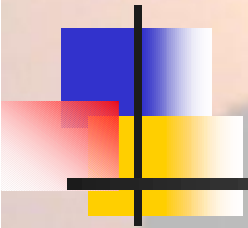


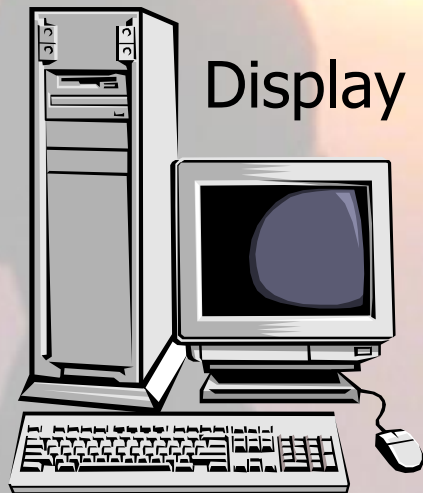
# Dependable Pervasive Computing



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# Active Spaces

Application  
Logic



Controller





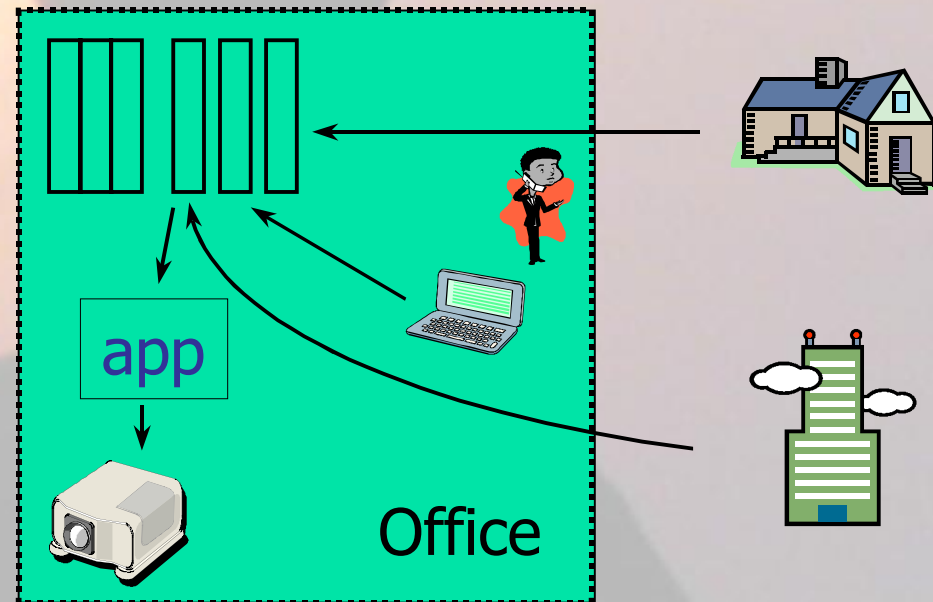
# Outline

