



# **Integrating Handhelds with ACEs: “Leashing” Devices Using a Services-Based Architecture**

**Jeff Eschbach  
Motorola Labs**

**2002 Workshop on Advanced Collaborative Environments**

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- **ACEs**
  - Advanced Collaborative Environments
  - Virtual Space (venue): share content/media, span multiple physical spaces
  - Physical Space (node): traverse virtual spaces as a single unit; interact with other nodes
  - Broadband: multiple streaming audio/video feeds
  - Tethered, resource-rich machines
  - Ex: AG nodes for group-to-group interaction
- **Wireless handhelds**
  - Ubiquitous, especially in scientific community
  - Can support only limited streaming media
  - Mobile, maneuverable, and “personalize” experiences
- **Bring nodes and handhelds together**
  - Integrate to leverage advantages of both
  - Handheld becomes an extension of the node
- **Leashing: integrate handhelds with node**
- **Service architecture: implement leashing**



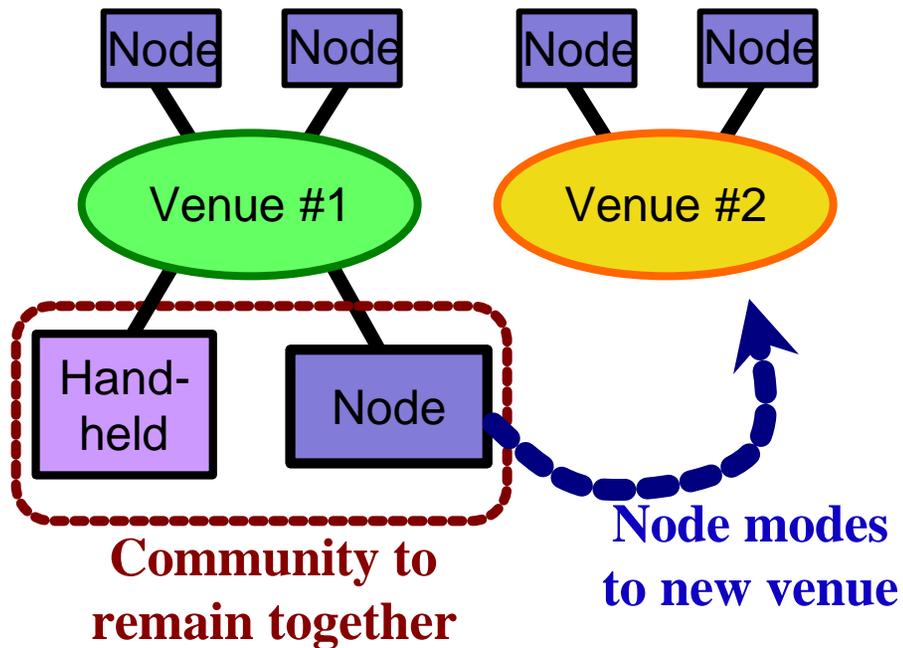
ACE environment:  
Access Grid node at Motorola Labs



Handheld able to send and  
Receive some streaming media

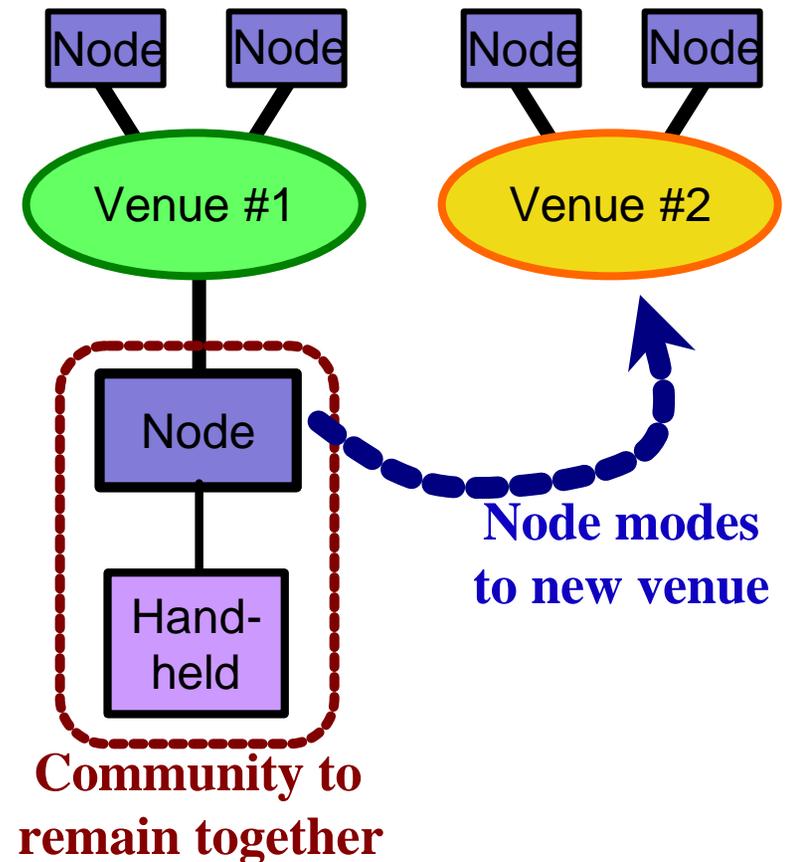
- **Issues with using wireless handhelds with ACEs**
  - Resource-constrained
    - Limited bandwidth, processing power, display area, etc.
  - Unable to replicate fully-functional “stand-alone” nodes
    - Many media streams in group-to-group interactions can overwhelm handheld
  
- **Benefits to associating a handheld *with a specific node***
  - For node
    - Maneuverability, mobility and personalization of user experience
    - Example: Handheld with camera is associated with node
  - For handheld
    - Process of changing venues is made transparent to the handheld
    - Example: Monitoring the “Motorola Labs” node, not a specific venue
  - For user
    - Can participate in meetings while external from node’s room
    - Can request specific feeds/data to be sent to/from handheld

