Linux goes safety and takes it to the next level.

Carsten Emde
Open Source Automation Development Lab
(OSADL) eG
Why is Linux so successful?

Linus Torvalds, October 1991:
"[...] I'm working on a free version of a Minix-look-alike for AT-386 computers. [...] I am willing to put out the sources for wider distribution. It is just version 0.02 [...]"
Why is Linux so successful? (2)

Linus Torvalds, 1997: "Making Linux GPL'd was definitely the best thing I ever did”

<table>
<thead>
<tr>
<th>Date</th>
<th>Linux version</th>
<th>Lines of code</th>
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<td>August 1991</td>
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<td>March 2011</td>
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<td>~13.500.000</td>
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Why is Linux so successful? (3)

Linus Torvalds, 1997: “Making Linux GPL'd was definitely the best thing I ever did”
What is the GPL?

The GNU GPL (General Public License) is a software license with “copyleft”.

The typical rules of an Open Source license with copyleft are:

**Four Rights („freedoms“):** Software may be...
- used
- *analyzed*
- passed on (obligation must be obeyed)
- *modified*
  without any restriction.

**One Obligation:**
- The four rights must be granted to the licensee when the software is passed on.
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*requires access to the sources (“Open Source”)

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From Open Source to Open Innovation

Joint research and development of various different companies and institutions (including competitors)

- Goal of participating companies and institutions: Joint added value
- Underlying concept: Open knowledge economics
- Type of organization: Collaborative environments
What are the possible advantages of Open Innovation?

**User and provider**
- Standardization of hardware and software interfaces
- Larger base of knowledge, expertise and experience
- Avoiding unnecessary parallel development
- Reduction of development cycles

**User**
- Participation at the innovation process

**Provider**
- Satisfied users
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Cost reduction
Is Open Innovation appropriate for a particular project?

The pyramid of differentiation

Yes

No

“Differentiating” know-how

“Non differentiating” know-how
Is Open Innovation appropriate for a particular project?

The pyramid of differentiation
Example: Machine software

Yes

Operating system libraries

Application libraries

Applications

QM

Testing

GUI

No

Operating system

Drivers & other kernel modules

Application libraries

Operating system libraries

Application

QM

Testing

GUI

Yes

Differentiating”
know-how

“Non differentiating”
know-how

Is Open Innovation appropriate for a particular project?

embedded world conference 2011
Nuremberg, Mach, 3
Is Open Innovation appropriate for a particular project?

The pyramid of differentiation
Example: Machine software

Is Open Innovation appropriate for a particular project?
Linux goes safety and takes it to the next level

- Servers
- Embedded systems
- Mobile devices
- Desktop computers
- Netbooks

1991 - 2011
Linux goes safety and takes it to the next level (2)

1991

Real-Time Linux

Desktop computers

2001

Safety-Critical Linux

Embedded systems

Mobile devices

? Netbooks

2011
Conclusion

• The success of Linux is closely related to its license (GNU GPL).

• When Linux is passed on, the sources must be made available.

• Never use Open Source, if the software contains differentiating know-how.

• A Linux community was able to convert a GPOS into an RTOS kernel.

• A Linux community should also be able to provide certification paperwork.

• Real-time and safety-critical Linux has the potential to replace any other operating system, as long as it must not contain differentiating know-how.