Ambient Human-to-Human Communication

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The long call

- Increasing energy prices
  - Environmental and security concerns
- Extended capabilities
  - Video conferencing
  - Broadband communication
- Reduced telephone costs
  - VOIP
  - Effectively free call
- Experience of connectedness
  - Calls over 3 hours

OUTLINE

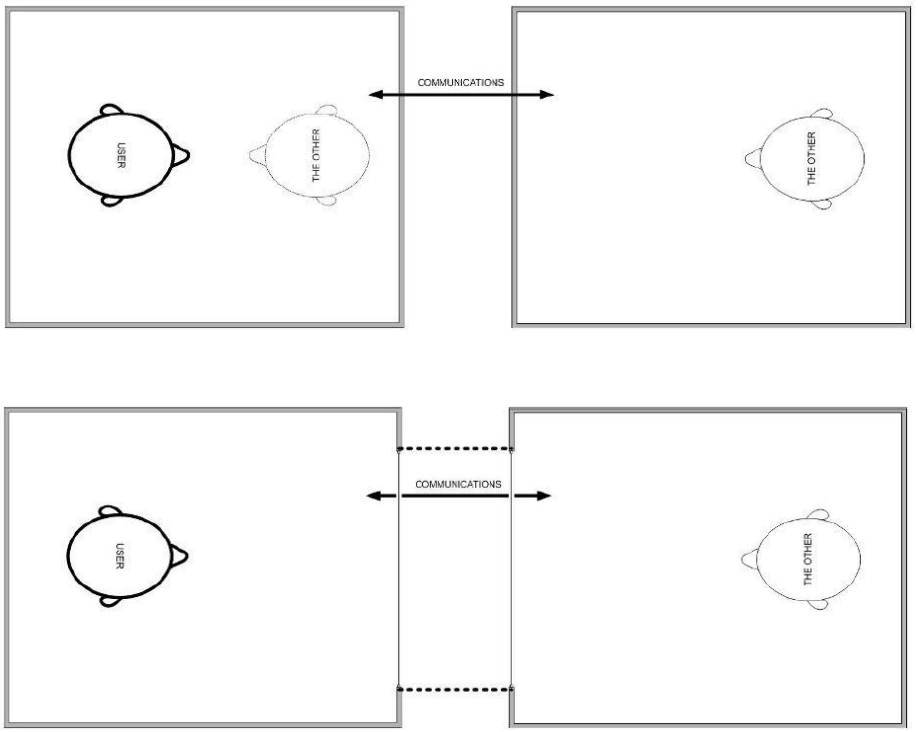
- Issues with Current technologies
- Desired Effect
- Ambient speech
  - Architecture
  - Spatial Speech Reproduction
  - Control of Interpersonal Distance
- Location Tracking
- Calibration and Configuration
- Ambient Visual Representations
- Conclusions