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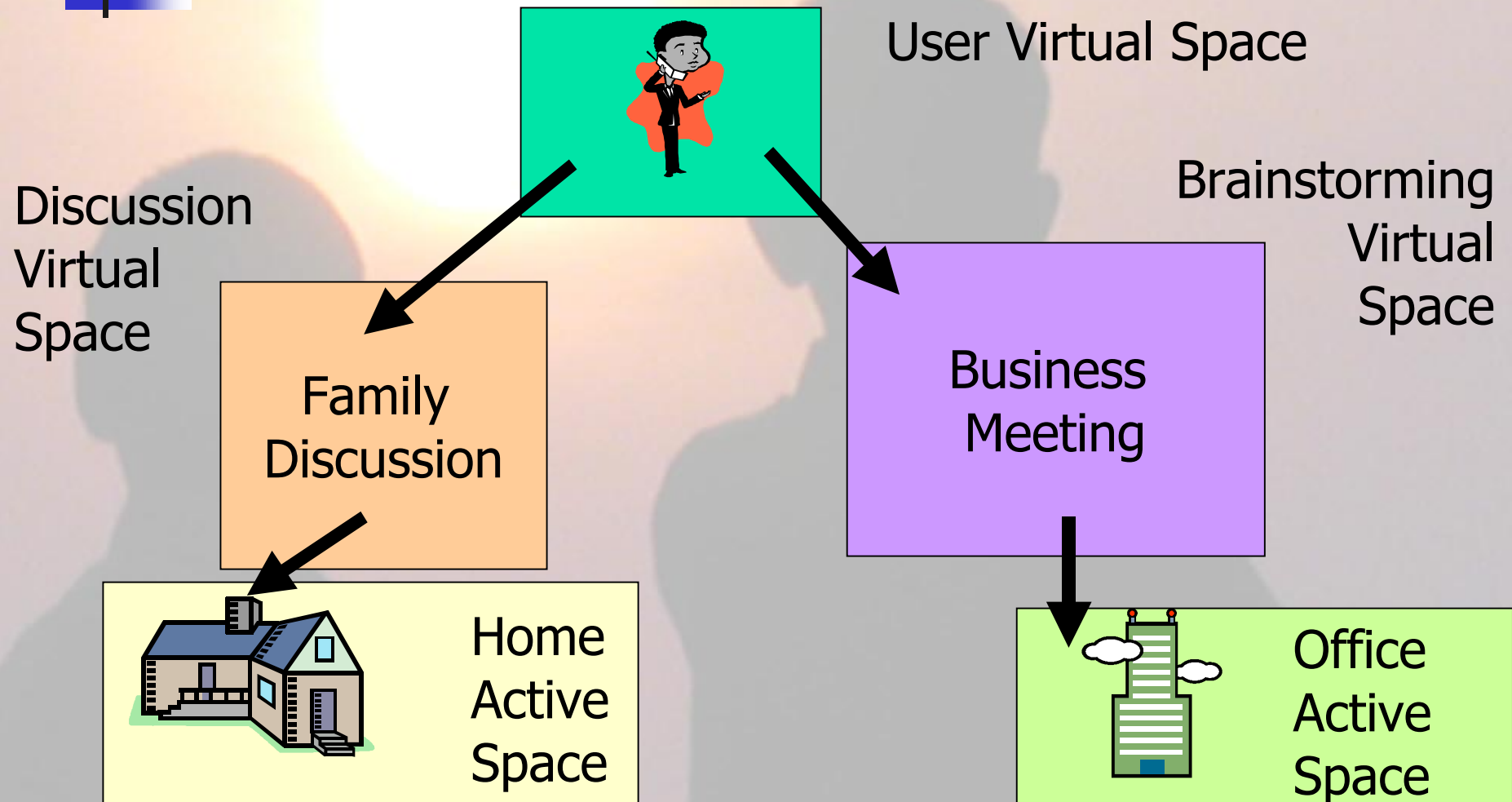
- Motivation
- Gaia Architecture
- Component Management Core
- Event Manager
- Context Service
- Data Management
- Presence Service
- Security Service
- Application Framework

# Motivation

- User Virtual Space
  - applications
  - data
  - preferences
  - configurations



