



# GridLite - A Framework for Managing and Provisioning Services on Grid-Enabled Resource Limited Devices

Raj Kumar, and Xiang Song (+)

Hewlett Packard, OST & HP Labs, 1501 Page Mill Road,  
MS: 1181, Palo Alto, CA-94304

[raj.kumar@hp.com](mailto:raj.kumar@hp.com)

(+) College of Computing, Georgia Institute of Technology,  
801 Atlantic Dr, Atlanta, GA-30332

[songx@cc.gatech.edu](mailto:songx@cc.gatech.edu)



# Outline



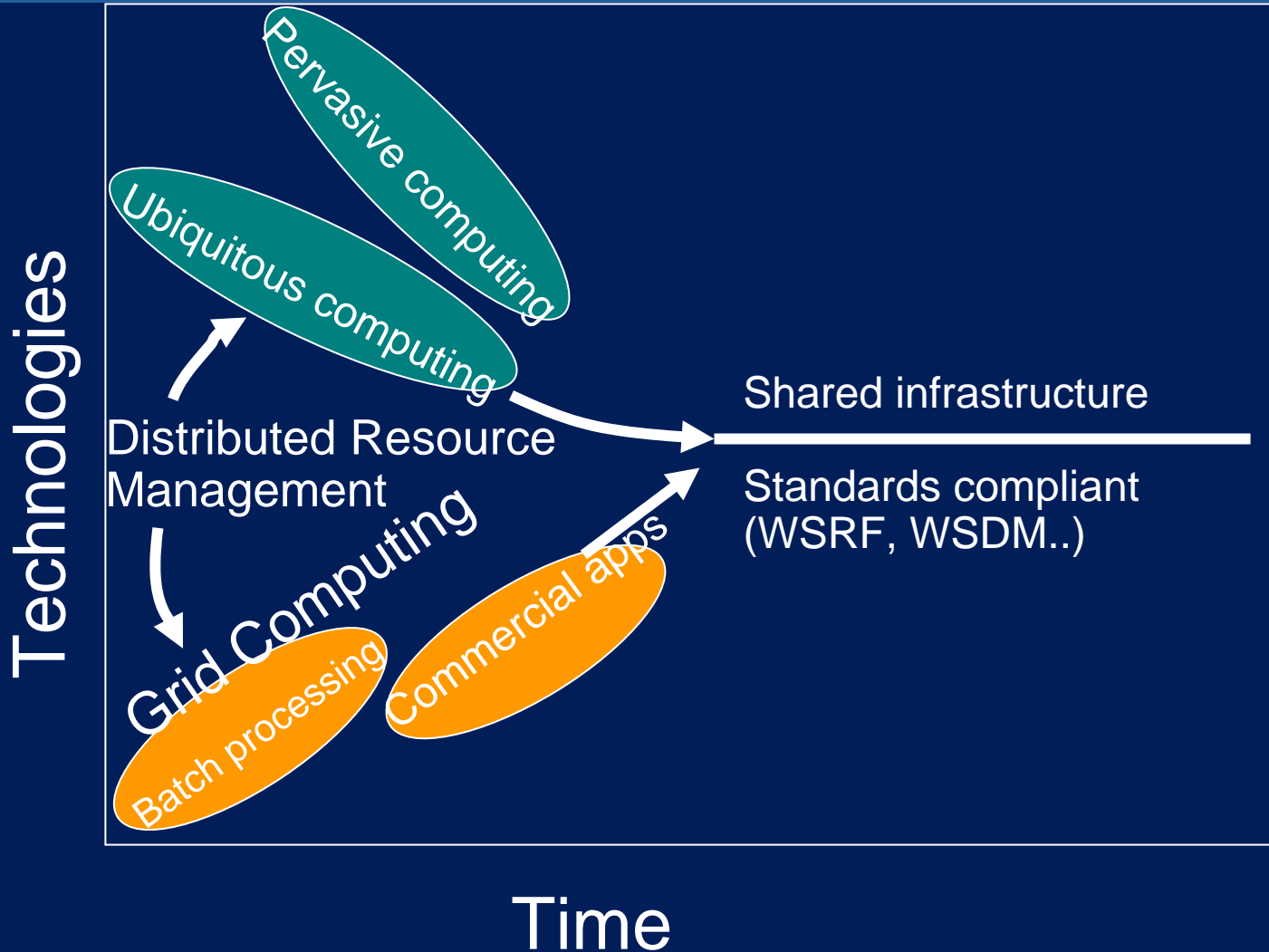
- GridLite Goals
- Technology Landscape
- GridLite Architecture
- Use cases and services
- Screen shots
- Related work
- Summary

# GridLite Goals



- Define an extensible framework that provides services to mobile users on ubiquitous, resource-limited devices using a Grid infrastructure
- Provide a wired infrastructure for provisioning of **persistent services**, and **smart helper services** running on handheld devices which tap into this infrastructure
- Build on the research done in the areas of **ubiquitous computing**, and **grid computing** during last several years
- Provide users an **ubiquitous access to grid resources, higher productivity, entertainment, and being always connected**
- Implementations on the client side include **iPAQs, smart phones** and other handheld devices; and Linux and Windows servers on the server side
- The architecture that implements GridLite is adaptive, intelligent, and based on industry standards like XML, SOAP, WSDL, WSRF, and GT4

