OSEK/VDX

Networked Embedded Systems

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Outline

1. Introduction
2. OSEK OS
3. OSEK COM
4. OSEK NM
5. OSEK OIL
6. OSEK TIME

Introduction

- OSEK/VDX is a norm, not only an OS
- means: "**O**ffene **S**ysteme und deren **S**chnittstellen für die **E**lektronik in **K**raftfahrzeugen"
- developed by several German automotive companies
- PSA joined later
- same system basis on every ECU

System Overview

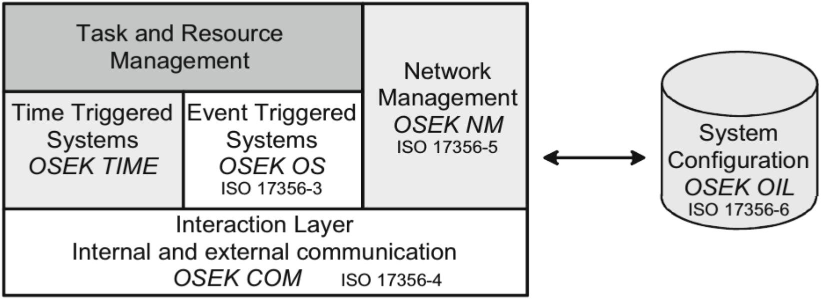

Figure: norm and system overview [ZS14]

Scheduler I

- main component
- event-based
- static priorities
- several scheduling classes (BCC1 to ECC2)
- ISR interrupts tasks

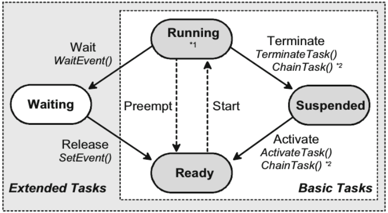

Figure: statechart [ZS14]

Scheduler II

- BCC1
  - most simple class for scheduling
  - unique priorities
  - no task interrupts another task
  - no event handling
  - static scheduling is possible
- ECC2
  - most complex class
  - event handling, preemption, ...
  - to schedule, every priority has a fifo
  - first priority than Round Robin

Events and Ressources

- to synchronize tasks, you need to use binary events
- memory access synchronized by ressources
  - ressources take priorities
  - avoid priority inversion
- shared ressources take the highest task priority
- task which holds a ressource, copy the priority of it

Priority Inversion

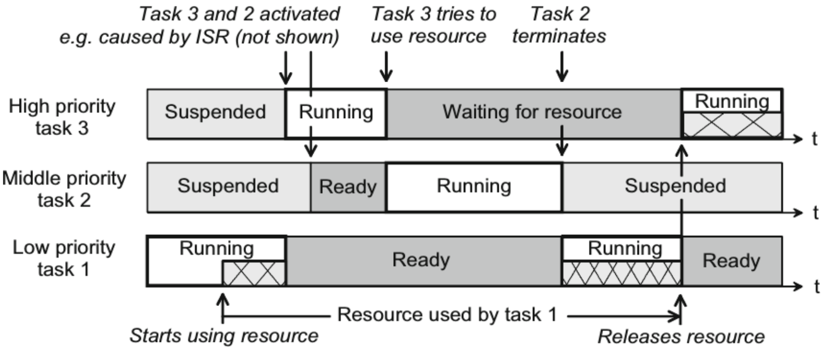

Figure: priority inversion [ZS14]

Priority Inversion

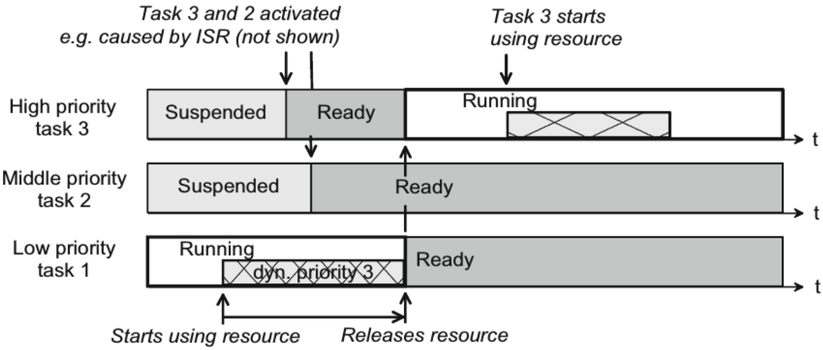

Figure: avoid priority inversion [ZS14]

