



Talking Assistant

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TA: Features and Use

- Target: hands-free & eyes-free mobile operation
 - Terminal devices today
 - are mostly hands & eyes, little mouth & ears
 - paradox: cell phone sizes grow ↔ voice technology improves
 - local processing & storage: independent & flexible
 - location tracking: #1 context awareness covered
 - personalization & networking: use ambient computers „around“
- TA features & integrates FOUR categories of audio applications:
- speech/audio I/O → Software (/HW) UIs, context-aware info (‘go left’)
 - audio notification/alert (‘Dow falling, NYSE closes in 20min.’)
 - audio streams, including (e.g., VoIP) conversation
 - personalized radio (e.g., as ambient corporate info)

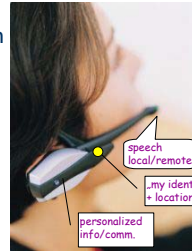


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Vision of generations 1,2,3

- G1: Applications
 - Museum, tour & exhibition guide
 - The classical LBS application
 - Hands & eyes free mobile work
 - Augmented chem./pharma/... lab
 - To support application areas where desktops and PDAs are unsuitable
 - Voice-based interaction, optionally wall displays & head-up displays
 - Lecture Support
 - Use TA as radio microphone
 - Tracking is used to control camera recording the lecturer
 - Research in ubiquitous nomadic computing: MUNDO
 - ME: Single permanently personalized device for trust establishment & bootstrapping communication
 - Research in augmented office & home appliance automation
- G2: Earplug size: “from research to market”
 - Industry could productize in 1-2 yrs.
- G3: Invisible: for public use „outside home“
 - timeline: some 5-8 years out



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Hardware

- Headset (V2)
 - Audio I/O
 - MP3-Decoder
- Networking
 - Bluetooth
- Sensors/Actuators
 - Electronic Compass (heading)
 - Acceleration sensor
 - static: tilt (pitch & roll)
 - dynamic: gestures, picking, silent commands
 - IR receiver
 - Detects signals from beacons in the environment
 - IR emitters
 - Tracking based on stereo vision



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Positioning System: IRIS-LPS

- Location is #1 context information
 - Many other physical/situative properties depend on location
 - Indoor location system for
 - Office environments
 - Lecture halls
 - Exhibitions, Mobile Work



- Components
 - Active IR emitting tags (with μC)
 - Two USB cameras & PC

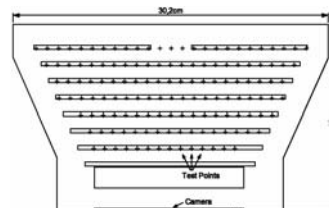
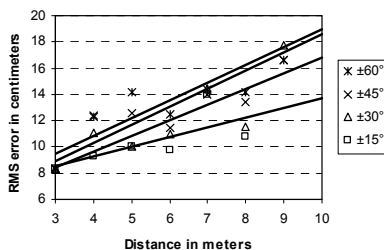
- IR-based systems / InfraRed Indoor Scout-LPS

	Badge	IRIS	Polaris
Coverage:			
	10x10m (=33x33ft)		
Accuracy:	Room scale	16cm	0.35mm



Evaluation

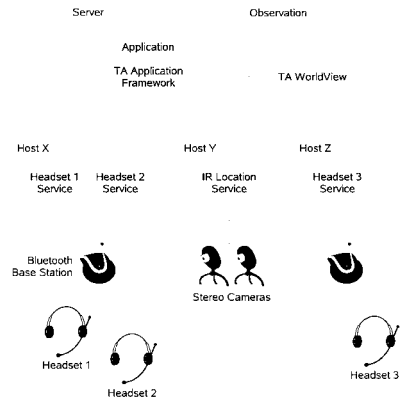
- Lecture hall
 - Size: 15.1 x 9 meters
 - Basement, no windows, fluorescent light
 - 138 test points
 - 16.67cm RMS error





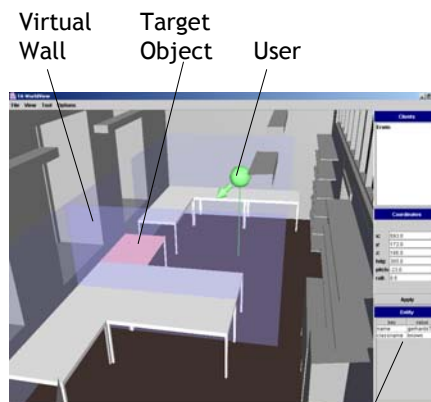
Software

- Architecture
 - Based on Web Services, XML/SOAP-based protocol between components
- Services
 - Headset service: Runs on an active access point (at the “edge” of the wired network infrastructure)
 - IR Location Service: Interface to positioning system
- TA Application Framework
 - API for applications
 - Provides context information derived from sensor data
 - Supports operations on world model
 - Event-based programming model