# Grid Technology Convergence



# Technology Landscape: Development environment for handhelds

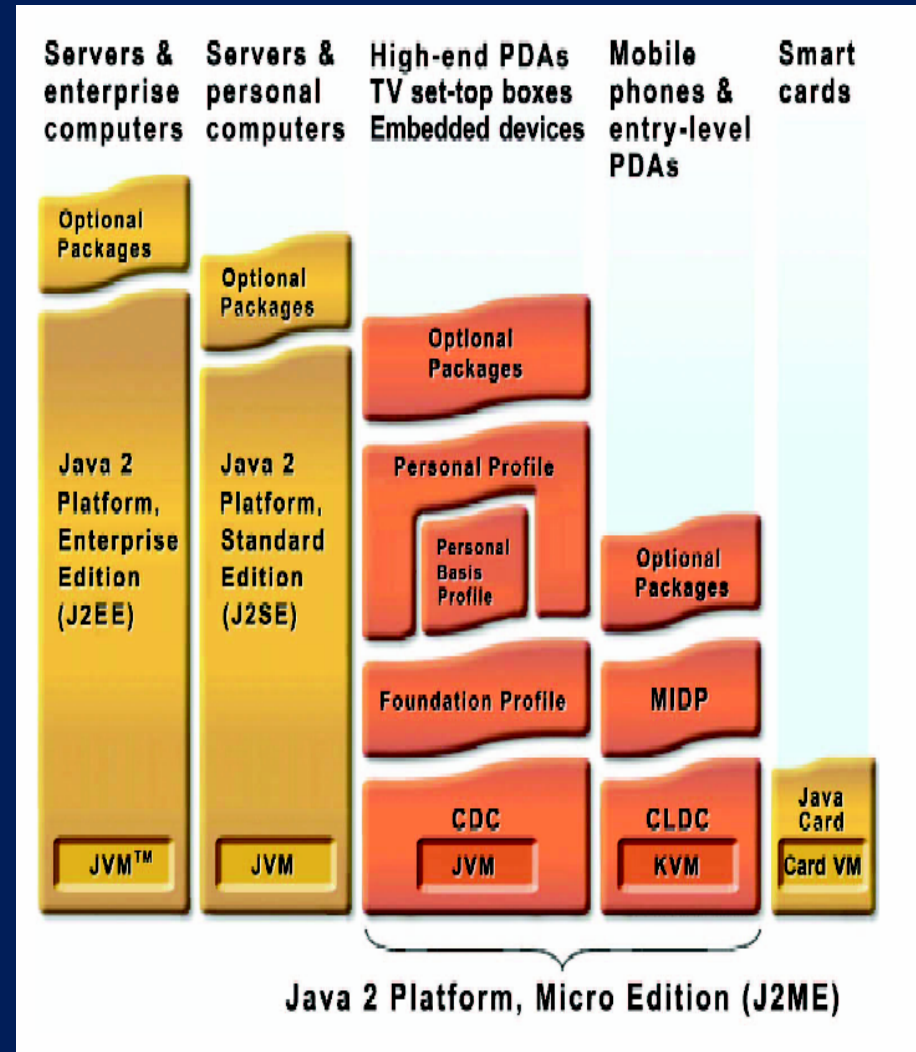


- Resource constrained environment
  - Limited memory and storage (2MB-64MB)
  - Limited battery power
  - Limited compute power
  - Limited network bandwidth
  - Limited display and input capabilities
- Diversity
  - Multiple processors, OSes, JVMs, APIs



# J2ME options

- Configurations and Profiles
- CDC + Personal and Foundation profiles
- CLDC + MIDP profiles



# GridLite architectural considerations

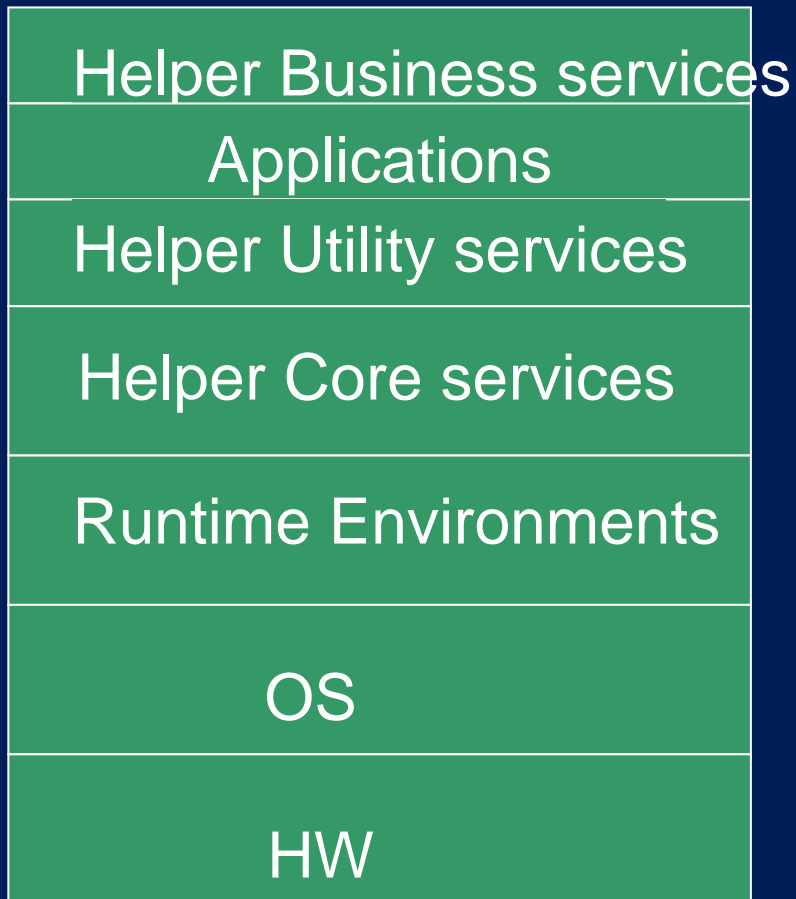


- Provide grid infrastructure support that mitigates device resource constraints and provides **illusion of unlimited resources**
- Provide **intelligent helper services** on the device which free up the user from mundane tasks
- Make the grid infrastructure support **transparent** to the user
- Some **core services**
  - Storage management
  - Application management..
- Some **domain specific utility services**
  - Music management service
  - Health care services..

