

# RJD Ravenscar-Java

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*Development*

Version 2.2  
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**Project Partners:** CISS, Aalborg University  
FOSS A/S, Hillerød  
Vitus Bering Denmark

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## 1. Purpose of the Project

The purpose of the project is to

- implement the Ravenscar-Java Profile on the aJ-100 processor
- find out to what extent Real-Time UML<sup>1</sup> with advantage can be applied when designing embedded real-time systems
- investigate through development of an industrial case how useful the Ravenscar-Java Profile is for design and development of industrial embedded systems with real-time requirements
- compare the Ravenscar-Java solution with a C++ solution.

## 2. Background

In 1999 "The Real-Time for Java Expert Group" was established under "The Java Community Process" to produce a *Real-Time Specification for Java (RTSJ)*. The first version of RTSJ came in 2001<sup>2</sup>.

David Hardin from aJile Systems was a member of this expert group, and in the same year aJile Systems came out with their *aJ-100 Real-Time Java processor*<sup>3</sup>. They state [aJ]:

aJile's microprogrammed RTOS has most of the functionality specified in the RTSJ. However, compliance to the RTSJ will require business initiatives to pursue.

The Real-Time Systems Research Group at York<sup>4</sup> formulated in 2001 *The Ravenscar-Java Profile: A Profile for High-Integrity Real-Time Java Programs* [Pu]. About it, Andy Wellings writes [We, p. 349]:

The main goal of Ravenscar is to define a computational model for application programs so that they can be analysed for their timing properties on single-processor systems.

*Forum for Real-Time Java in Embedded Systems*<sup>5</sup>, was established in 2002 by Hans Søndergaard as a group at Alexandra Instituttet A/S<sup>6</sup>. The purpose of Forum for Real-Time Java in Embedded Systems is to

- get experience with real-time programming in Real-Time Java
- get experience with construction of embedded systems in Java
- get experience with programming of Java processors, such as aJ-100
- use Java in industrial contexts.

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<sup>1</sup> UML Profile for Schedulability, Performance, and Time, Version 1.1

<sup>2</sup> <https://rtsj.dev.java.net/>

<sup>3</sup> <http://www.ajile.com/aj100.htm>

<sup>4</sup> <http://www.cs.york.ac.uk/rts/>,

<sup>5</sup> <http://rtj.vitusbering.dk/sw5204.asp>

<sup>6</sup> <http://www.alexandra.dk/>.

### 3. Perspective

Since the appearance of Java in 1995, it has spread tremendously as a software development tool. It is used to program everything from servers to smart cards, cf. Figure 1.

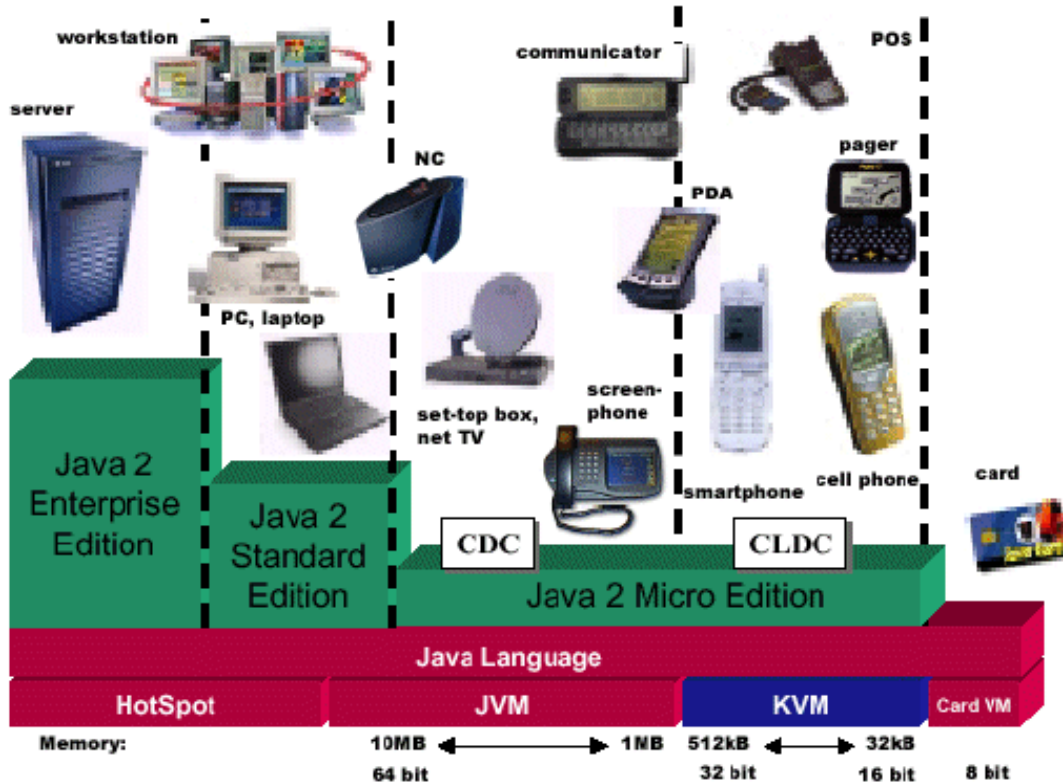


Figure 1. Java Application areas

Java is object-oriented, strongly typed, multithreaded, and has automatic garbage collection. This means that the development time of a software system implemented in Java is considerably shorter (25%-40% according to [Ha]) than if C/C++ was used.