## Handheld associated with venue

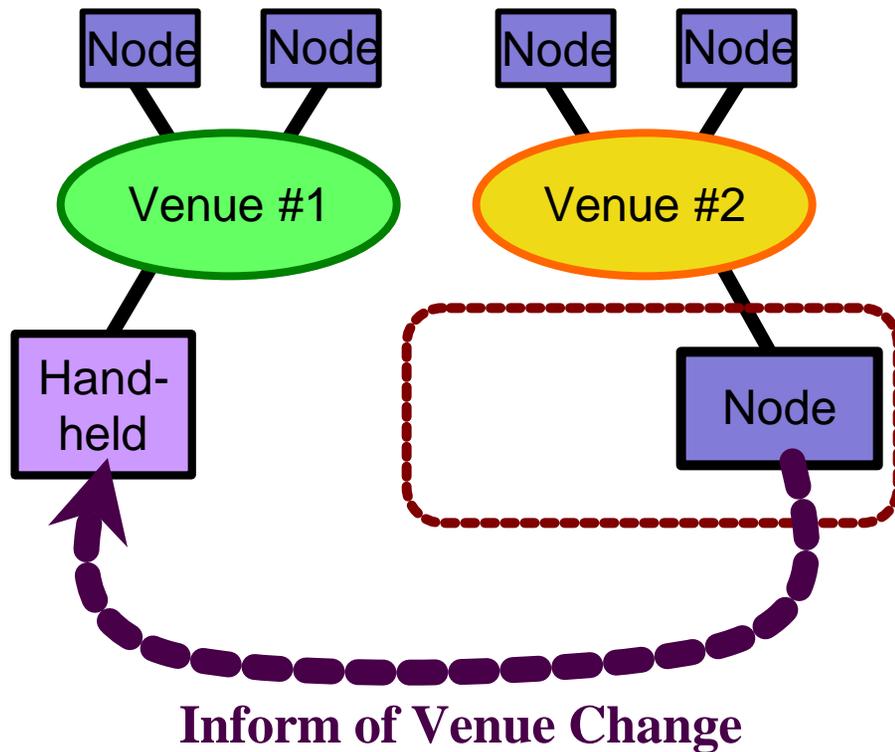


\* Note: animated slide at end of presentation

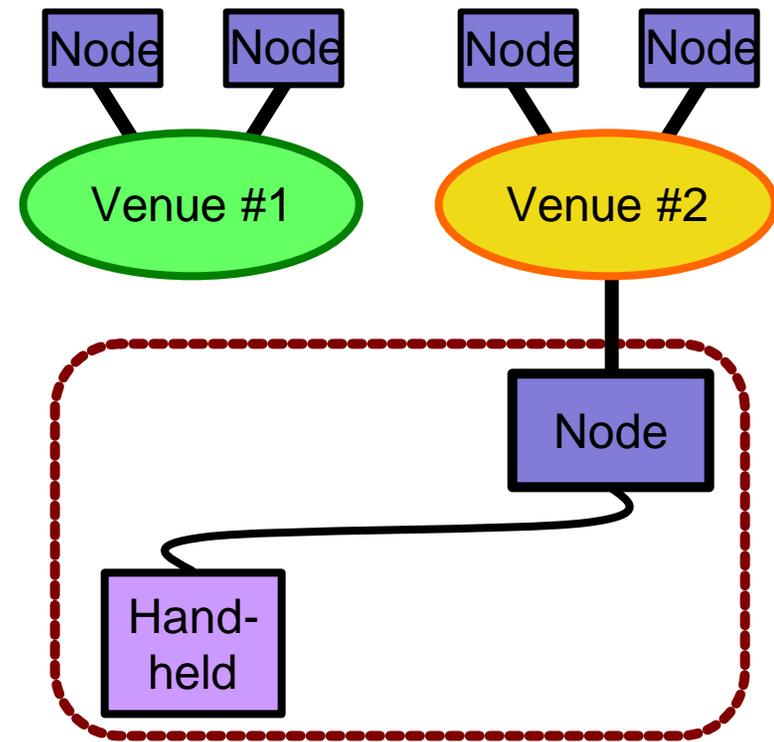
## Handheld associated with node



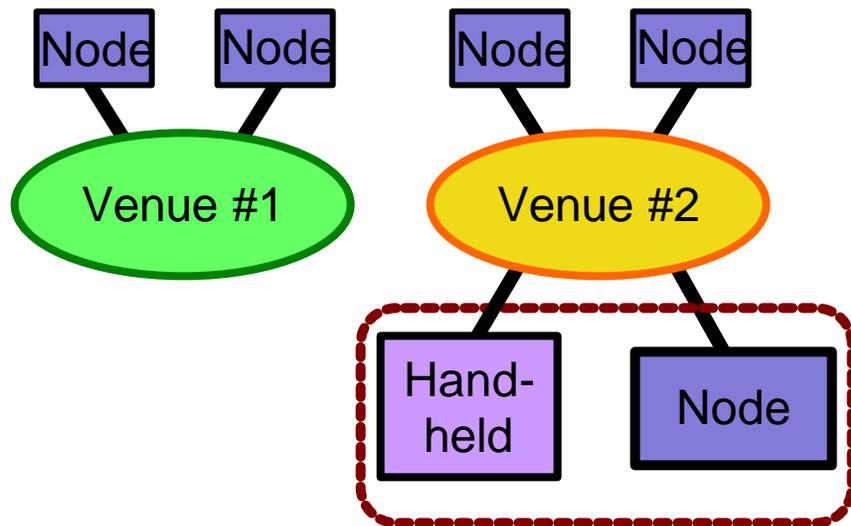
## Handheld associated with venue



## Handheld associated with node

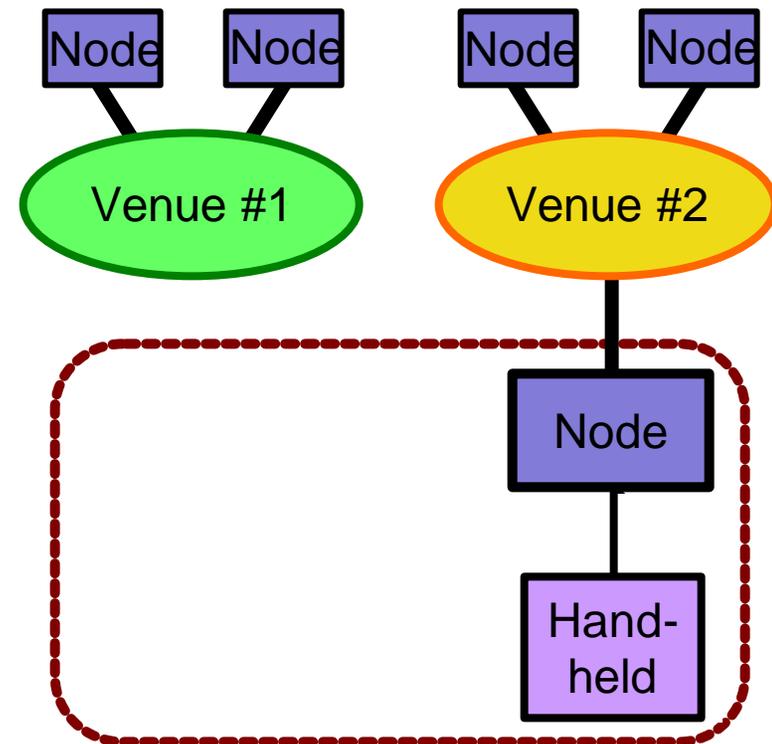


## Handheld associated with venue



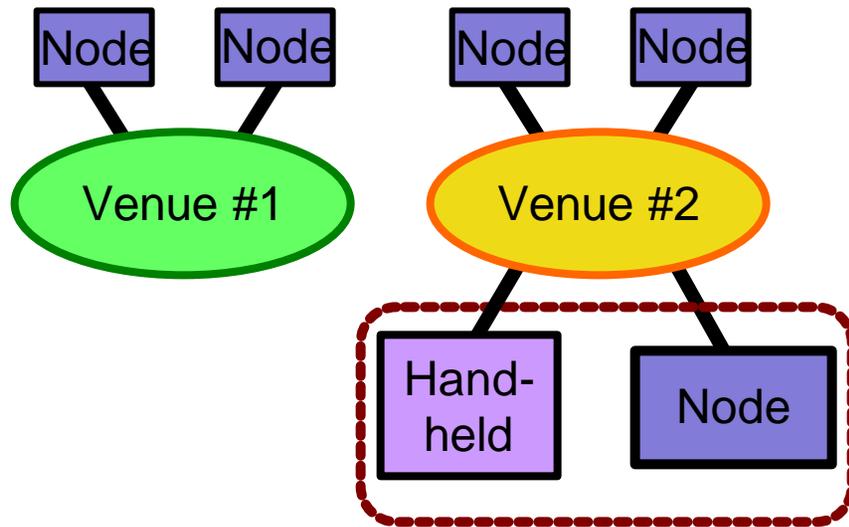
**Venue change  
requires active  
navigation by  
handheld**

## Handheld associated with node

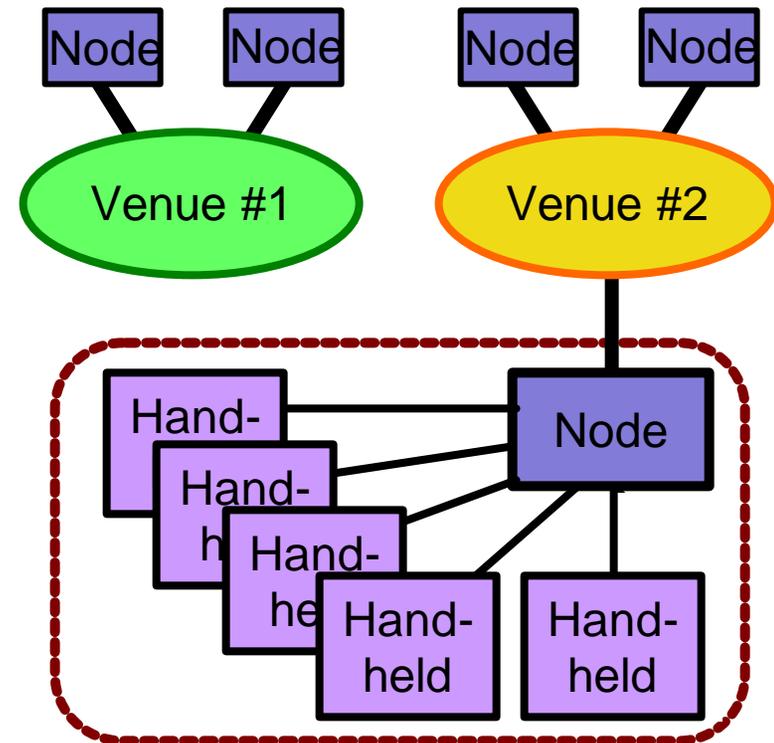


**Venue change transparent  
to handheld**

## Handheld associated with venue



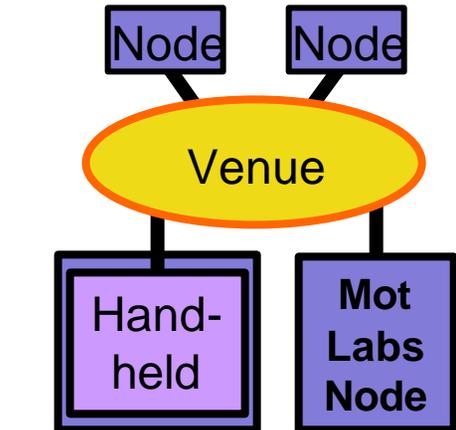