TA WorldView

- World model
 - Detailed geometric model of the real world
 - Metadata layer for object description
- TA WorldView
 - Inspection of the running system, Debugging



Object Metadata



TA: Summary

- TA is an open hardware and software platform
 - Important for research
 - Adding sensors to devices to derive context information
 - Standard Bluetooth headsets
 - have very limited audio quality: only 8 kHz PCM
 - One SCO (HV1) connection can consume the full bandwidth of a piconet
 - Pairing requires user interaction & this behaviour can't be changed => roaming impossible
- Novel Positioning System
 - Affordable, because based on COTS components
 - High range
 - Compared to AR Toolkit:
 - Smaller hardware: No need to carry cameras and therefore big computers with much processing power
 - No markers



Badges

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Badges

- IR Badges
 - Unidirectional Badges
 - Badge sends badge ID in fixed intervals
 - Very low power requirements
 - Badge with battery: Range ~10m diffuse, long-range slow IR
 - Solar badge: Range ~5m direct line of sight
 - Room receiver box
 - IR receiver, connects via RS232 or USB to PC
 - Bidirectional
 - Association between ME (badge) and US (device tag)
 - Short-range fast IR communication: ~1m direct line of sight
 - Receives ID from device tag, sends „tag seen“ message to room receiver
- Other location systems
 - IR+RF: Room receiver box sends room ID; TA has RF interface
 - IRIS-LPS
 - WLAN signal strength

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MundoCore

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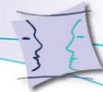
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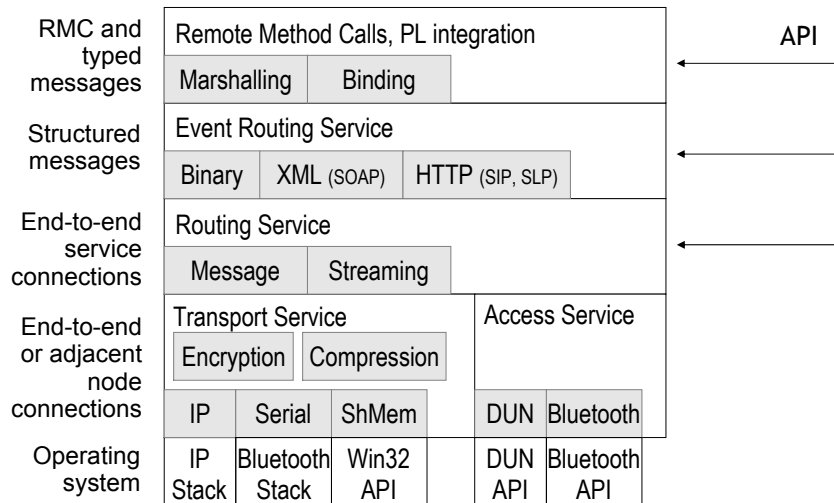


Middleware

- Pervasive computing middleware requirements
 - Modularity: Minimal kernel + services
 - Small footprint
 - Support for high mobility: efficient horz/vert handovers
 - Heterogeneity: Hardware & OS from sensor to server
different object models, or .net CTS everywhere?
- Basic abstraction
 - Publish/subscribe
- Services
 - **migration unit**: objects belong to a service
 - **manages execution**: VPs in Dejay (wrt. msgs: JMS Sessions)
 - **service fidelity** & network-boostered services
 - Net not only hosts data & services, but...
 - ...increases performance/features of mobile device (e.g., net-based voice recognition, more storage, higher QoS)



MundoCore: Layers





Conclusion

- Publish/subscribe ...
 - good basic abstraction
 - enables service mobility
 - structured messages -> event filtering
 - typing -> RMC and binding
- ... with zones. Zone border gateways
 - transform between representations
 - restrict subscription forwarding -> scalability
 - restrict event forwarding -> security
- Outbound interfaces
 - Language extension (preprocessor-based)
 - Signal/slot-like concept (QT)
 - ListenerList bookkeeping should not be part of event source
 - Implementation should not be statically defined by programmer
 - Different dispatch mechanisms
 - Dynamic glue code generation