# Virtual space -> Active Space





# Dependability Issues

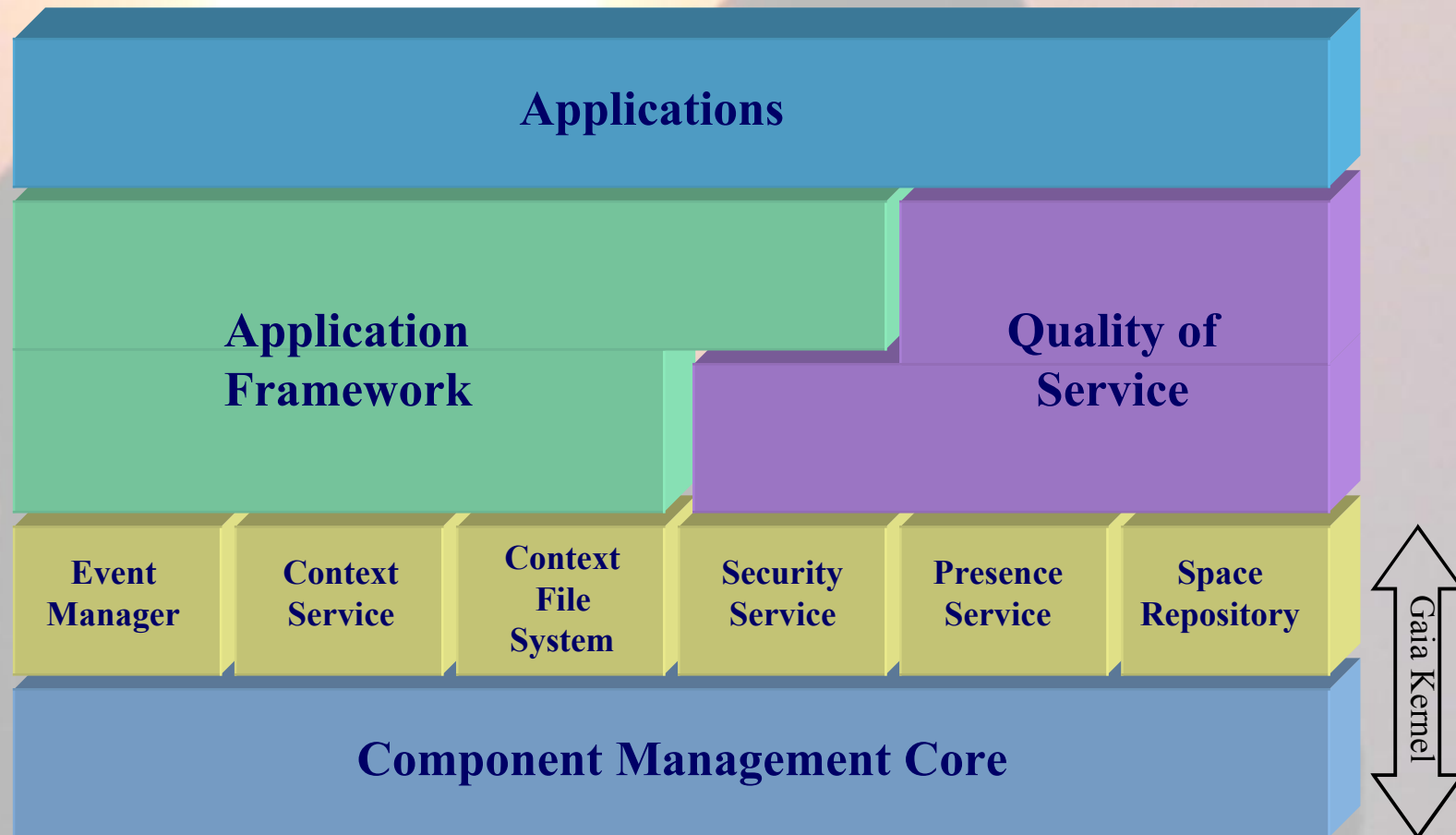
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- Active Space Devices
- Active Space Infrastructure
- Services
- QoS Provisions
- Active Space Applications
- Users

