



The FOAM Middleware Platform

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What is the FOAM middleware

- FOAM is:
 - Framework for Open Application Management
- That means middleware that defines:
 - a client/host run-time stack for CVIS applications.
 - a set of basic CVIS host facilities:
 - communication, location, vehicle data access
 - middleware for management
 - deployment / provisioning / security / dds
 - SDK – Software Development Kit
- FOAM runs CVIS!



The FOAM Objectives

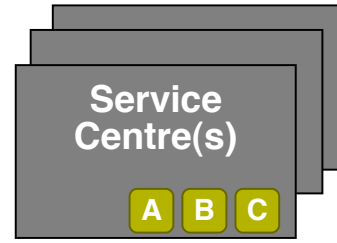
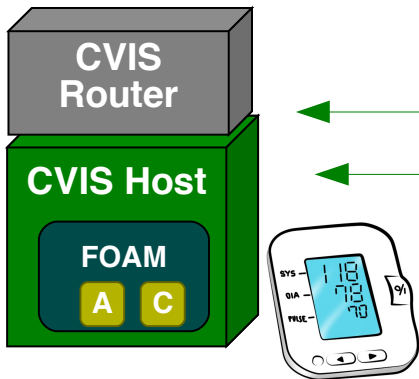
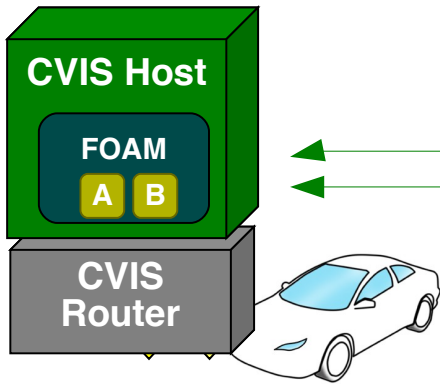
- OB1 - Demonstrate that new CVIS applications and services can be developed, deployed and provisioned on an open end-to-end framework and run-time environment
- OB2 - Demonstrate that external service and application providers can deploy new applications and services on CVIS infrastructure
- OB3 - Demonstrate that in-vehicle and roadside units can be remotely managed
- OB4 - Demonstrate the secure operations of CVIS infrastructure