# GridLite software stack



## Clients

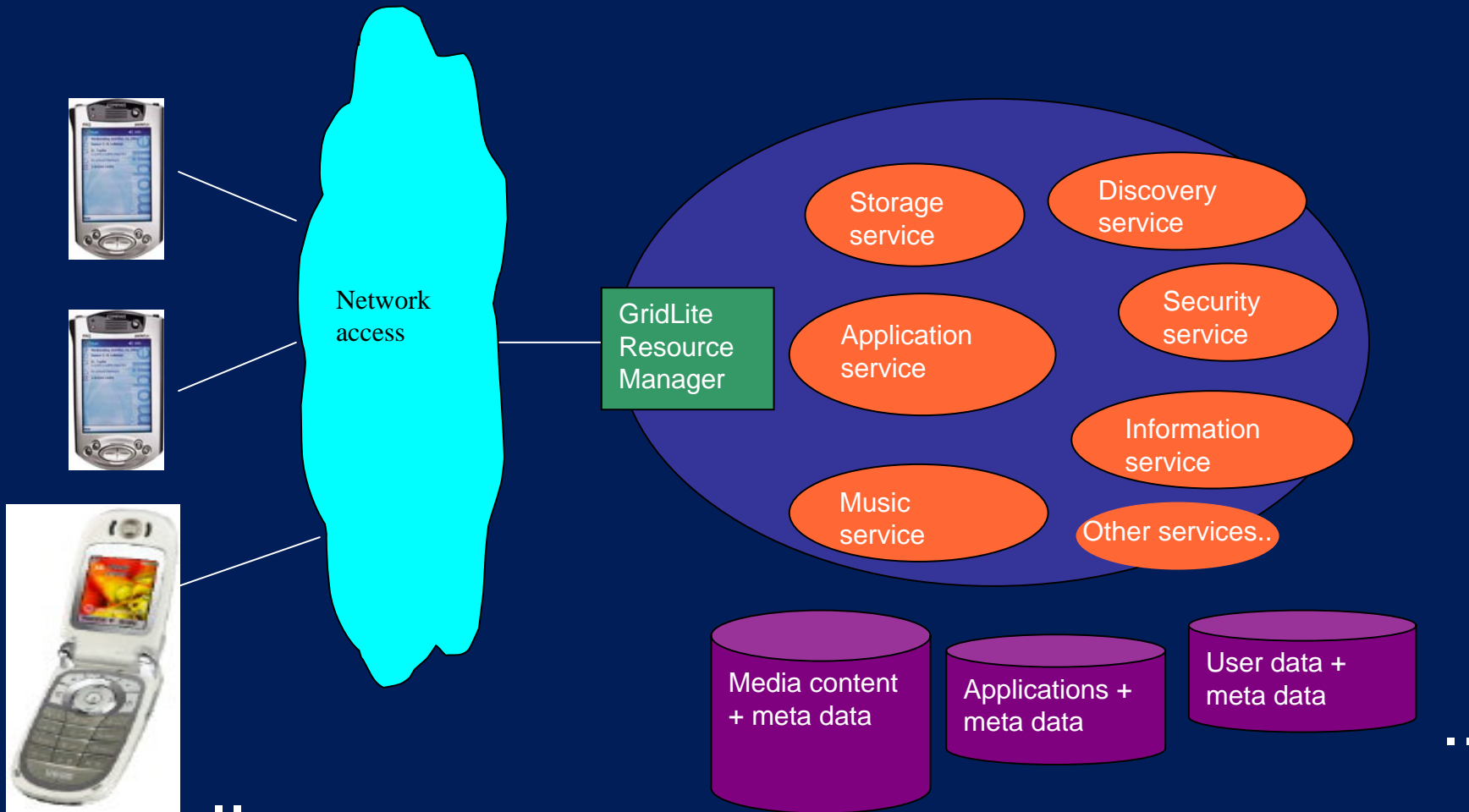


## Servers (Grid infrastructure)





# A GridLite system



# GridLite Use Cases and Services



## Services

- Application management
- Storage management
- Music management
- Health domain..

