MONASH University
Information Technology

Robin Kirk and Jan Newmarch
4th January 2005

A Location-Aware, Service-Based Audio System

Outline

- **Background and motivation**
- **Research questions**
- **Service-based audio architecture**
- **Context-aware computing**
- **Location tracking systems**
- **Location-aware audio**
- **Conclusion and future research**

Background and motivation

- **Most audio architectures are based on a local model**
  - Java Media Framework (JMF)
  - Microsoft Direct Show
    > Not designed for network enabled devices
- **Networked multimedia architectures**
  - HAVI
    > Firewire specific
  - Networked Multimedia Middleware (NMM)
    > Does not support dynamic discovery or partial failure

Background and motivation

- **Current audio systems are not designed to handle situational change**
  - Doorbell or phone rings
  - User picks up the phone to make a call
  - User leaves the room
  - Another user enters the room who dislikes country music

Research Questions

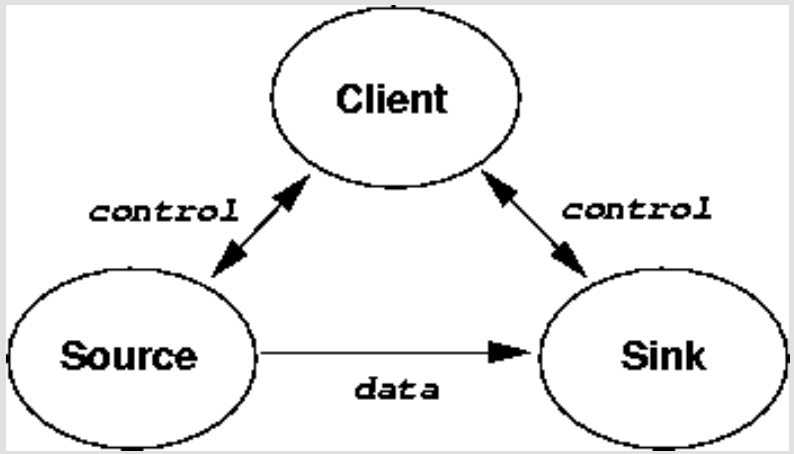
- **What is the best method of connecting audio sources to output devices where multiple formats and protocols are used?**
- **How to design an audio system that can handle situational change?**

Service-based Audio Architecture

- **Facilitates the advertisement, discovery and connectivity of audio with output devices**

Service-based Audio Architecture

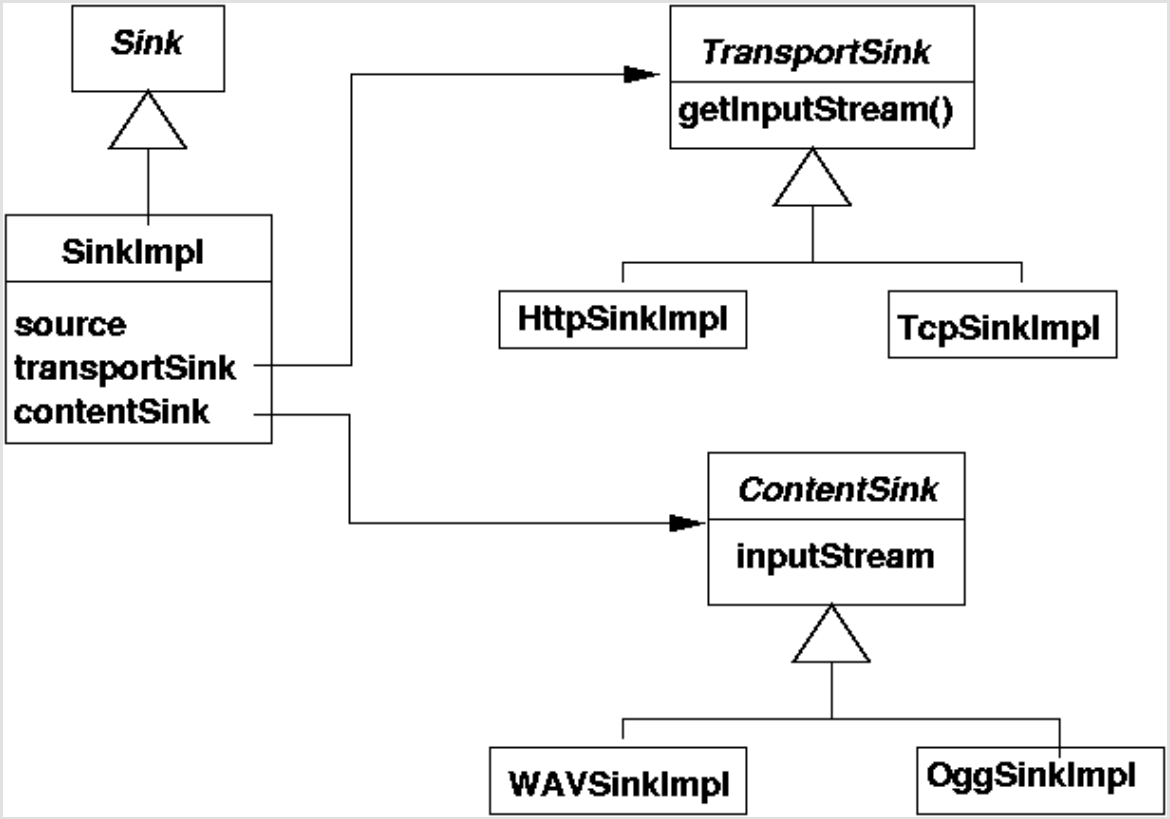
- **Three components at the most abstract level**
  - Audio sources
  - Audio sinks
  - Controller clients
- does not address any incompatibility issues between services