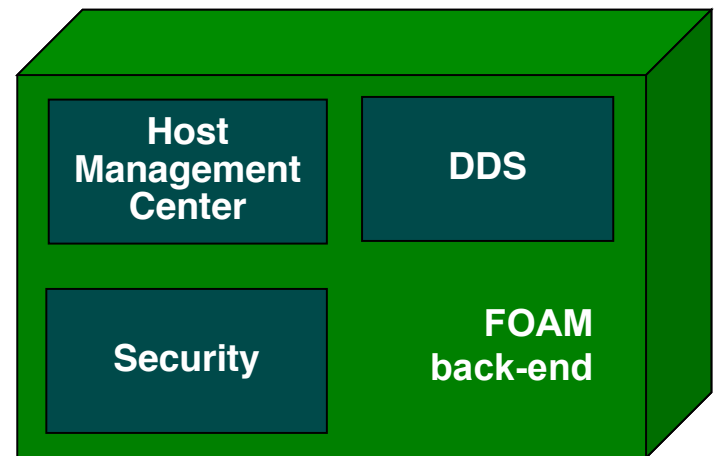


CVIS according to FOAM

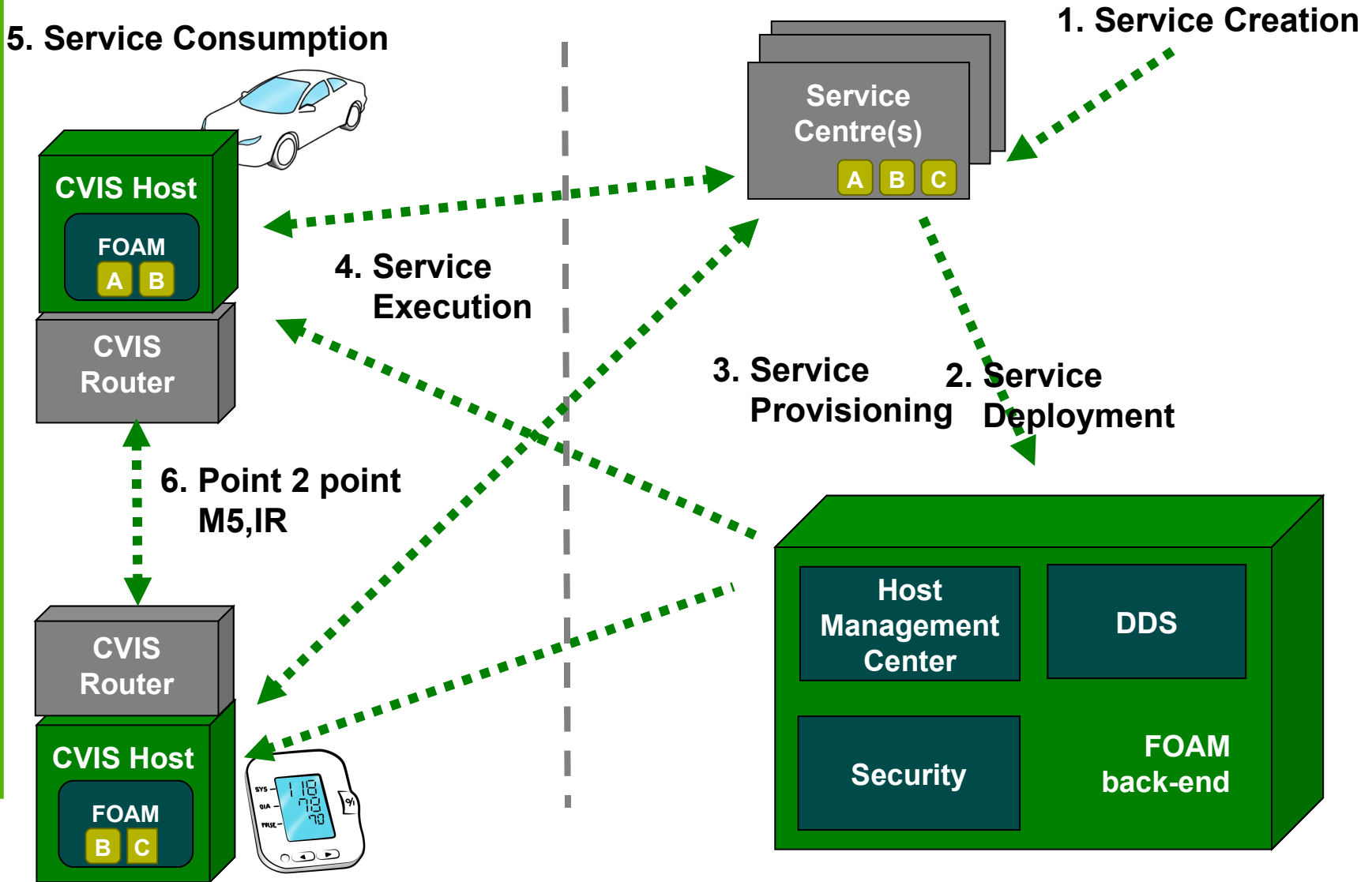
Run-time environment for the CVIS Service Applications



