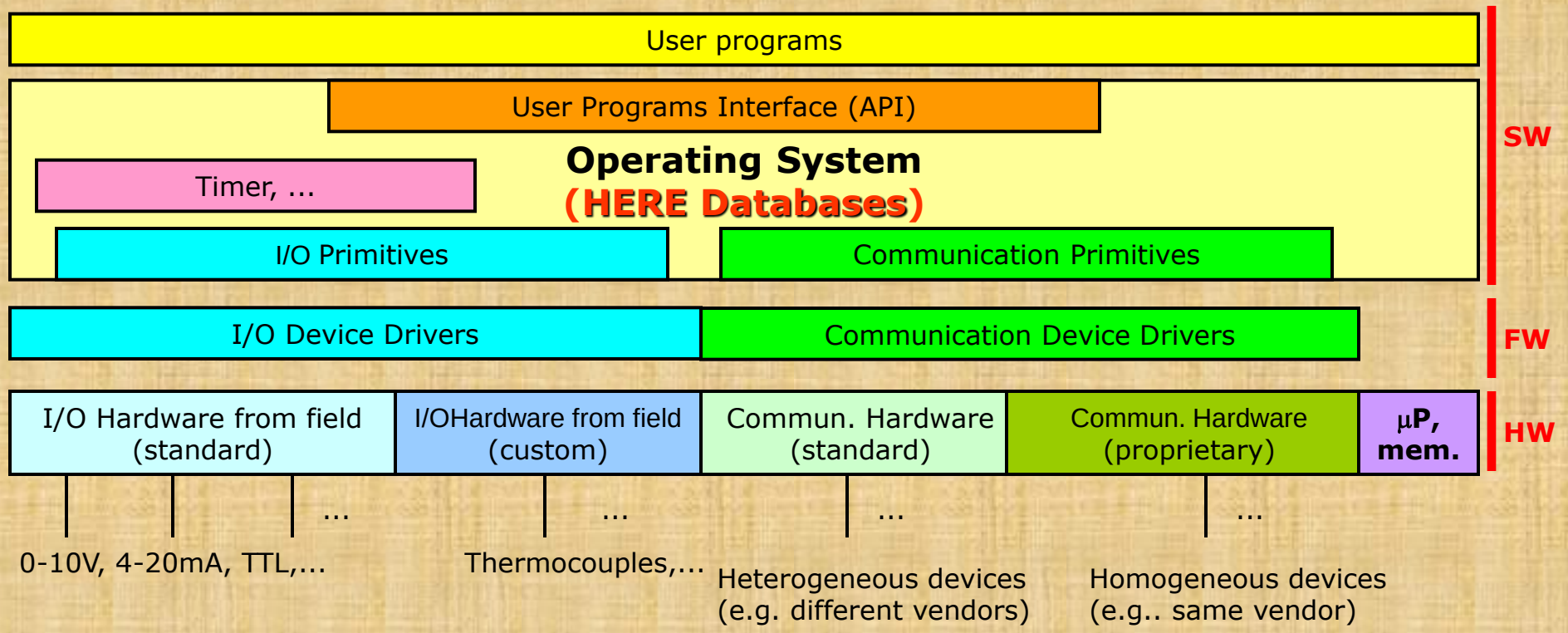
INTEGRABILITY WITHIN LARGER INFORMATION SYSTEMS

CONTROL SYSTEMS ARE CORRECTLY VIEWED AS A PART OF THE INDUSTRIAL INFORMATION SYSTEM, THUS THEY MUST BE WELL INTEGRATED WITH:

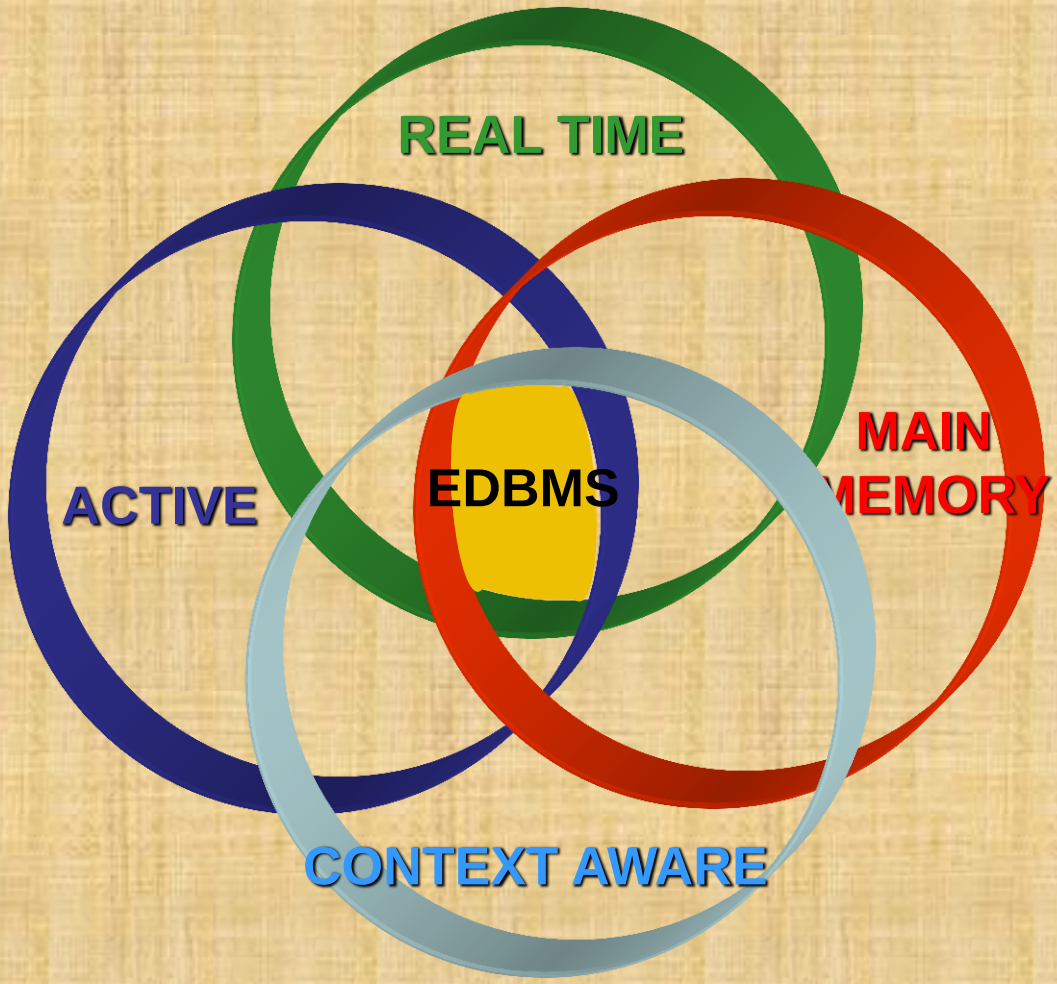
- **PLANT MONITORING SUBSYSTEMS**
- **PRODUCTION MANAGEMENT,**
- **SUPPLY CHAIN MANAGEMENT,**
- **LOGISTICS,**
- **…**

The IEC 61131 standard

The typical structure of an “intelligent” device, such as a PLC…



EMBEDDED DBMS FEATURES



EMBEDDED DBMS FUNCTIONALITY

FEATURES / APPLICATION	REAL TIME	ACTIVE	MAIN MEMORY
PROCESS / DEVICE CONTROL	YES HARD / FIRM	YES	POSSIBLY
MOBILE / INTERNET APPLICATIONS	YES FIRM / SOFT	YES	POSSIBLY
SMART CARD APPLICATIONS	NO / SOFT	NO	YES