Service-based Audio Architecture

- **Compatibility issues**
  - Many audio formats
  - Many networking protocols
  - May push or pull data
- **Content Interfaces**
  - Placeholders for different formats
  - New formats are easily added later
- **Transport Interfaces**
  - Transport Sources expose an InputStream (pull)
  - Transport Sinks expose an OutputStream (push)

Service-based Audio Architecture



Service-based Audio Architecture

- **Uses Jini for service management**
  - Jini supplies a service advertisement and lookup registry
  - It has inbuilt reflection
  - It has an event model
  - It supplies a resilient failure mechanism
  - It can bridge to other middleware systems
  - It can handle "legacy" devices through a surrogate model or through Java JNI

Context-aware Computing

- **Context, a definition**
  - "Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves"

    Dey, Abowd "Toward a better understanding of Context and Context-Awareness"**Georgia Institute of Technology, GVU Technical Report GIT-GVU-99-22.**

Context-aware Computing

- **Context-aware applications can adapt to changes in an environment**
  - Movement of people or audio devices
  - Ambient noise levels
  - Device event notification
  - User current task and preferences

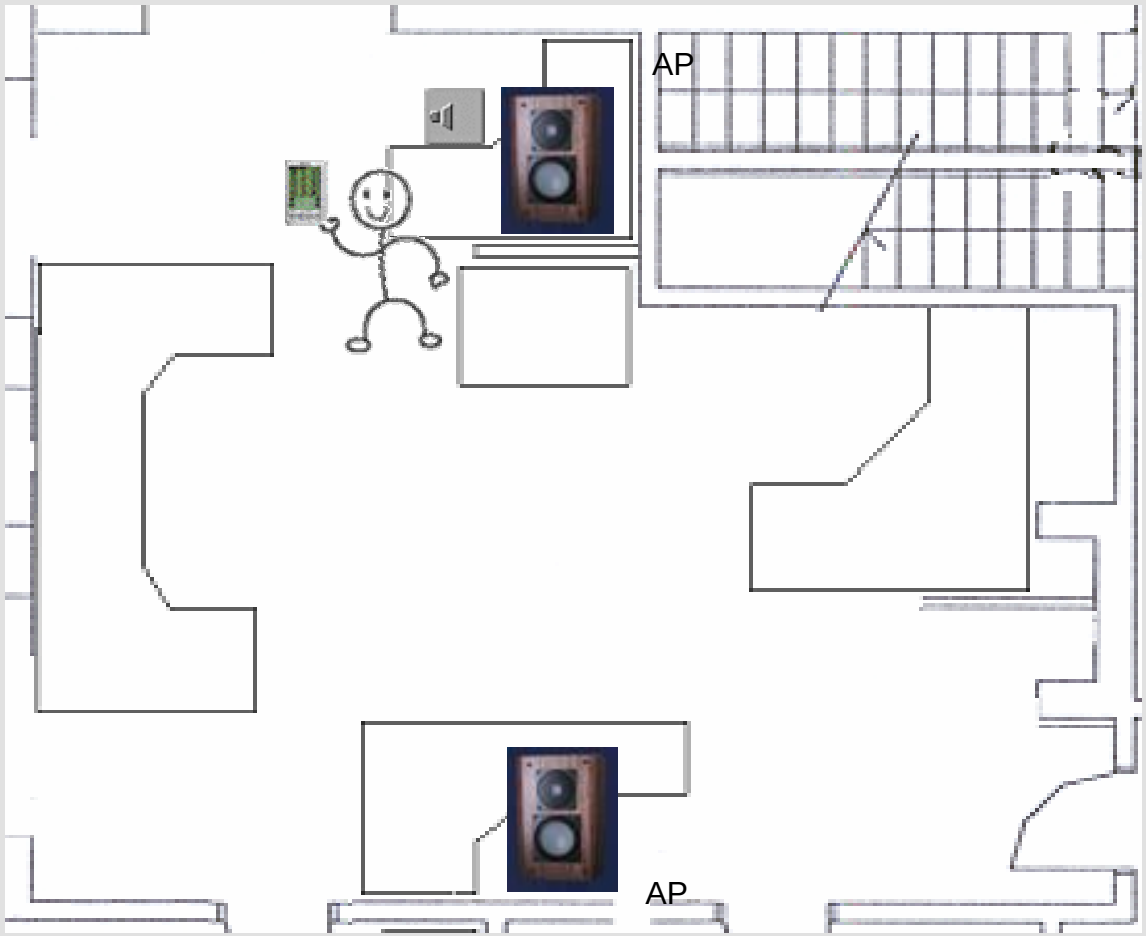