FOAM servers for management of applications



Typical FOAM Interaction





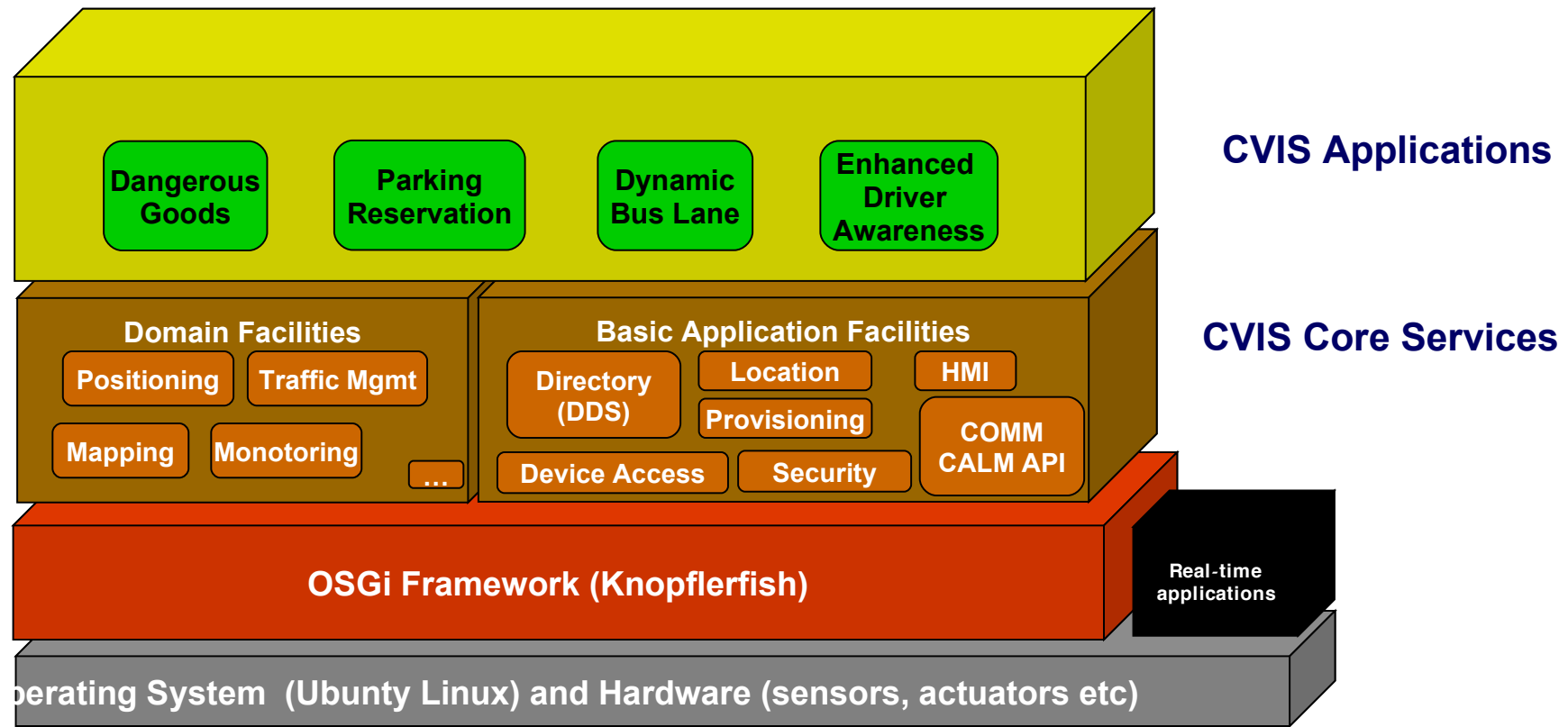
CVIS Application Run-time Environment



- It is Java / OSGi based thereby:
 - Uniform, same platform for ALL hosts
 - roadside, in-vehicle, model, brand.
 - capable of hosting a wide range of services,
 - Remotely managed
- The CVIS core technologies partners are jointly adding
 - CVIS Core Services
 - CVIS Domain Facilites
- This creates a good environment for CVIS Application Development
- Communication is key, CALM (DSRC + WAN, IPv6)



The CVIS Application Run-time Environment





FOAM – CVIS Basic facilities

- **OSGi Framework and Lifecycle Management**; which provides the basic run-time environment and lifecycle management of applications
- **Human Machine Interface**; which provides a standard set of graphical elements for providing graphical user interfaces to End Users.
- **Distributed Discovery Service**; which facilitates looking up applications and facilities deployed in the CVIS infrastructure.
- **Security**; which facilitate security services such as authorization and authentication and secure communication.
- **Identity (as part of the security framework)**; which performs the identity management to allow identification with authenticated pseudonyms
- **CALM Communications**
 - **Connection Manager**; which provide services for setting up communication channels between CVIS hosts, either using WAN (3G), or P2P (CALM)
 - **Data Broadcast**; which facilitate broadcasting of data using CALM fast P2P communication
 - **Service Advertisement**: which facilitate announcing & establishing P2P connections using CALM fast.
- **Local device tree**; which facilitates access to tree data on a CVIS subsystem (e.g. a Vehicle Tree)
- **Location**; which facilitates access to Location related functions



FOAM Objectives

- OB1 - Demonstrate that new CVIS applications and services can be developed, deployed and provisioned on an open end-to-end framework and run-time environment
- OB2 - Demonstrate that external service and application providers can deploy new applications and services on CVIS infrastructure
- OB3 - Demonstrate that in-vehicle and roadside units can be remotely managed
- OB4 - Demonstrate the secure operations of CVIS infrastructure





FOAM-OB1

- **Objective:** Demonstrate that new CVIS applications and services can be developed, deployed and provisioned on an open end-to-end framework and run-time environment
- **Verified** by running first verifying the run-time environment it-self to guarantee a stable foundation
 - Completed by a running a set of test suites for the FOAM core OSGi environment and FOAM services.
- **Validated** by inspecting the results of the test site and open demonstrators