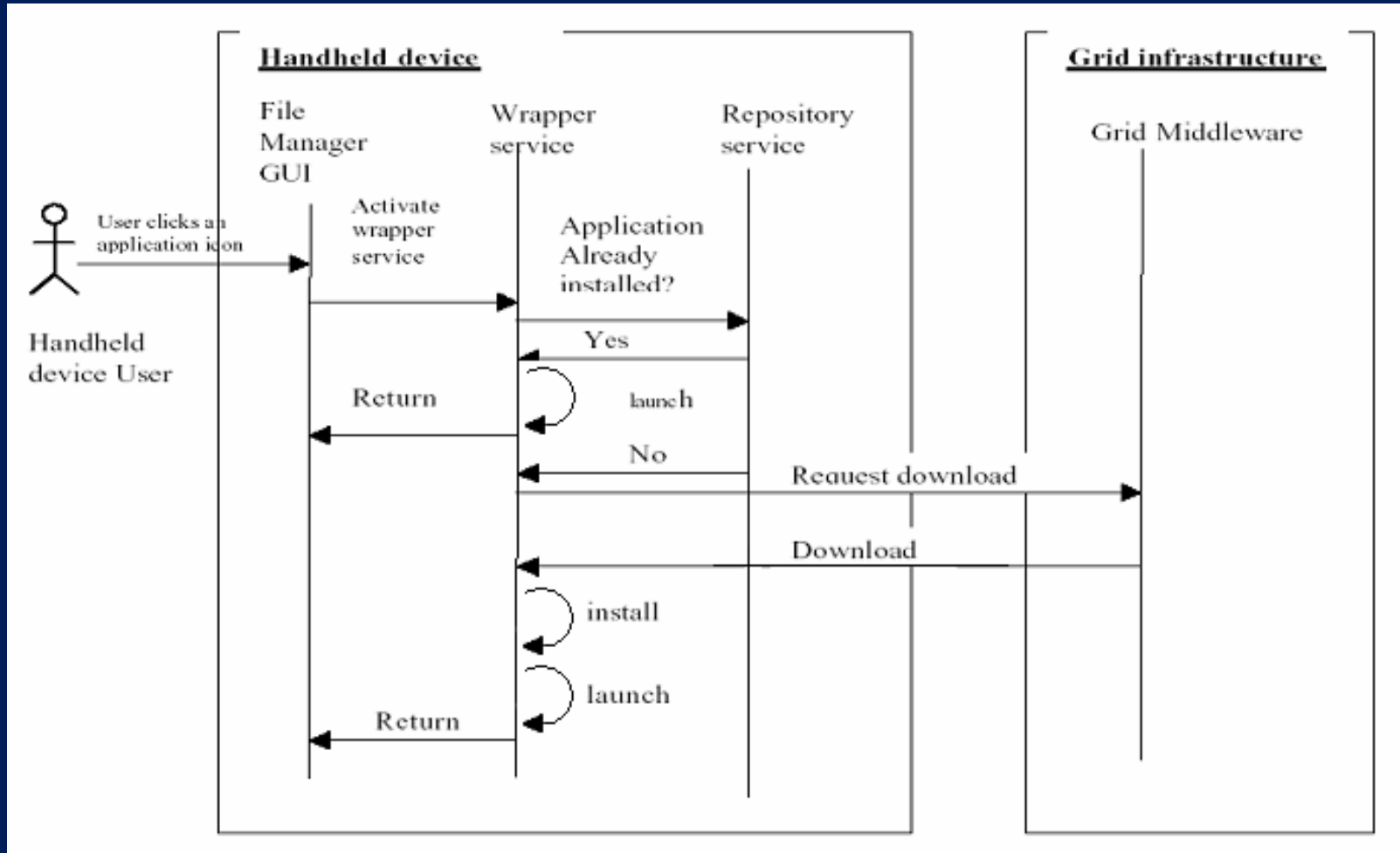
## General use cases

- User starts an application
- User accesses his/her data

## Music domain use cases

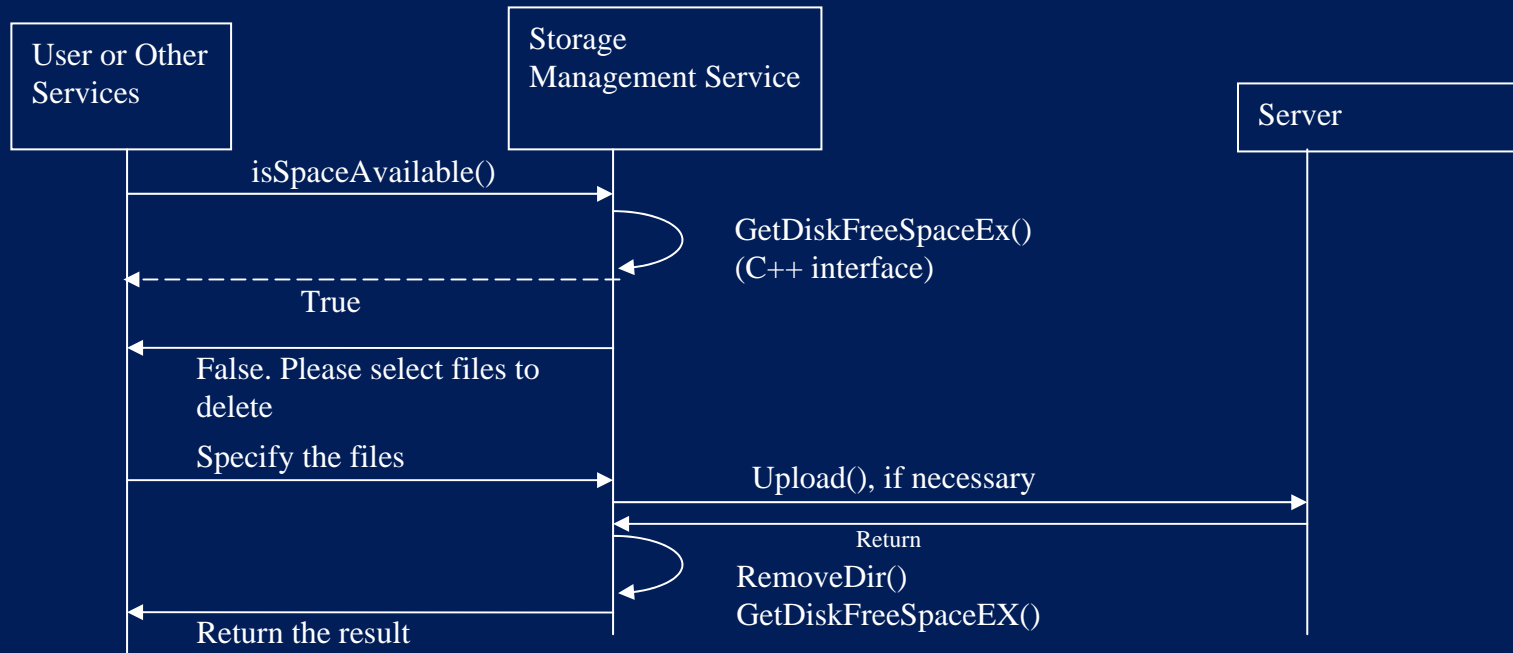
- User creates an account
- User creates a profile(s)
- User plays a profile(s)
- User queries media content
- User queries his/her profiles
- System admin backs up meta-data
- System admin backs up media content
- System admin queries historical logs
- System admin queries user enrollment
- System admin queries resource usage
- System admin predicts future growth
- System admin installs new media content
- System admin removes media content
- Notification use case

# Application Management Service



A sequence diagram showing a user's interaction with a grid-enabled handheld Device for launching an application that may or may not be resident on the device