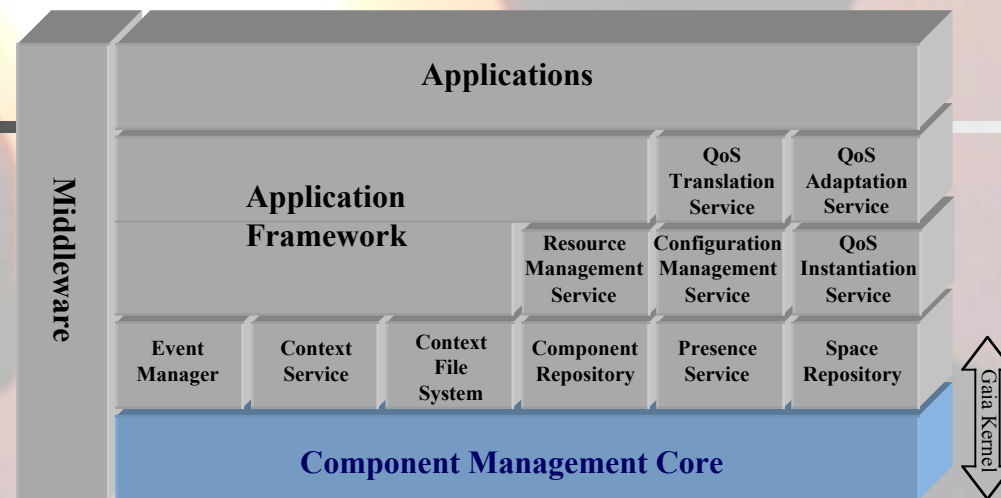


# Gaia Architecture

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# Component Management Core





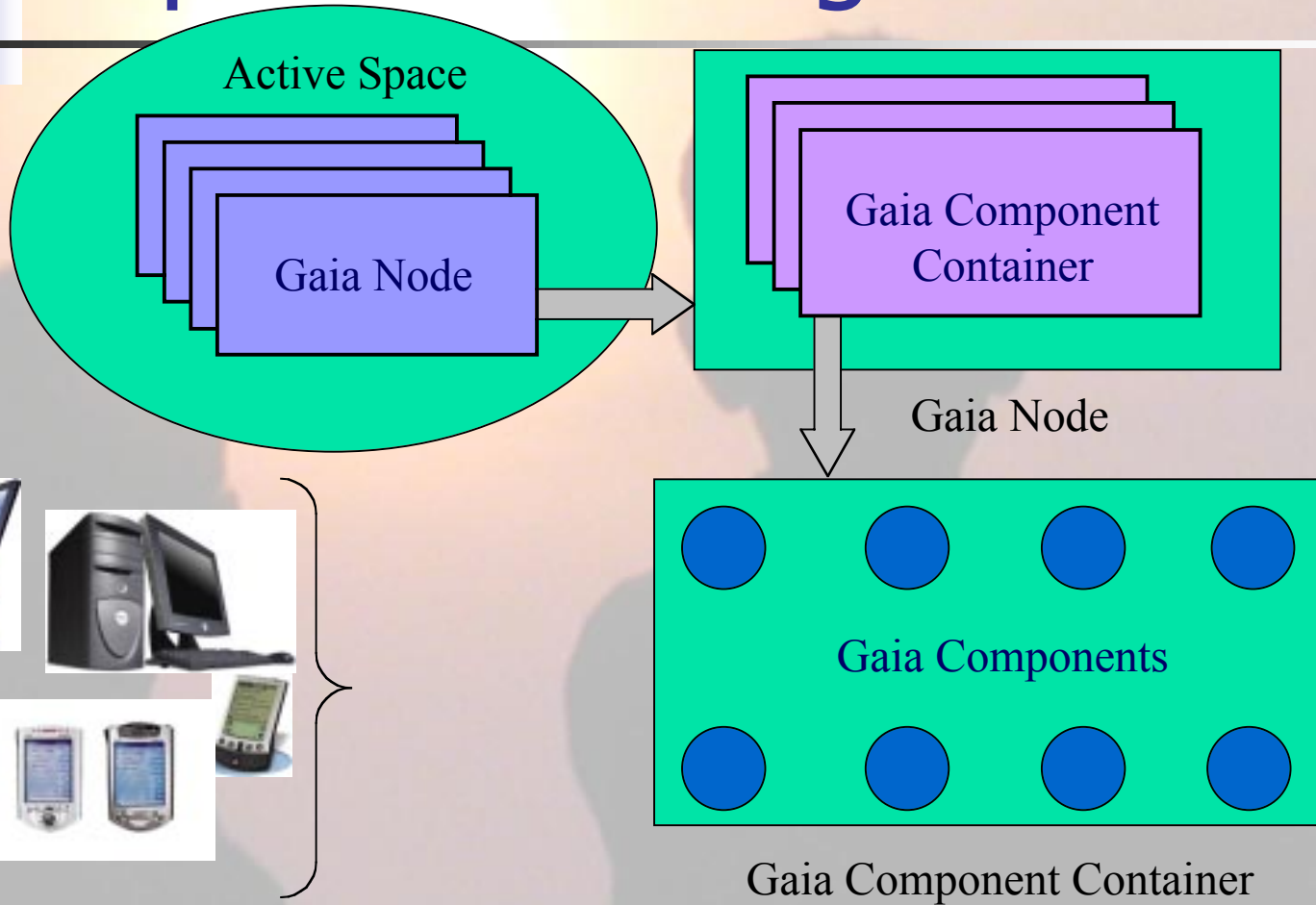


# Component Management Core

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- Provides functionality to manipulate components in Gaia:
  - Creation
  - Destruction
  - Uploading
- Contains three basic abstractions:
  - Components
  - Component Containers
  - Nodes

