Mobile Augmented Reality

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November 23, 2004, NedGraphics

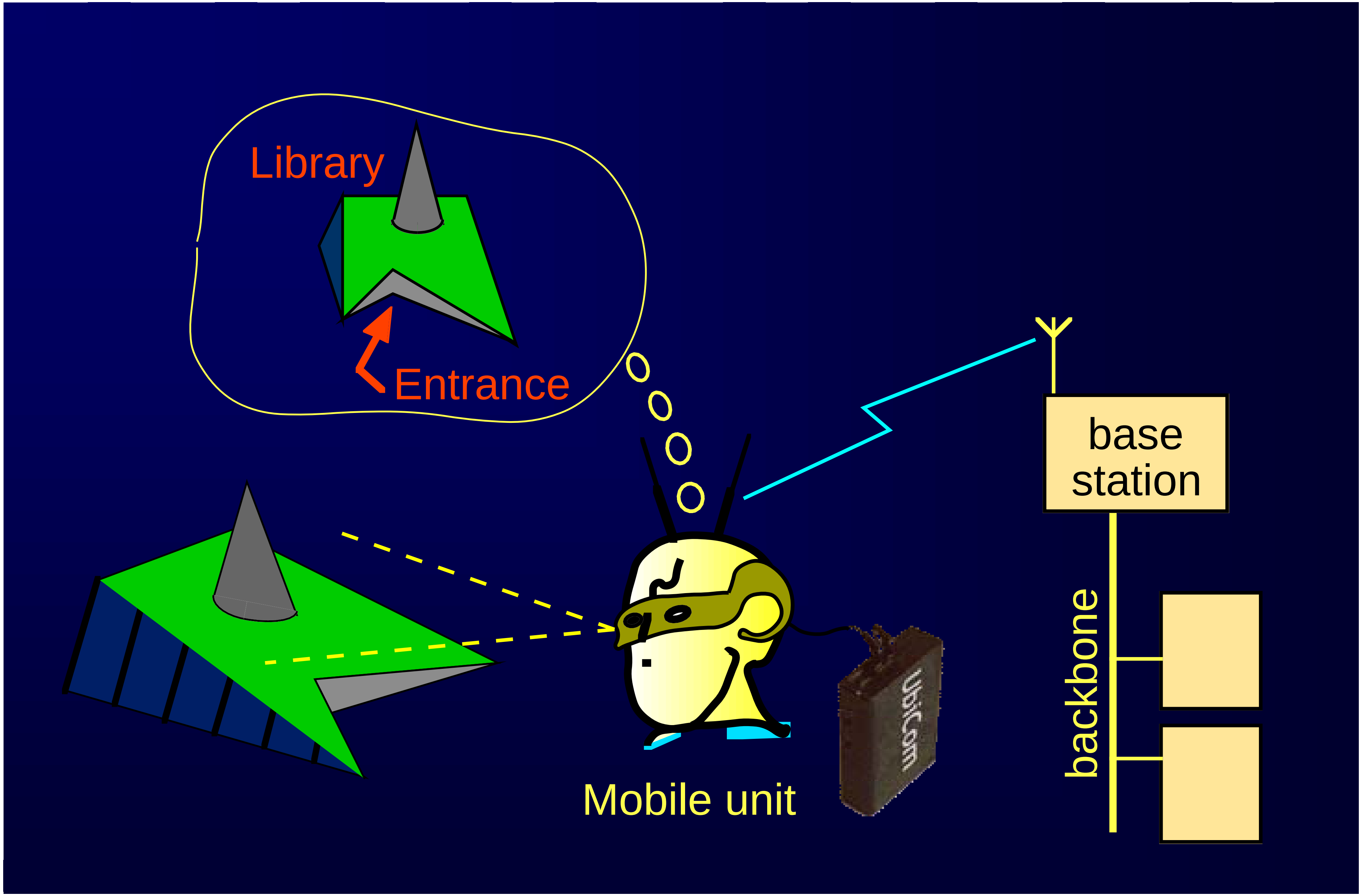