## Handheld associated with node



**Especially important when leashing multiple devices**

- **Self-contained node**

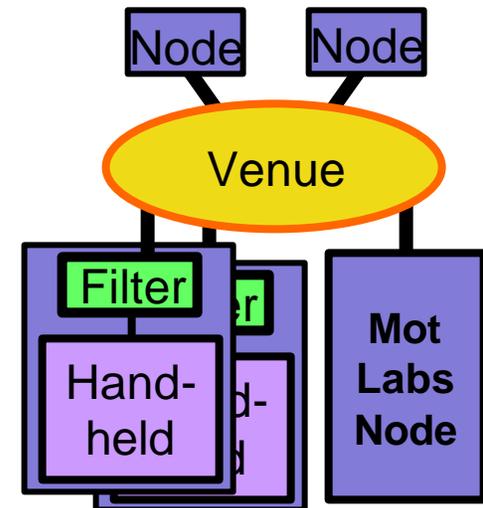
- Port all node capabilities to a handheld device
  - Lacks power, will always lag *advanced* collaborative environments
  - Inherently less hardware (cameras, video area)
- Handheld not associated w/ existing node; not address “single-community” scenario



Self-contained model

- **Filter/proxy**

- Handheld navigates venues, gets filtered content
- Handheld not associated w/ existing node; not address “single-community” scenario
  - Addresses a different problem
  - Initial solution to “overwhelming media” problem
- Access-Grid-to-Go at UIC