# Storage Management Service



**Sequence Diagram of Storage Management Service**

# Options in handheld devices- iPods vs iPAQs & Smart Phones



iPOD

iPAQ & Smart Phone

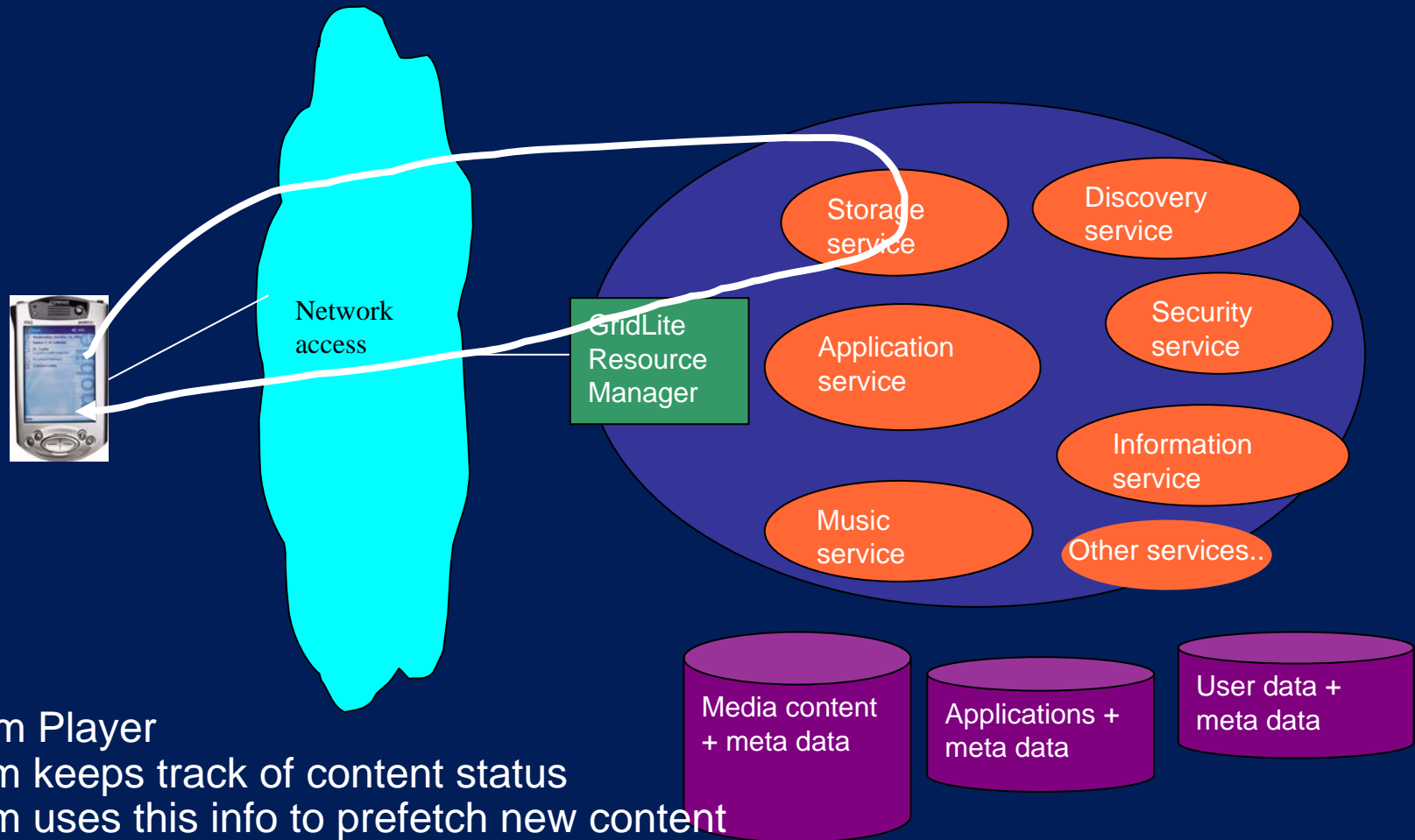


- Single function
- No significant infrastructure support
- Standalone operation
- Unused storage
- Non ubiquitous data

- Multiple functions
- Significant infrastructure support
- Standalone and connected operation
- System wide shared storage on servers
- Ubiquitous data (access from anywhere)
- Wireless capability
- JVMs available