Issues with the current technologies

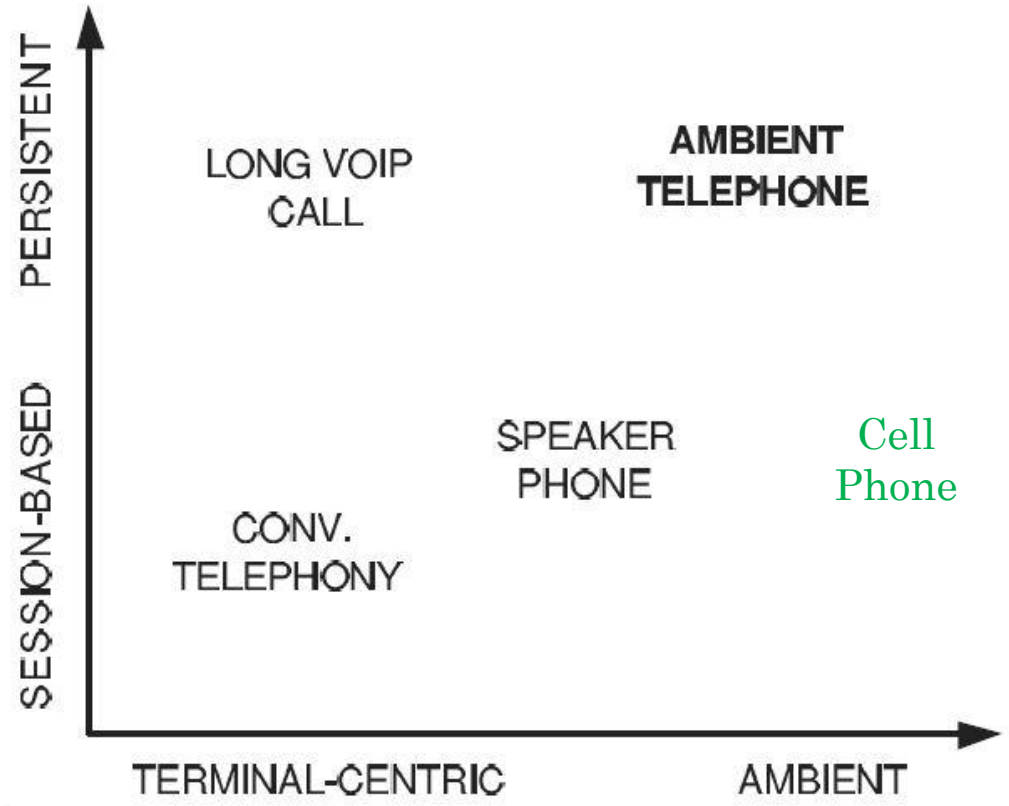
- Terminal devices (video conferencing, VOIP call)
  - Unavailable for other tasks
  - Fatigue on long call
- Worn Devices (Bluetooth earpiece)
  - Inconvenient for long term use
  - Battery
  - Wear and tear
- Interpersonal Distance

Desired Effect

- Social Presence
  - "The other being here"
- Mixed Reality
  - Augmented Reality
    - Synthetic Objects
  - Augmented Virtuality