Filter/proxy model

- **Leashing...**

- **Mechanism to integrate handheld with nodes**

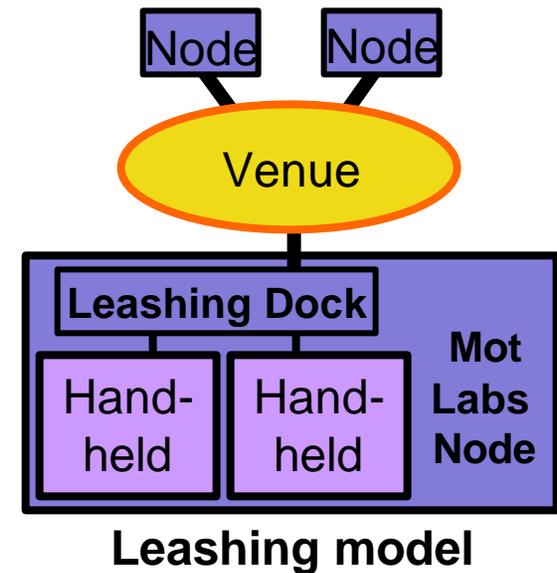
- *Associate* with node
- *Maintain* handheld in node's context while traversing virtual spaces
- *Regulate* flow of media streams

- **Dock**

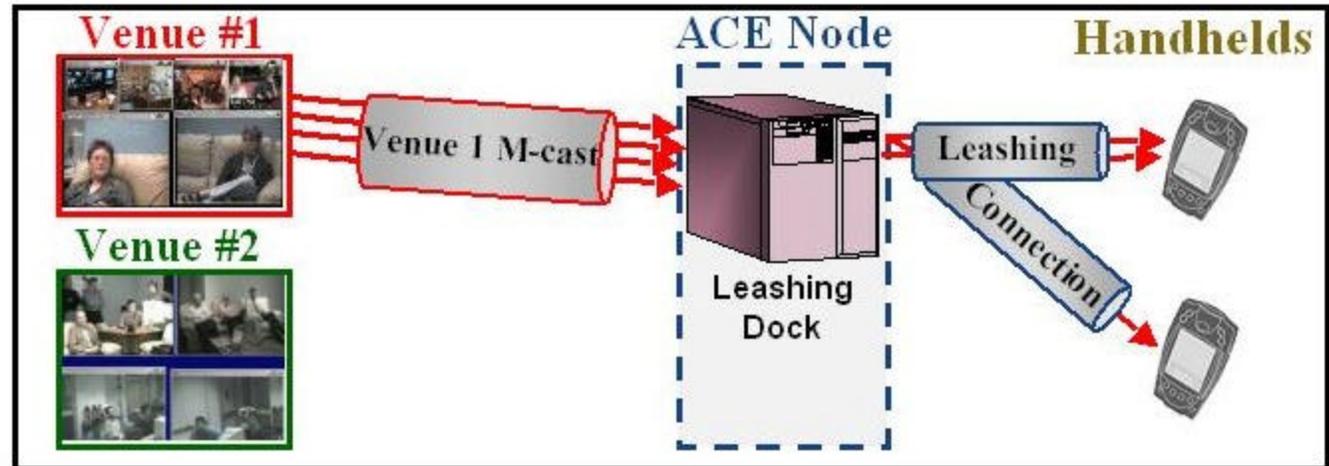
- Integrated as a component of the node
- Automatically moves w/ node through virtual spaces (e.g., joins correct m-cast addresses)
- Handheld associates with the dock for a given node
- Receives all media for the room, provides appropriate subset to associated handhelds (e.g., all audio, one video feed)
- Receives media from handheld, includes it in the venue

- **Towing**

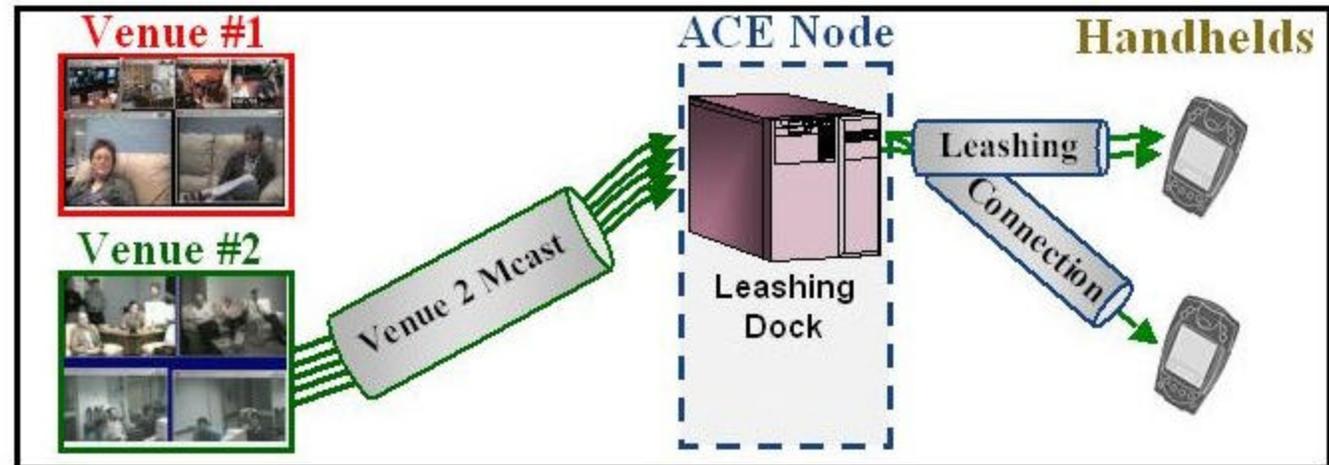
- Devices receive subset of media from dock (node)
- Handheld “towed” through virtual spaces with the dock (node)



- Handhelds associated w/ node (dock) via leashing connection
- Node joins venue #1
- Dock receives all venue feeds via multicast
- Dock forwards subset of feeds via leashing connection