FOAM-OB1 Conclusion

- All 13 test sites and test locations successfully developed, deployed and provisioned CVIS applications
- A set of 21 applications was developed and used for the public road tour at Intertraffic from
 - Includes apps from CF&F, CINT, CURB and COMO as well as core tech demonstrators / examples from POMA, FOAM and COMM.
- **FOAM-OB1 has been reached**





FOAM-OB2

- **Objective:** Demonstrate that external service and application providers can deploy new applications and services on CVIS infrastructure
- **Validated** by inviting external parties to participate in a CVIS Application Innovation Contest
- In 2009 an Application Innovation Contest was launched.
 - The contest was divided in several phases. A total of 22 high quality concepts was received.
 - A CVIS appointed jury selected 4 applications for the final during ITS Stockholm where the audience voted for the winner





FOAM-OB2 Conclusions

- The Application Innovation Contest demonstrated external parties can successfully develop applications.
- Some remarks:
 - POMA and COMO software not included in the SDK used, license issues and availability
 - Limited access to real HW problematic. Only emulated CALM available, with limitations
- FOAM-OB2 has been reached





FOAM-OB3

- **Objective:** Demonstrate that in-vehicle and roadside units can be remotely managed
- **Verified** by service provisioning and deployment tests at Lindholmen test site
 - Fully verified the following 4 scenarios:
 - Provisioning initiated from HMC to CVIS Vehicle Host (administrator pushed)
 - Provisioning initiated from HMC to CVIS Road-side host. (administrator pushed)
 - Provisioning initiated from CVIS Vehicle (User pull)
 - Provisioning triggered by external event (Receiving Subscription Request message)
- **Validated** by inspection of successful demonstrators





FOAM-OB3 Conclusions

- The core function was verified in LSP test site
- The successful showcase events in Berlin, Helmond, Stockholm and Amsterdam demonstrated the remote management capabilities of the FOAM environment
- FOAM-OB3 has been reached





FOAM-OB4

- **Objective:** Demonstrate that CVIS is a secure environment for data communications between authorized users.
- **Verified** by testing a small test client
- **Validated** by inspection of fully secure CVIS application





FOAM-OB4 Conclusions

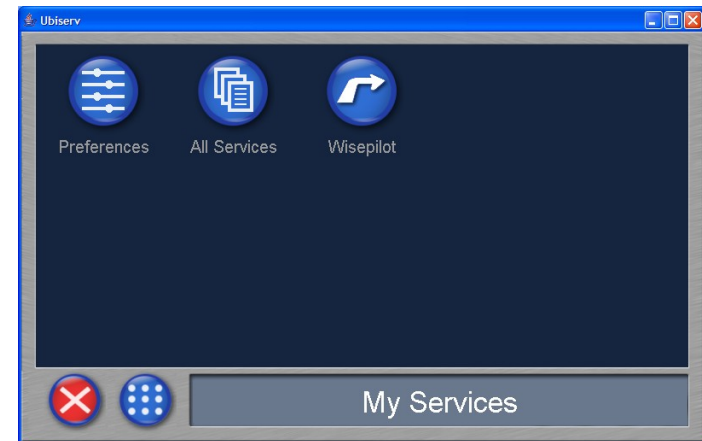
- The core function was verified at test site / lab
- The testing and validation of the CF&F Dangerous Goods Application shows that FOAM can be set up as a secure environment
- **FOAM-OB4 has been reached**
- Remarks
 - Only one CVIS app was requesting to use secure communication
 - The testing and validation of the Sevecom identity manager was not part of the FOAM validation.





Other FOAM Achievement

- Major achievements in FOAM that was not part of the original FOAM objectives
- A foundation of FOAM services suitable for standardization as a *facilities layer*
- A rich set of test suites available open source
 - Can be the basis for later certification programs
- The ITS App Store concept





Summary

- FOAM has provided the middleware for CVIS
- The successful showcase events in Berlin, Helmond, Stockholm and Amsterdam and the application innovation contest are the best proof points for the FOAM middleware.
- In Amsterdam we had 21 applications running in the same host, supplied by different partners, most of them running in the background, exchanging data.
 - The iPhone allows 1 app at a time, no background processing
- **Conclusion:** the objectives have been reached



Thanks for your attention...

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