CURRENT TECHNOLOGIES



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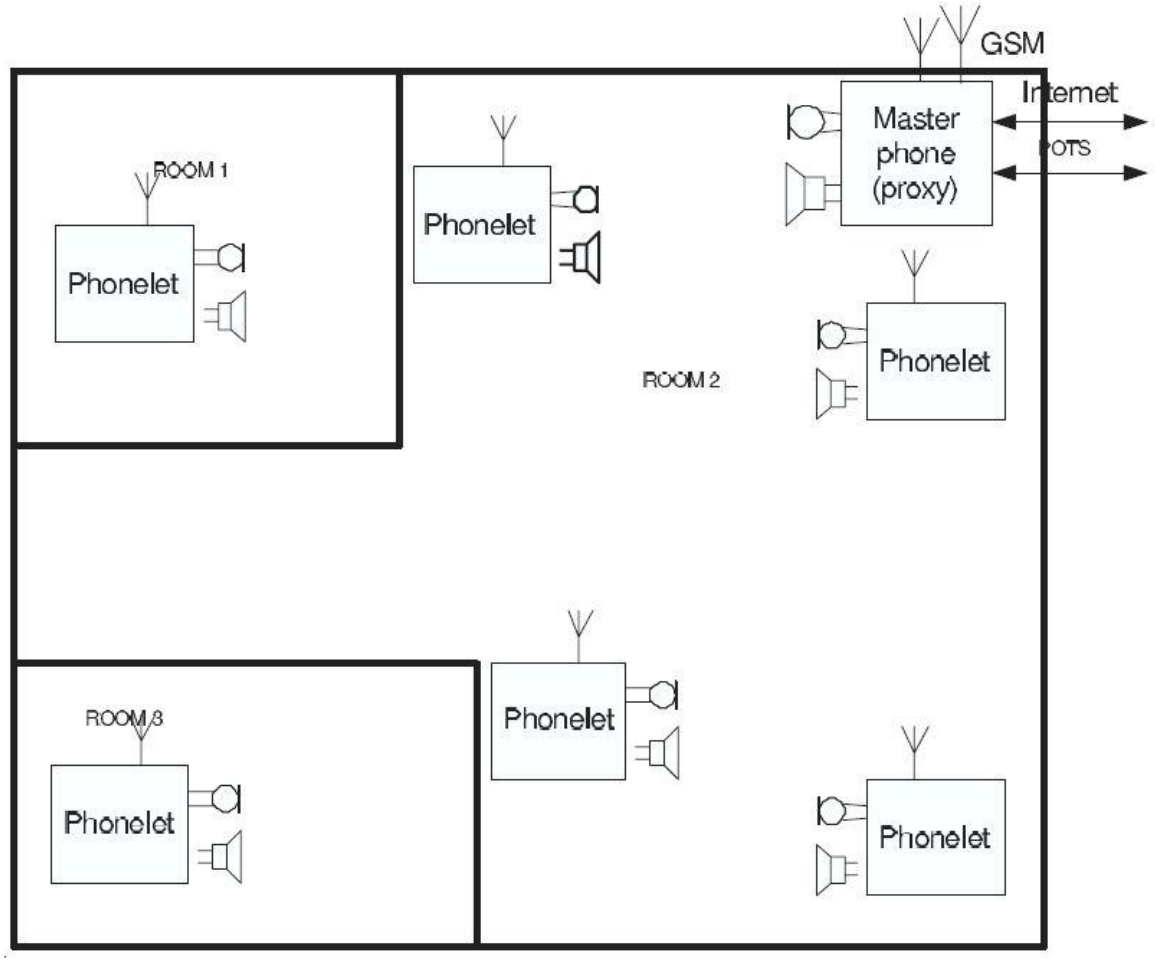
Architecture



Spatial speech reproduction

- Challenge – create a positioned sound in a large area
- Follow me Effect
  - All speakers play the same sound
    - +sounds like the remote person is walking with you
    - -both ends of speaker array is noisy
    - -disturb others that are not engaged in the conversation
  - Only play from the nearest speaker
    - +localized sound
    - -sound jump from one speaker to the next one
  - Second source
    - +low complexity
    - +localized
    - -minimum distance is the nearest loud speaker

Control of the interpersonal distance

- Involved parameters
  - Intensity of sound
  - Ratio between direct and reverberated intensity
  - Others
    - Head scattering
    - Interaural level difference
    - Interaural time delay
- Techniques to create a virtual sound
  - Audio Spotlight
  - Directional loudspeakers with surround audio system

Location tracking

- Important for accurate ambient voice
- Identification is necessary
- Methods
  - Triangular
    - Needs beacon (receiver or transmitter)
  - Proximity
    - Needs beacon
  - Scene Analysis
    - Beaconless
    - Identification is hard

Calibration and configuration

- Geometry of the space needs to be calculated
- Radio signal techniques (device location)
  - WLAN and DECT systems are not accurate enough
  - Ultra-Wideband (UWB) is more accurate
- Audio/Visual technologies
  - Sound and light behavior is different from radio waves
  - Sensor Array
    - +offline calibration
    - -need to be recalibrated after adding or moving each component
  - Continuous Adaptation (high order FIR filter)
    - +no initial setup
    - -initial quality would be low
    - +through the training process quality improves

Ambient visual representations

- Technologies
  - Multi-Display
    - Display in each room
    - Call migrates from each display according to user movements
    - Already supported by middleware
    - Intelligent power
  - Video Projection
  - Pixelated Light Technologies

Conclusions

- Chapter is an overview
  - Current technologies
  - Ideas for further improvements
- Focused on single user
- VOIP on mobile devices
- Security and Privacy
- Disembodied Voice

Thank you

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