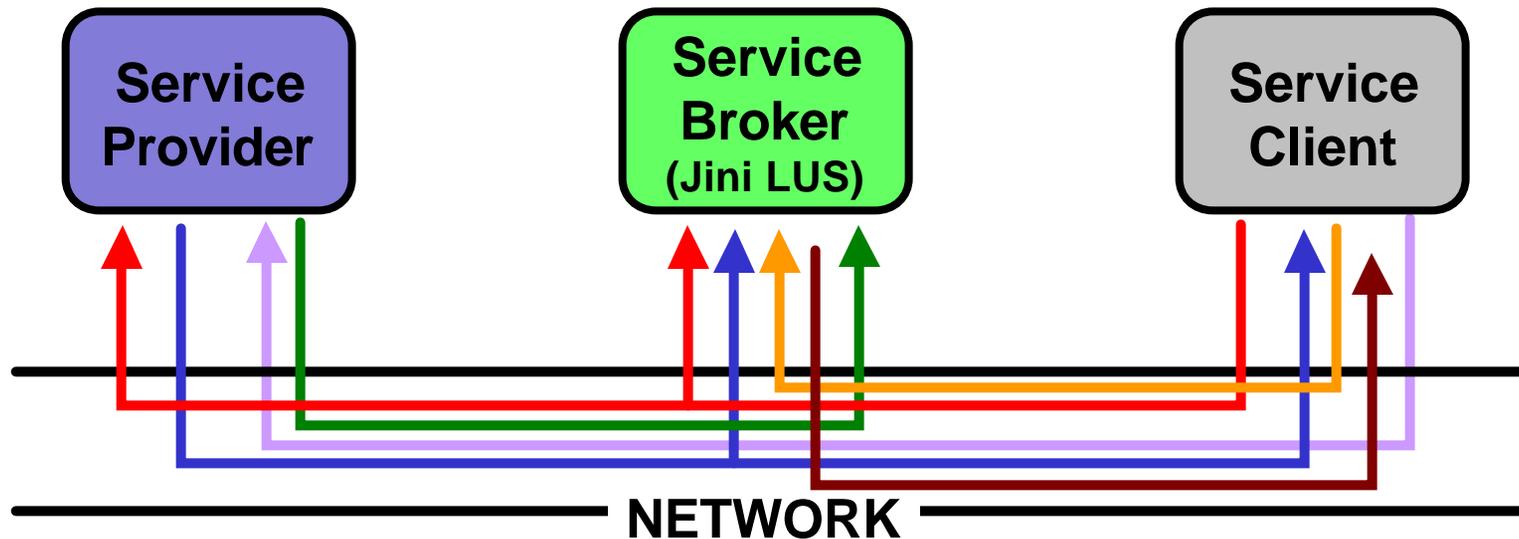
- Node joins venue #2
- Dock receives new venue feeds via new multicast address
- Dock forwards subset of new feeds via leashing connection
- Venue change transparent to leashed handhelds



- Leashing connection
  - Establish and maintain
  - Multicast or multiple unicast
  - Transparency to other nodes
    - Merging outbound audio
    - Include handhelds' video feeds
  - Routing: packet header modifications
- Different device capabilities
  - Different feed(s) to different handhelds
  - Adapting to dynamic resources
- Feed selection criteria
  - When send audio to handhelds
  - Which video feed(s) to send
    - Fixed vs. dynamic
    - Rank/prioritize video feeds
    - Feed in “focus”: base on audio, motion, priority
- **Standardized interface: different dock implementations**
- **Platform heterogeneity: multiple OS's**
- **Extensibility: other applications for handheld w/ nodes**

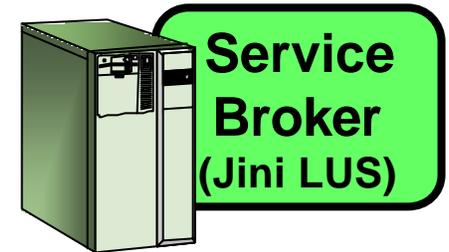
- Service architectures
  - Represent components and applications as services
  - Extensible: service definition, service advertisement, service discovery
- Service architecture within a node
  - Private/local area network; control over environment
  - Web services possible, but typically for WAN
  - Jini
    - Java based: platform heterogeneity
    - Other advantages: maturity, less complexity, network plug-n-play
- Implement leashing dock as a service
  - Common interface: enables different dock implementations
  - Devices can discover leashing mechanisms across multiple nodes

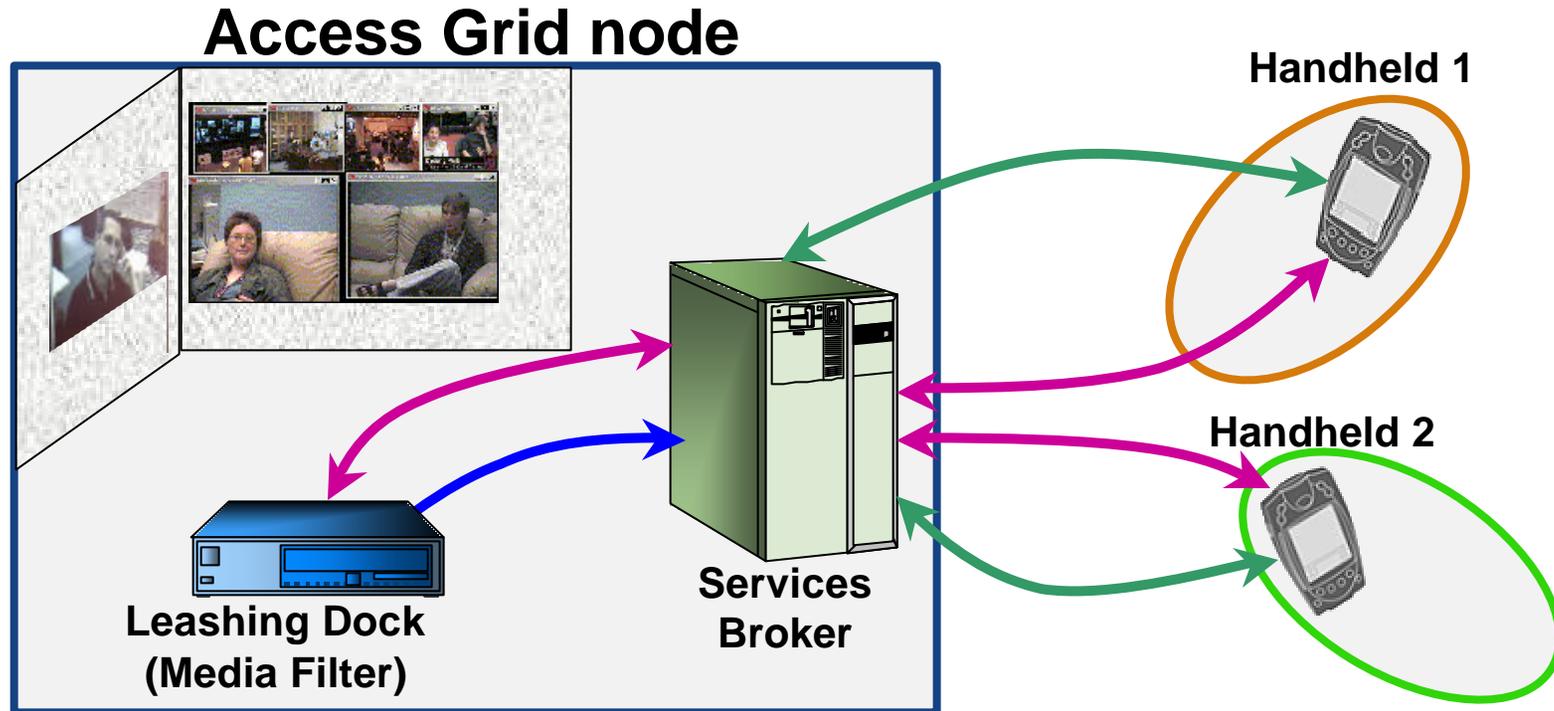
- 1) Setup: service definition  
(service interface & service attributes)
- 2) Discover/locate broker
- 3) Service advertisement:  
register service item
- 4) Discover/locate broker
- 5) Look up a service
- 6) Download service item
- 7) Use service