# Component Management Core



Gaia Node  
Examples

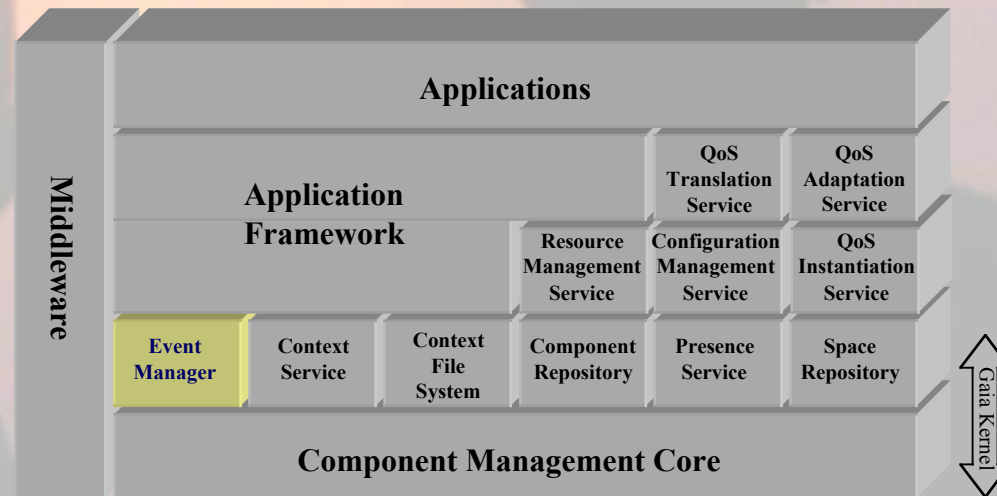


# Device Dependability

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- Lua script boots Active Space using master/alternative configuration files
- Gaia Container registers with repository
- Components in Gaia Containers register with repository
- Keep alive events