Counter and Alarm

- leave the CPU tasks have to terminate or to wait
- use alarms for periodic tasks
- alarm may use an action
- trigger the alarm by using a counter

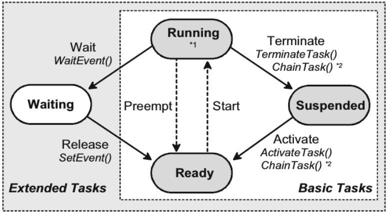

Figure: statechart [ZS14]

System Overview

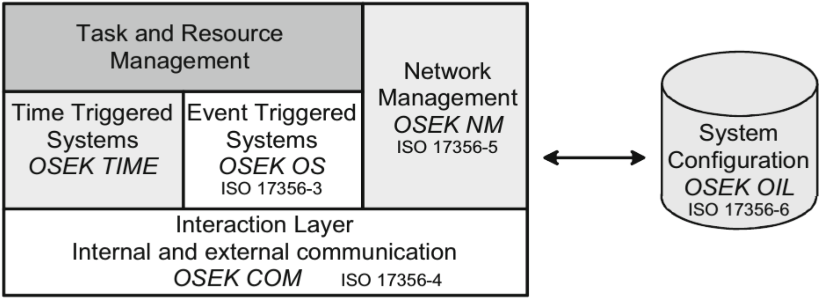

Figure: norm and system overview [ZS14]

Communication I

- transparent communication between tasks and ECUs
- unqueued and queued
- I-PDU for bus transport
- single and periodic mode

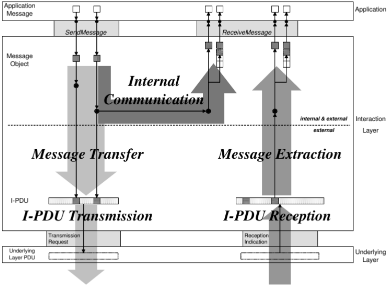

Figure: communication [ose04]

Communication II

- sender calls *sendMessage*
- copy message into a buffer and return to caller
- receiver receives a notification
- receives the message via *receiveMessage*

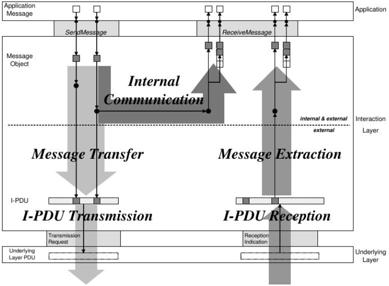

Figure: communication [ose04]

Communication III

- any message has to be defined static in the oil-file
- external communication belogs to a I-PDU message
- I-PDU messages handle more than one message
- it is a bit vector, not byte aligned
  - bounded values
  - sender truncate MSB
  - receiver fills MSB with 0
- byte order of native types predefined per message
- only predefined (compile time) addresses possible

System Overview

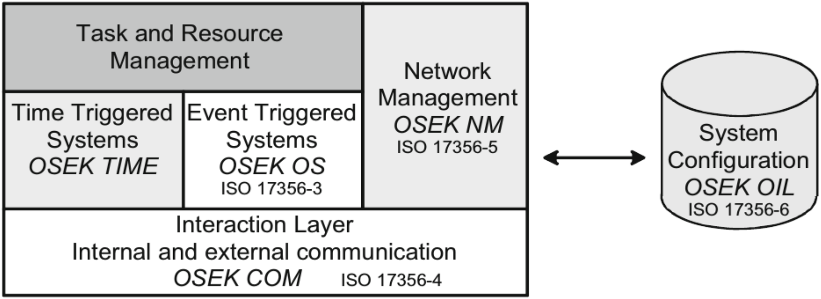

Figure: norm and system overview [ZS14]

Network Management

- only on broadcasting channels
- no master
- all nodes have to be present at development time
- two diffent modes possible
  - indirect network management
  - direct network management
- for indirect NM, every node is a passive channel observer
  - every message, refresh internal storage of active nodes

Direct Network Management

- nodes have an ascending ID
- sending order is predefined
- ring messages for keep alive signal
- if no answer, an alive message is send by all nodes
- reinitialization phase begins and all nodes send alive messages
- now every node recognizes its neighbours → normal operation