\* Note: animated slide  
at end of presentation

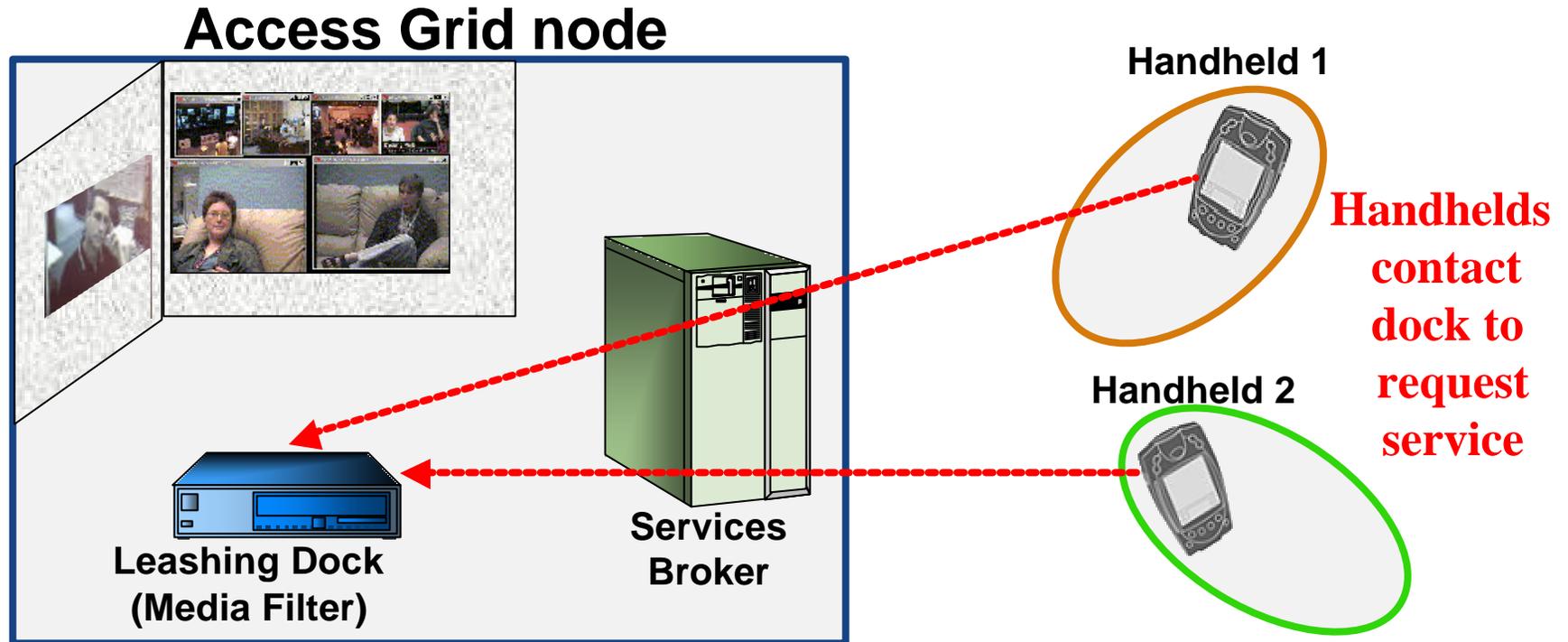
- Service broker
  - Allows service registry, listing, and lookup
  - Mediator: provides information/stub code for service
- Service provider: leashing dock
  - Provide streams to leashed devices
  - Discover broker
  - Registers service with broker
- Service clients: wireless handhelds
  - Discover broker
  - Lookup leashing service from broker