# Event Manager



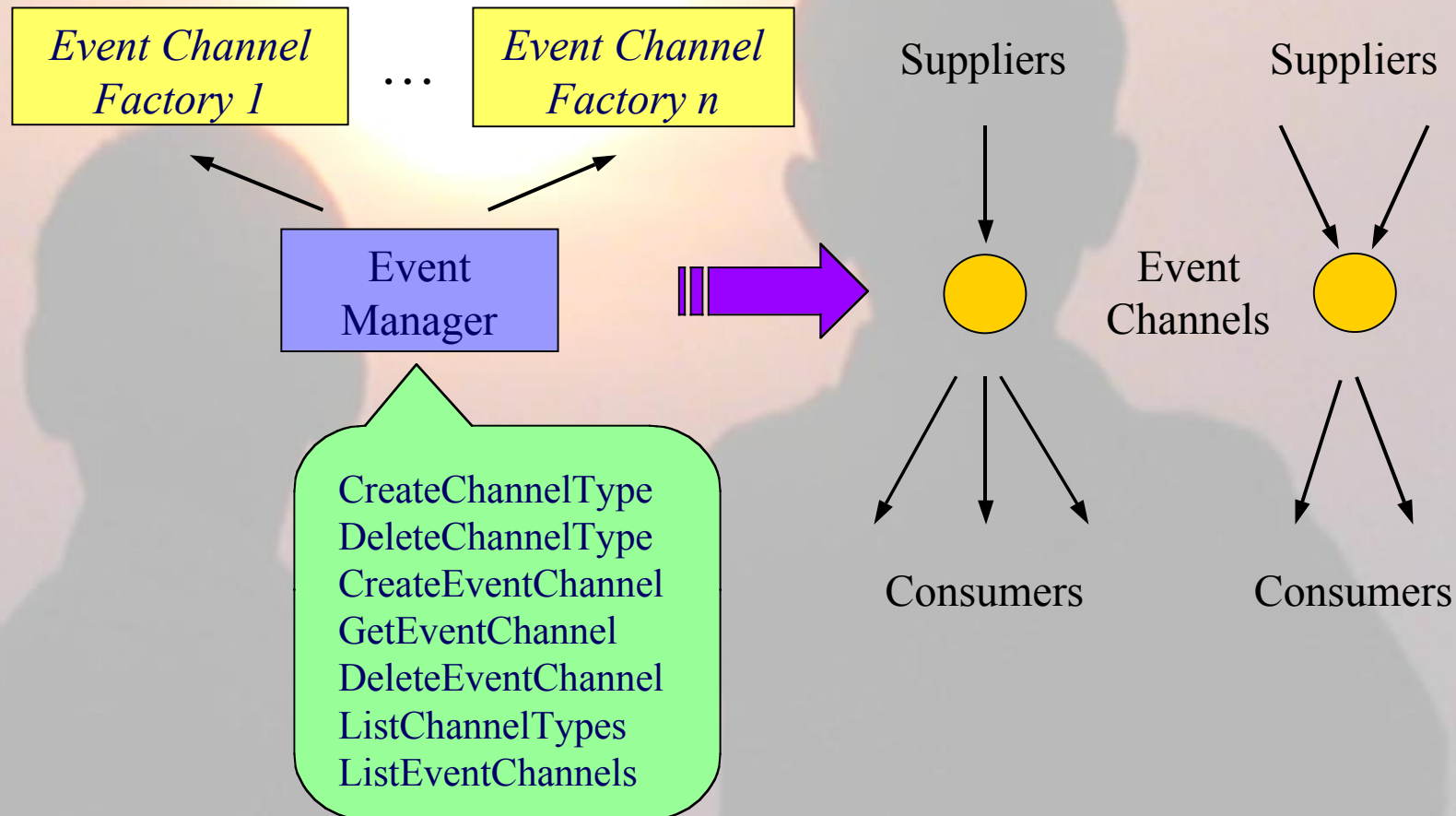


# Event Manager

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- Loosely coupled communication based on channels.
- Supports push, pull, and hybrid mechanisms.
- Supports creation of named event channels and distribution of load.
- Persistent Events, Databases

# Event Manager



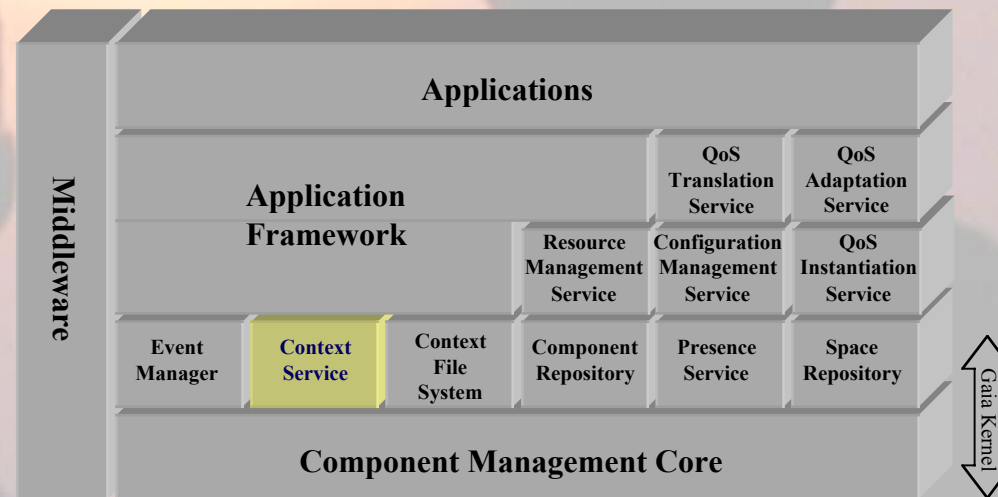


# Dependability Issues

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- Event manager tracks channels
- E manager restarted by script
- E channels run independent of E manager

# Context Service







# Context-Aware Applications

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- Situational information, or context, increases richness of communication in human-computer interaction.
- Makes it possible to produce more useful computational services.
- Example contexts: location, time, weather, stock prices, moods, user activity, ...