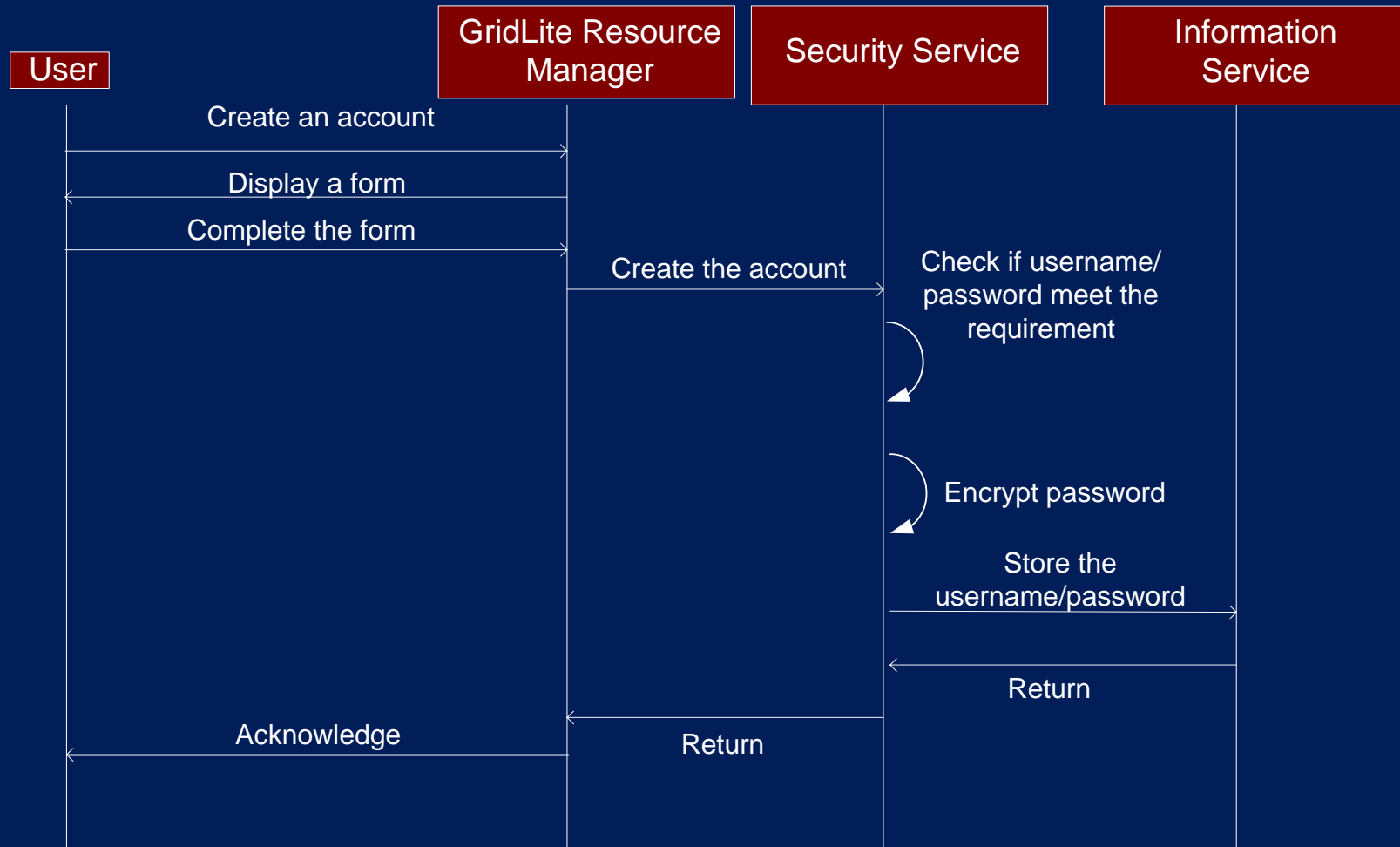
**GridLite**

# Music distribution In a closed loop system

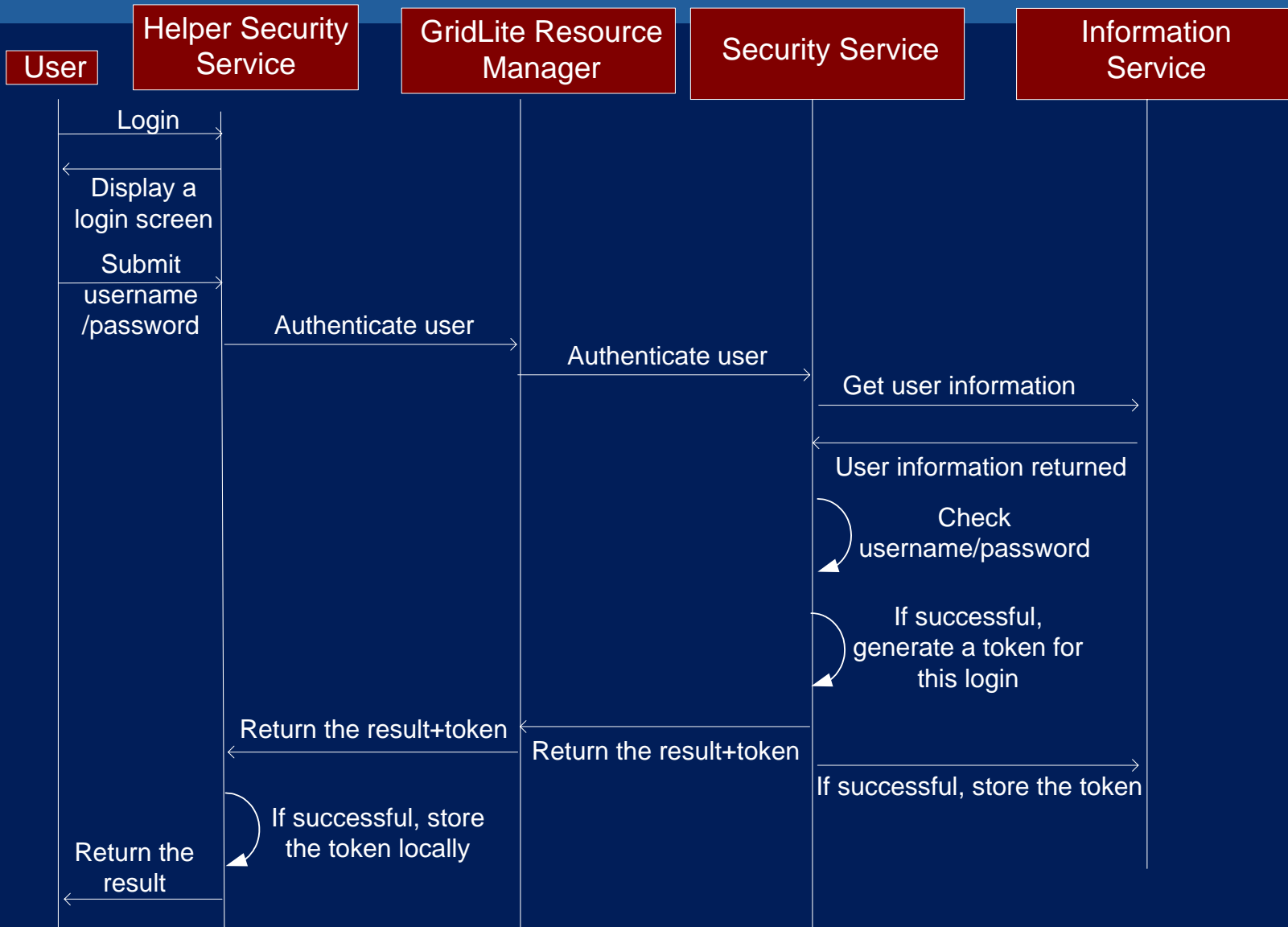


- Custom Player
- System keeps track of content status
- System uses this info to prefetch new content
- User can pre-program desired music experience