Determining Indoor Location

- **Four main techniques**
  - Infra-red
    - > Active Badges
  - Proximity
    - > Smart Floor
  - Ultrasonic
    - > Active Bats
  - Radio-Frequency
    - > Ekahau
    - > AeroScout

Location-aware Audio

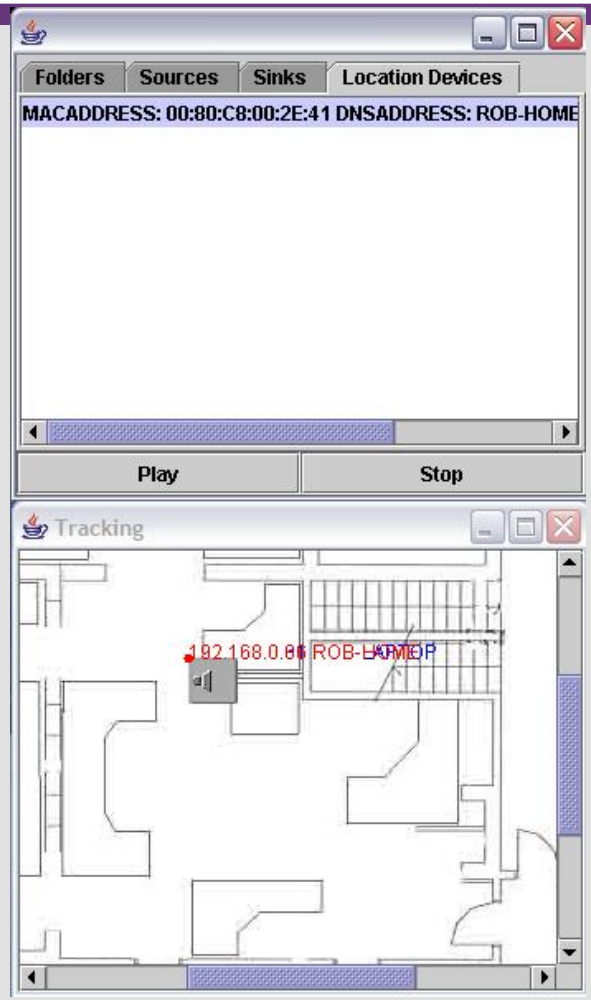
- **“Follow me” audio**
  - Begins playing audio to the nearest sink to the tracked device
  - Periodically checks the active sink is closest, if not, the audio is played at the new closest sink
    - > User or sink may have moved

Location-aware Audio



Location-aware Audio

- **Client**
  - Choose songs
  - Select sinks
  - Select tracked device that will be carried around



Location-aware Audio

- **Source/Sink**
  - Push over TCP/IP
    - > Sink exposes output stream
    - > Source reads from file and writes to output stream
  - Supports WAV, MP3, OGG, AU
    - > Uses Tritonus plug-ins

Conclusions and Future Work

- **Location system problems**
  - 5 second delay in location system
  - 2 metre error
    - > Need more access points
- **Extensions**
  - Location-based volume adjustment
  - Ambient noise level volume adjustment
  - Integration with smart devices
  - User preference system

Questions….

- **jan.newmarch@infotech.monash.edu.au**
- **robin.kirk@infotech.monash.edu.au**