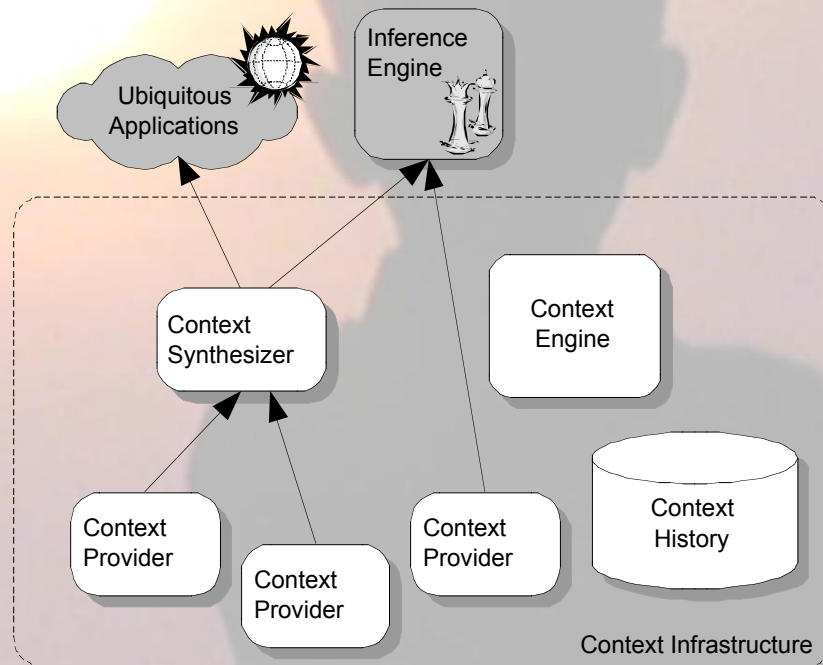


# Context Service

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- Provides a taxonomy and uniform representation of context types.
- Provides an infrastructure to promote design, implementation, and evolution of context-aware applications.
- Ontologies DAML+OIL and Prolog Reasoning Engine.

# Context Infrastructure





# Security and Context

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- ✎  $\forall \text{People } X \text{ Access}(X, \text{Display}) :-$   
*SocialActivity(Room 2401, UbiComp Seminar) \wedge IsPresenter(Ubicomp Seminar, X)*
- if there is a UbiComp Seminar going on in the room, then the presenter has access to the display.

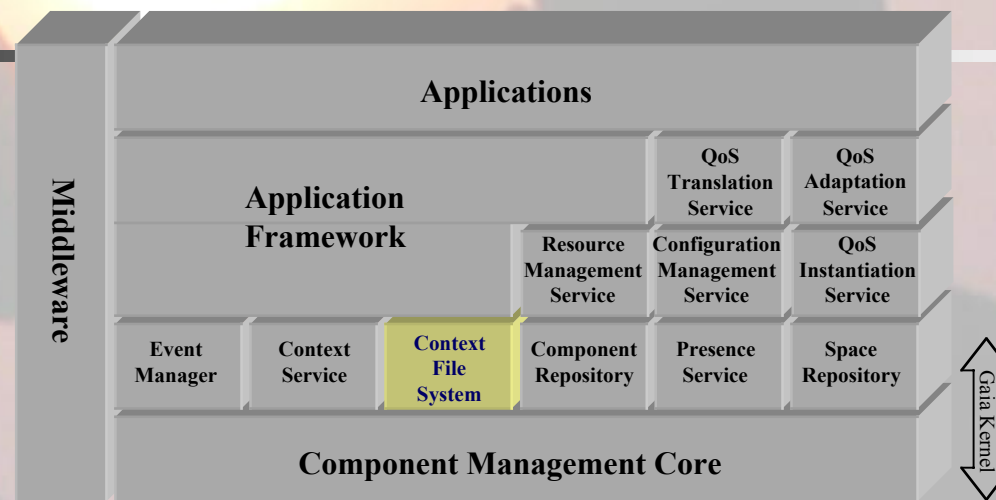


# Dependability Issues

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- Reliability of context providers, consumers, channels
- Context engines can reason about temporal, interval logic and about probabilities. What might be useful in run time models?

# Context File System





# Context File System

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- Data Organization:
  - Context affects data organization.
  - Data important in current context is easily accessible.
  - Can attach context to files and directories.
  - Context: situation, location, space, group, time.
- Data Transformation:
  - Applications open data as desired type – *dynamically typed file system*.
  - System converts data to desired type.



# Dependability Issues

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- Availability
  - Replication
  - Security – Peer to Peer?
- 





# Questions?

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<http://choices.cs.uiuc.edu/gaia>

<http://cairo.cs.uiuc.edu>



# References

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- Manuel Román, Christopher K. Hess, Renato Cerqueira, Anand Ranganathan, Roy H. Campbell, and Klara Nahrstedt, *Gaia: A Middleware Infrastructure to Enable Active Spaces*. In *IEEE Pervasive Computing*, Dec 2002
- Fabio Kon and Fabio Costa and Gordon Blair and Roy H. Campbell, "The Case for Reflective Middleware", *Communications of the ACM*, 2002, V.45, 6; June, pp. 33-38.
- Manuel Roman and Fabio Kon and Roy Campbell, "Reflective Middleware: From Your Desk to Your Hand", *IEEE Distributed Systems Online*, 2001, V. 2, 5, July.