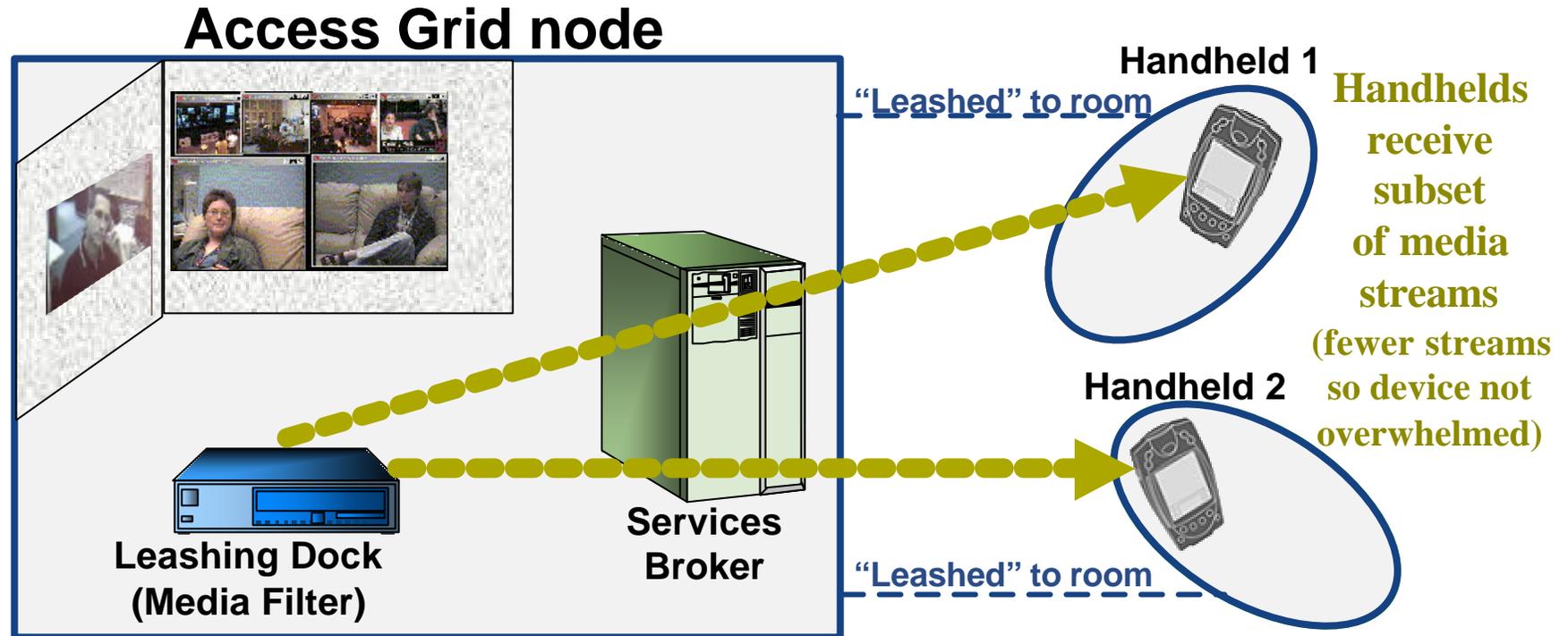


-  = Locate services broker
-  = Register handheld "leashing" service with the broker
-  = Look up services on broker; discover dock for leashing service
-  = 3 separate physical spaces (defined by a different colors)

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-  = All 3 spaces together now constitute a single "node"

- Standardize interfaces
  - Choice of model: Jini vs. web services
  - Core and optional methods
- Integration with venue-level services architectures
- Services beyond leashing for handhelds
  - Chat between devices
  - Language translation
    - Speech to text
    - Speech to text in new language
    - Speech to speech translation to new language with headphones
  - Extensible... many other ideas

- Services Architecture...
  - Jini implementation within node
- Filter...
  - Build upon initial concept for nodes @ UIC
- Associate...
  - Integrate filter w/ node as event listener
- Feed selection...
  - “Focus” via audio/video detection and priorities
  - Work with Tokyo Institute of Technology and Motorola Labs User Centered Research
- Leashed devices...
  - Linux iPAQs
  - Motorola handhelds

- **Leashing:**
  - merge node and handheld capabilities**
- **Node-based service architecture:**
  - extensible means to implement leashing**
- **Contacts**
  - **Jeff Eschbach:** [eschbach@labs.mot.com](mailto:eschbach@labs.mot.com)
  - **Nitya Narasimhan:** [nitya@labs.mot.com](mailto:nitya@labs.mot.com)
  - **Kabe Vander Baan:** [kabev@labs.mot.com](mailto:kabev@labs.mot.com)
- **Thanks!**

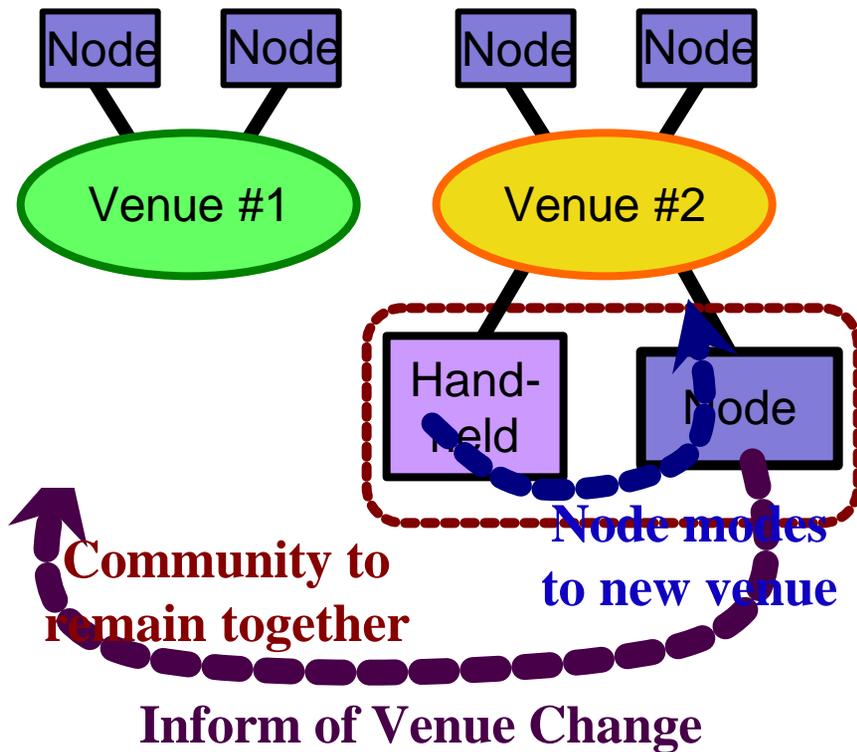


**WACE  
2002**

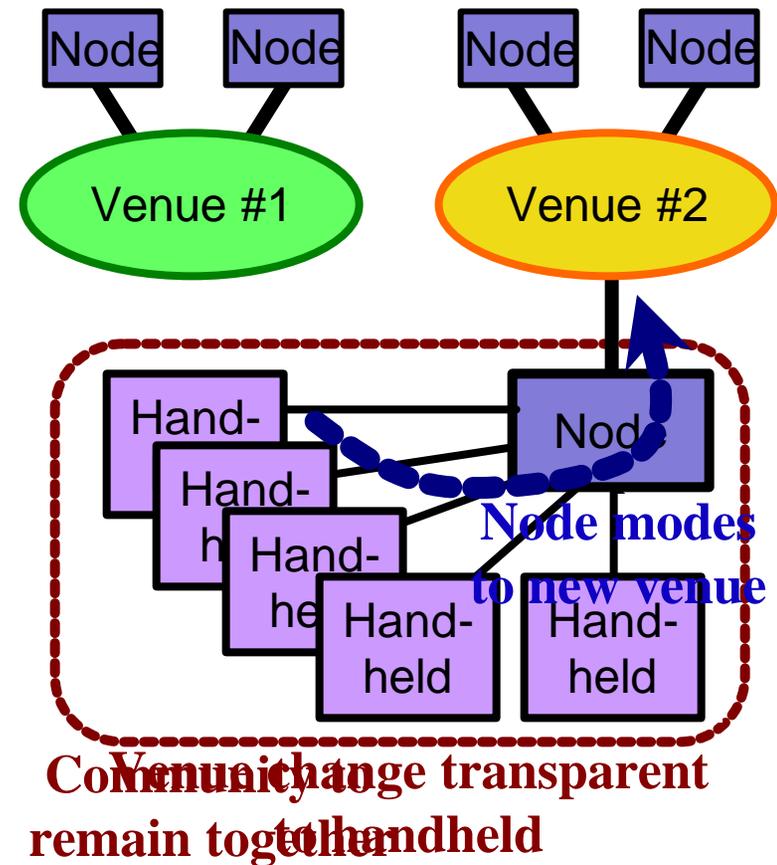
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**Following:  
animation versions for  
slides 4-7, slide 13,  
& slides 15-17**