# Create an account

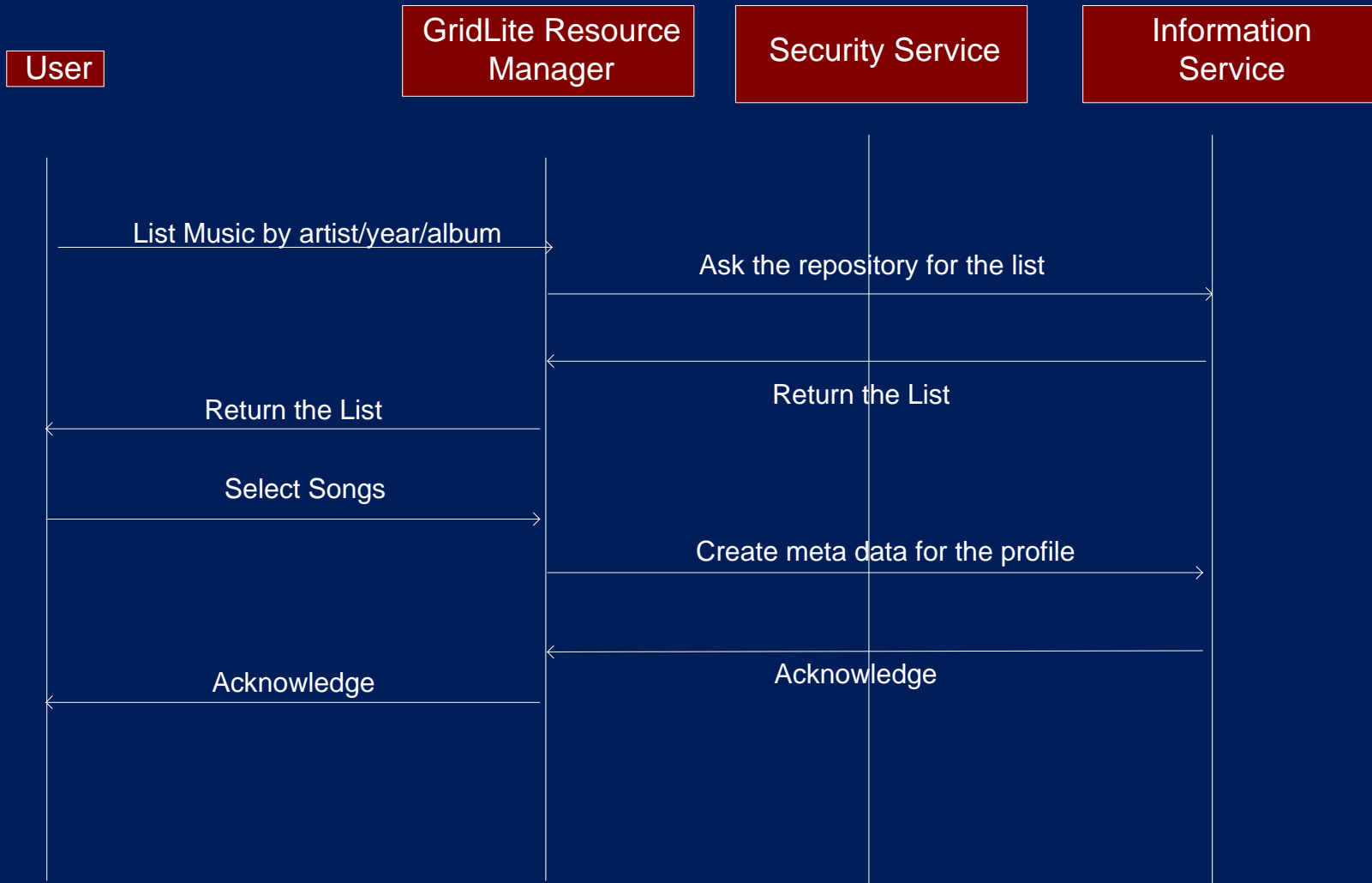


# Login

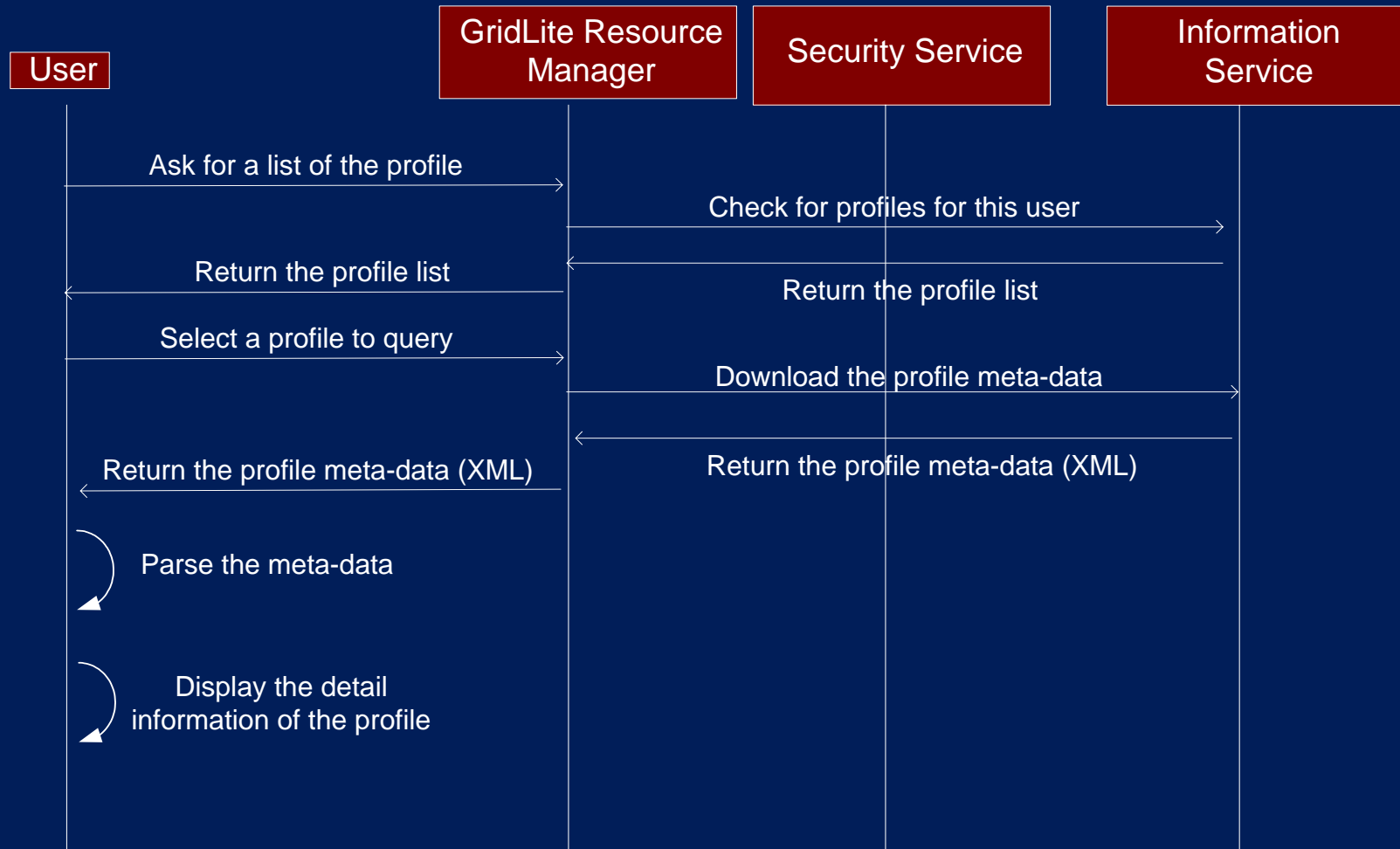




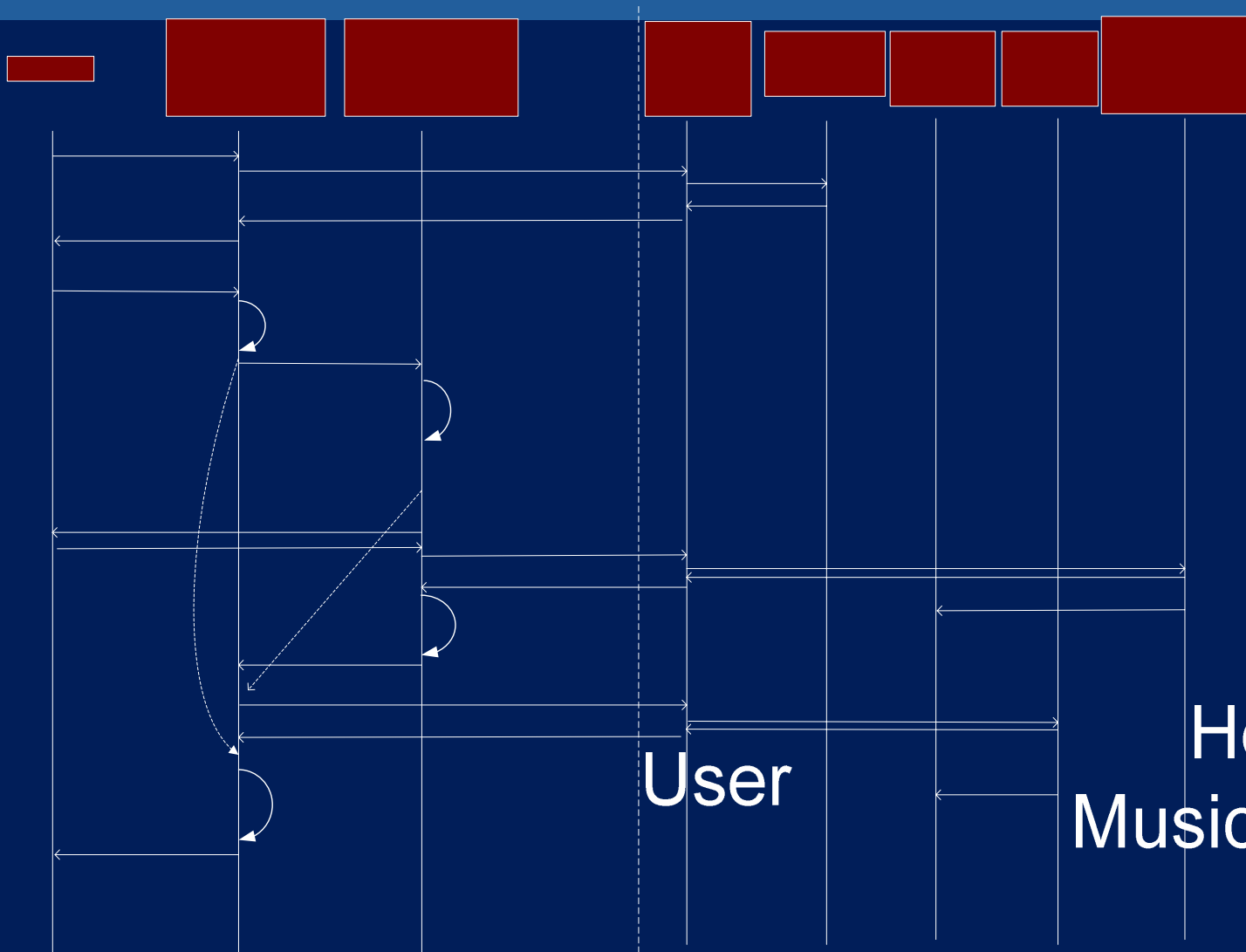
# Create a profile



# Query a profile



# Music Service

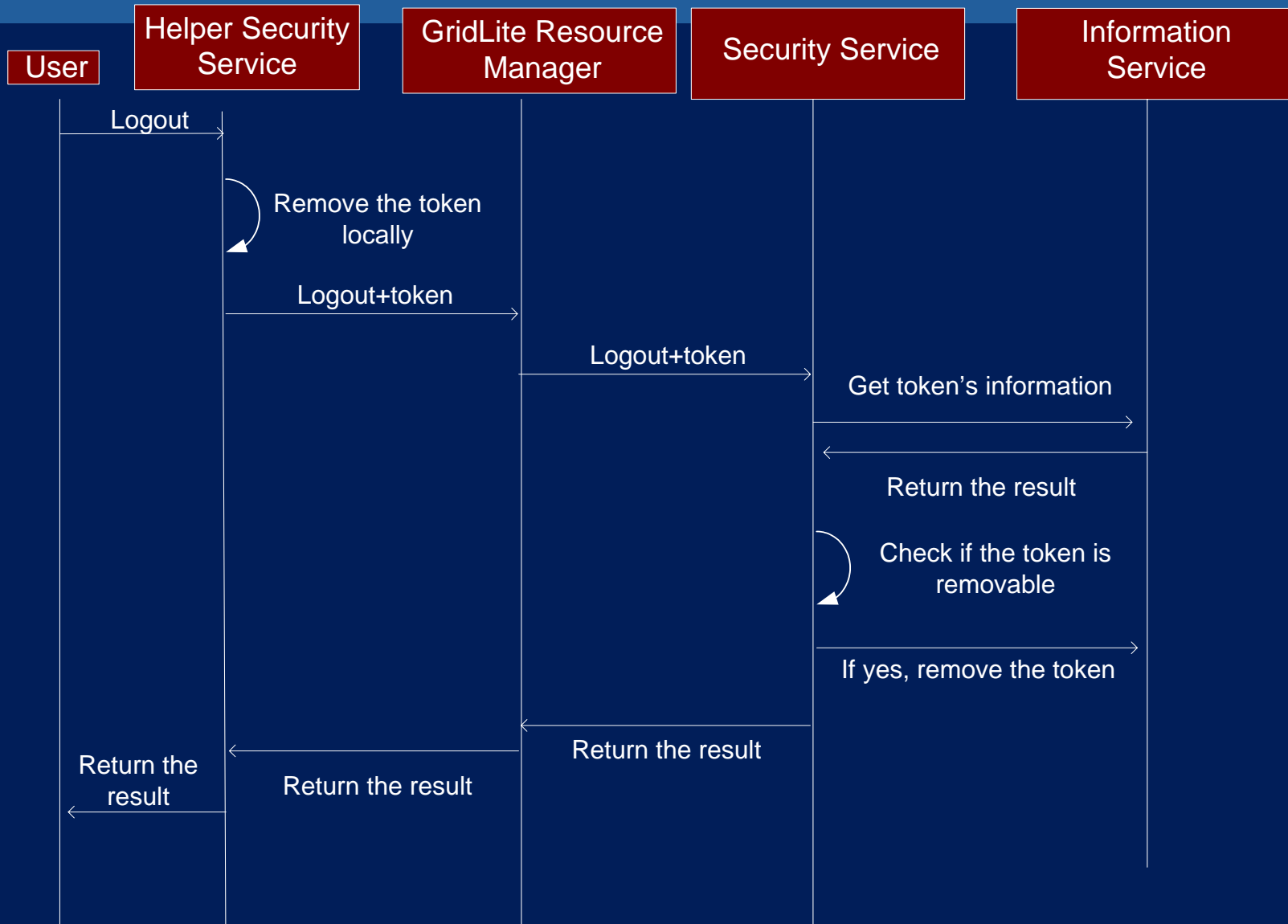


User

Helper Music Service

List profile(s)

# Logout



# Other GridLite services



- **Billing service**
  - service based model
  - buy and managed service model
- **Notification service**
- **Capacity planning service**
- **Data mining service**
- **Caching: server side**
- **Caching: client side**

# Invoking the music service



# Invoking the music service (continued)



# Invoking the music service (continued)





# Invoking the music service (continued)



# Playing music in a GridLite environment



# Related Work



1. The Obje™ Software Architecture, PARC research,  
<http://www.parc.xerox.com/research/csl/projects/obje/default.html>
2. Apple IPOD + iTunes,  
<http://www.apple.com/itunes/>

# Summary



- Defined architecture and built a **testbed** for GridLite (ongoing)
- GridLite for appliances uses **industry standards** like XML, SOAP, WSDL, WSRF, and GT4
- Handheld devices connected via GridLite can **unleash powerful services to end users**
  - Examples: music, health care, financials, and more..
- GridLite architecture enables management of **server side infrastructure** as well as the resource constrained **client devices**

# Questions?



# Thank you!