Who we are?

• Serbian company founded in late 2006
• Member & one of the founders of Serbian “Embedded Cluster”
• Fields of expertise:
  — Embedded systems
  — Industrial automation engineering (Hydro & Thermal Power plants, Sugar industry etc.)
  — Electrical power control systems
What we do?

- Platform Development
  - Relay protection
  - Engineering
  - PLC, RTU, SCADA
  - Embedded systems
We will talk about...

• Our Xenomai & Linux experiences
  – In perspective of our Relay Protection product – PCT210
  – Problems, good & bad things
  – What do we plan for tomorrow
Structure of PCT platform

- Analog Inputs, Digital Inputs/Outputs
- Backplane bus (IO, IO, IO, IO)
- Measurement Algorithms
- Protection Algorithms
- Disturbance recorder, Event log
- Higher level services, Communication, self supervision
- HMI Panel
- SCADA
- IEC61850
PCT210 – Hardware perspective

CPU

Operator Panel

PCT210

ARM 32-bit CPU

EMC certificate

Digital I/O

Analog Inputs

EtherCAT®
PCT210 – facts & components

- Relay Protection, scan time **1ms**!
- Backplane bus - EtherCAT
- CPU hardware: at91sam9260 (ARM9, 200MHz)
- Modern communication interface: IEC 61850, GOOSE, Ethernet, TCP/IP, RS 485 or RS 232
- Xenomai 2.4.x
- Graphical Programming software – IEDPro
  – Generating C code executed in Xenomai environment
EtherCAT

- Daisy chain Ethernet, high data rate
- 20-30us scan time
- On the fly packet processing
- Very deterministic
- IEEE1588 HW support, all modules synchronize with 20ns drift
- Using it “without” big stack
RT design

- EtherCAT is an external interrupt source
- ISR is doing the most of the work (every 1ms)
  - Spending almost 50% of the time
- RT user tasks: iec61850, goose, hmi server, disturbance & event recorders
- Linux domain – commands, maintenance
- Xenomai 2.4.x
  - rt_pipes & rt_msg_queues for communication
  - Extensive use of shared memory
Xenomai – good things

- It works. Perfectly! It gives hard real time performances.
- Community support is great
- Development pace is impressive
Bad things

• ARM9 limitations & problems:
  – Expensive context switching (God bless FCSE)
  – Shared memory caching problem

• Problems we had:
  – Cpu_idle task strange behavior (**nohlt** is the answer)
For the future

- Xenomai 2.5
  - Unlocked context switching
- ARM: at91sam9g20 (400MHz)
- New platform: Intel Tolapai – EP80579
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