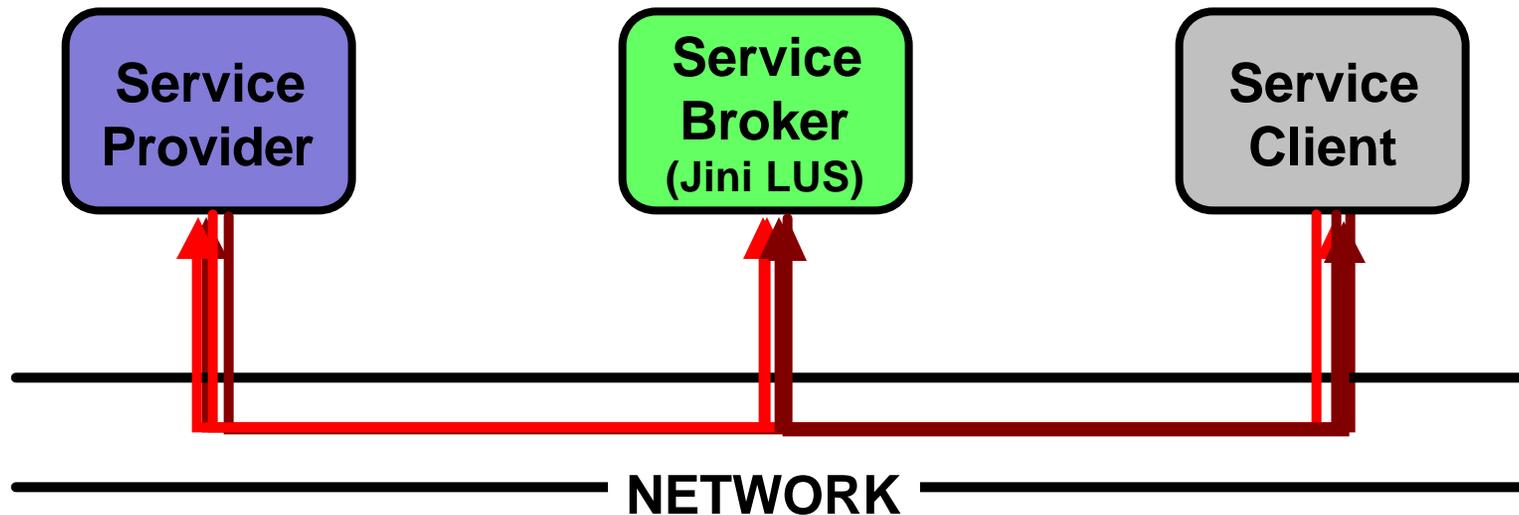
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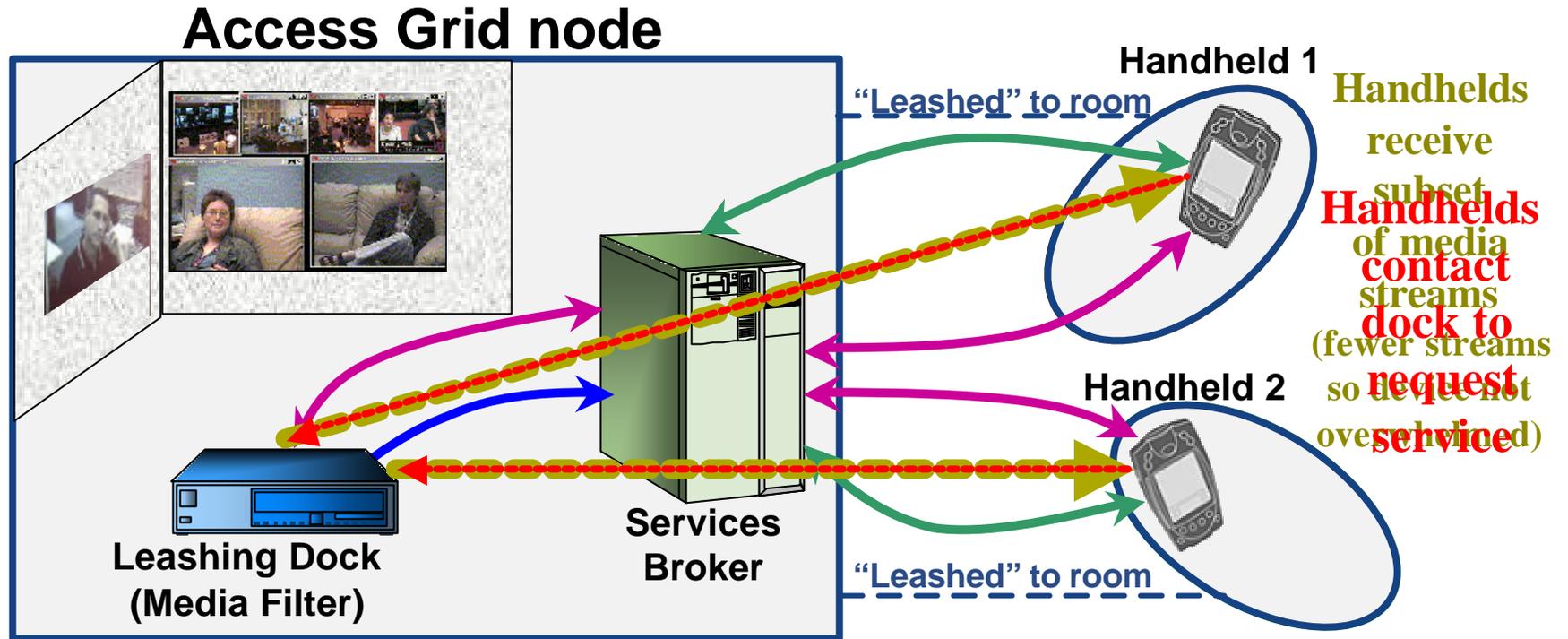


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Handhelds follow AG node through virtual spaces