Because a Java program has no control over the automatic garbage collection, and because the JVM does not support real-time threads, Java has until now been of little importance for development of embedded real-time systems. However, this has changed with Ravenscar, Real-Time UML and the aJile processor as explained above. Therefore, through this project we will

- analyse whether Ravenscar-Java is a realistic Java profile for industrial real-time systems
- show how Real-Time UML is used as a design tool
- compare a Ravenscar-Java solution with a C++ solution.

#### 4. Industrial Application

FOSS A/S<sup>7</sup> will provide an industrial case for the project. It will relate to a previous project, where IT-students at Vitus Bering Denmark in their thesis project: *Runway Observation System*, [ROS], in collaboration with DSE A/S automated data collection of friction on a runway and presented the information to the air traffic controllers. A part of the project examined the possibility to use the aJ-100 processor and Java together with existing devices.

An overview of the system with aJ-100 is seen in the following Figure 2.

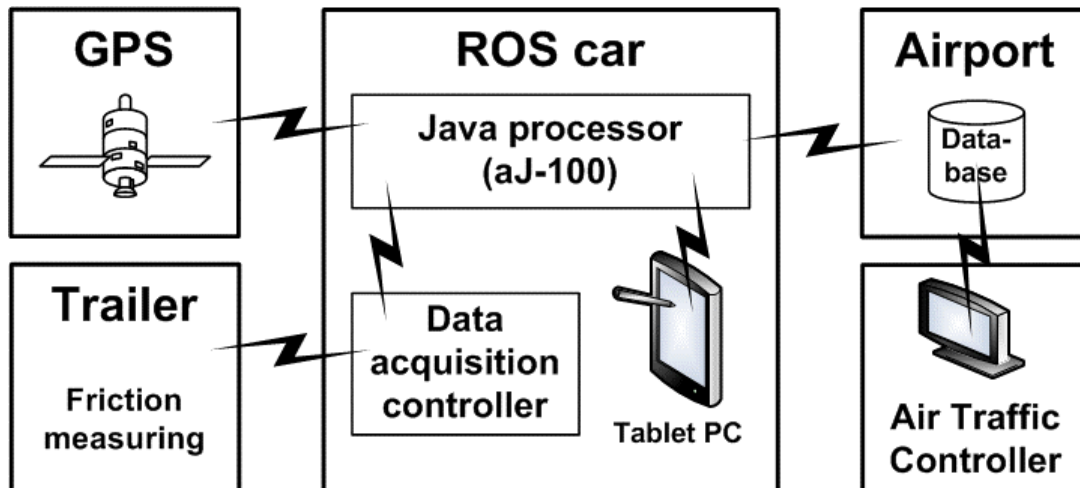


Figure 2. Data collection and display system with a Java Processor

The project was completed very successfully, especially as to the interaction with existing devices, but the project group had (unsolved) problems with the periodic threads and their initialization. These problems should be resolved by the Ravenscar-Java profile.

#### 5. Timetable for the project

The project is split up into the following three parts:

**1. Implementation of the Ravenscar-Java profile on the aJ-100 processor**

- Period: 1 August 2005 - 31 January 2006.

**2. Design of an industrial case using Real-Time UML**

- Period: 1 February 2006 – 31 July 2006

**3. Implementation of the industrial case using the Ravenscar-Java profile and evaluation of the result compared with a C++ solution**

- Period: 1 August 2006 - 31 January 2007.

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<sup>7</sup> <http://www.foss.dk>

## References

- [aJ] aJile Systems. Technical FAQs: Software.  
*What is the status of aJile's implementation of Real-Time Specification for Java?*  
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<http://www.omg.org/technology/documents/formal/schedulability.htm>
- [Pu] Peter Puschner and Andy Wellings. *A Profile for High-Integrity Real-Time Java Programs*. Proceedings of the 4<sup>th</sup> IEEE Symposium on Object-Oriented Real-Time Distributed Computing (ISORC). 2001.
- [ROS] Thomas Bræmer, Jan Lauritzen, Mads Nielsen, Mads Pedersen.  
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- [We] Andy Wellings. *Concurrent and Real-Time Programming in Java*.  
Wiley. 2004. ISBN: 0-470-84437-X.

## Document Control

Version	Status	Done by	Date
1.1	Project proposal (in Danish)	hso	5/5/2005
1.2	Contribution from CISS included	hso	31/5/2005
1.3	Only small corrections	hso	12/6/2005
1.4	Corrections included, after meeting between CISS, FOSS, Vitus Bering	hso	1/7/2005
1.5	Final version. In Danish	hso	23/8/2005
2.0	Translated to English. New front page, title and logo.	hso	26/7/2005
2.1	Timetable included	hso	25/9/2005
2.2	Reviewed by A.P.Ravn	apr/hso	7/10/2005