System Overview

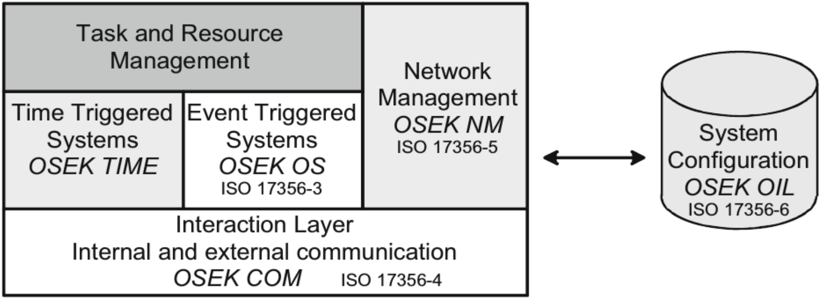

Figure: norm and system overview [ZS14]

OSEK Implementation Language

- used to configure the system
- all tasks, ressources, messages, ... have to defined here
- configuration is statically at compiletime
- no changes allowed

```
TASK OSEK_Task_Motor_AngleDispatcher {
  AUTOSTART = FALSE;
  PRIORITY = 3;
  ACTIVATION = 1;
  SCHEDULE = NON;
  STACKSIZE = 128;
};
```

```
DeclareTask( OSEK_Task_Motor_AngleDispatcher );
TASK( OSEK_Task_Motor_AngleDispatcher ) {

        /**
         * CODE
         */
        ...
        TerminateTask();
}
```

OSEK Implementation Language

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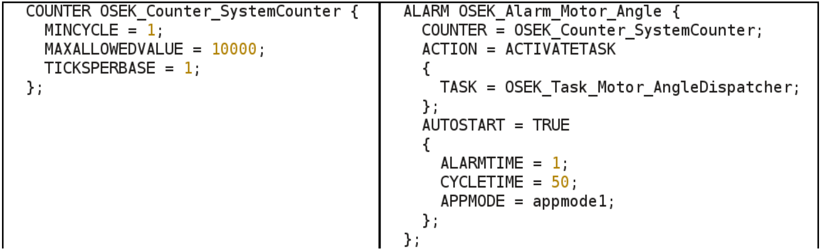

```
COUNTER OSEK_Counter_SystemCounter {
  MINCYCLE = 1;
  MAXALLOWEDVALUE = 10000;
  TICKSPERBASE = 1;
};
```

```
ALARM OSEK_Alarm_Motor_Angle {
  COUNTER = OSEK_Counter_SystemCounter;
  ACTION = ACTIVATETASK
  {
    TASK = OSEK_Task_Motor_AngleDispatcher;
  };
  AUTOSTART = TRUE
  {
    ALARMTIME = 1;
    CYCLETIME = 50;
    APPMODE = appmode1;
  };
};
```

System Overview

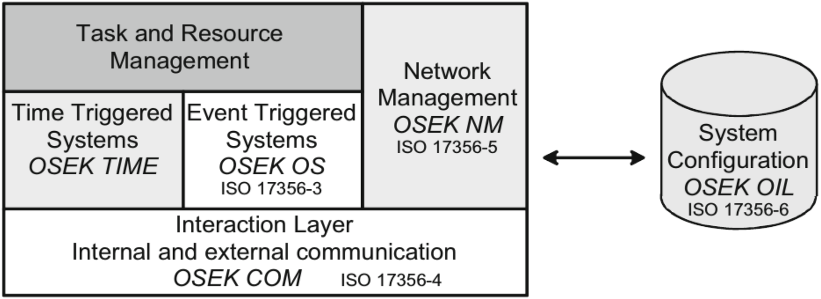

Figure: norm and system overview [ZS14]

Time-triggered OSEK

- completely different OS
- time-triggered scheduler
- OSEK OS is merley a low-prio task
- incompatible with old concepts
- no actual products, only spec
- further development in AUTOSAR

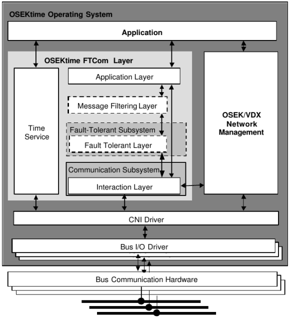

Figure: architecture [ose01]

Q/A

Bibliography

[ose01] OSEK/VDX Time-Triggered Operating System. http://portal.osek-vdx.org/files/pdf/specs/ttos10.pdf, July 2001.

[ose04] OSEK/VDX Communication. http://portal.osek-vdx.org/files/pdf/specs/osekcom303.pdf, July 2004.

[ose05] OSEK/VDX Operating System. http://portal.osek-vdx.org/files/pdf/specs/os223.pdf, February 2005.

[ZS14] Werner Zimmermann and Ralf Schmidgall. Bussysteme in der Fahrzeugtechnik. Springer Vieweg, 5th edition, 2014.