Delft University of Technology

Crash Course:
What is Augmented Reality

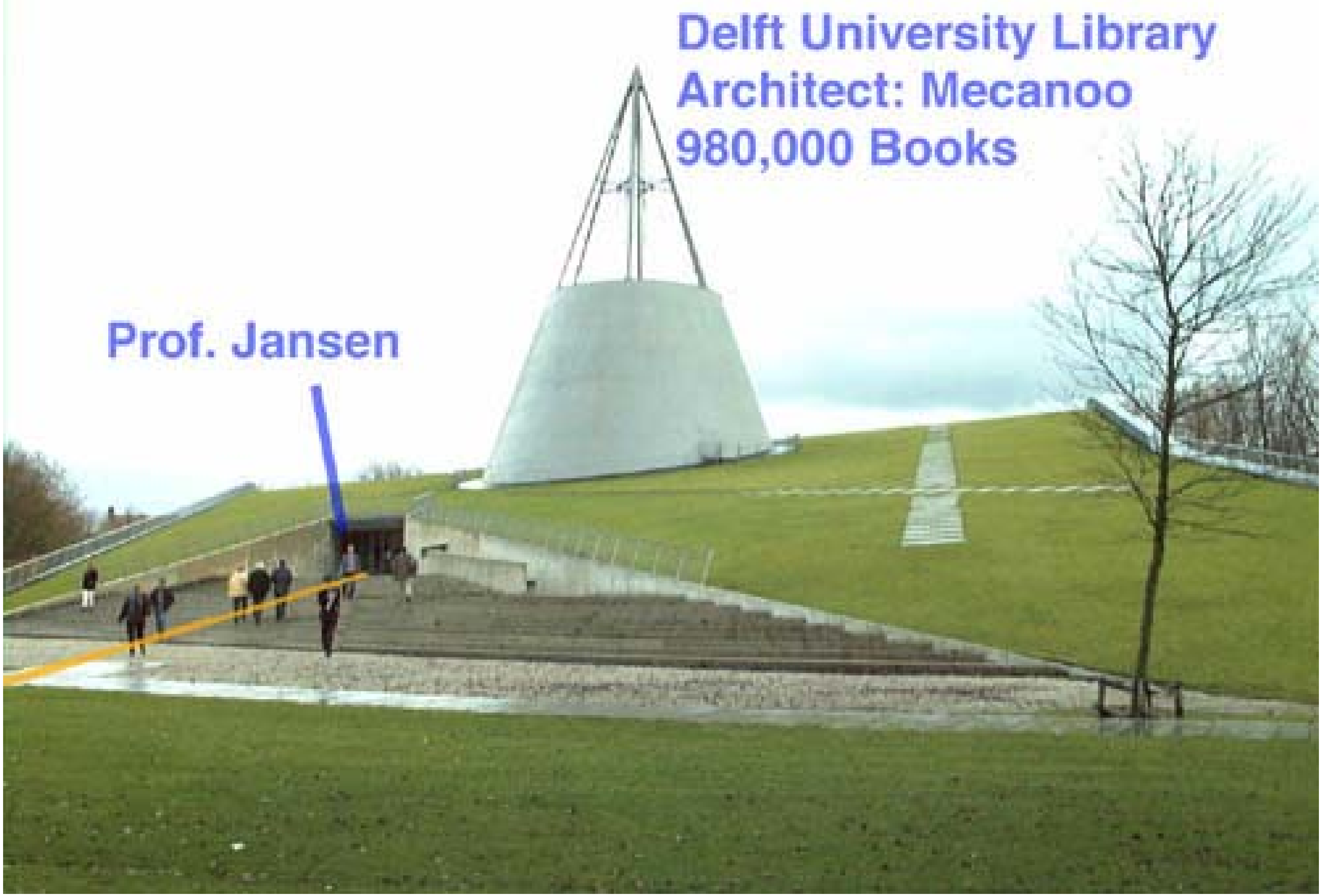
UbiCom

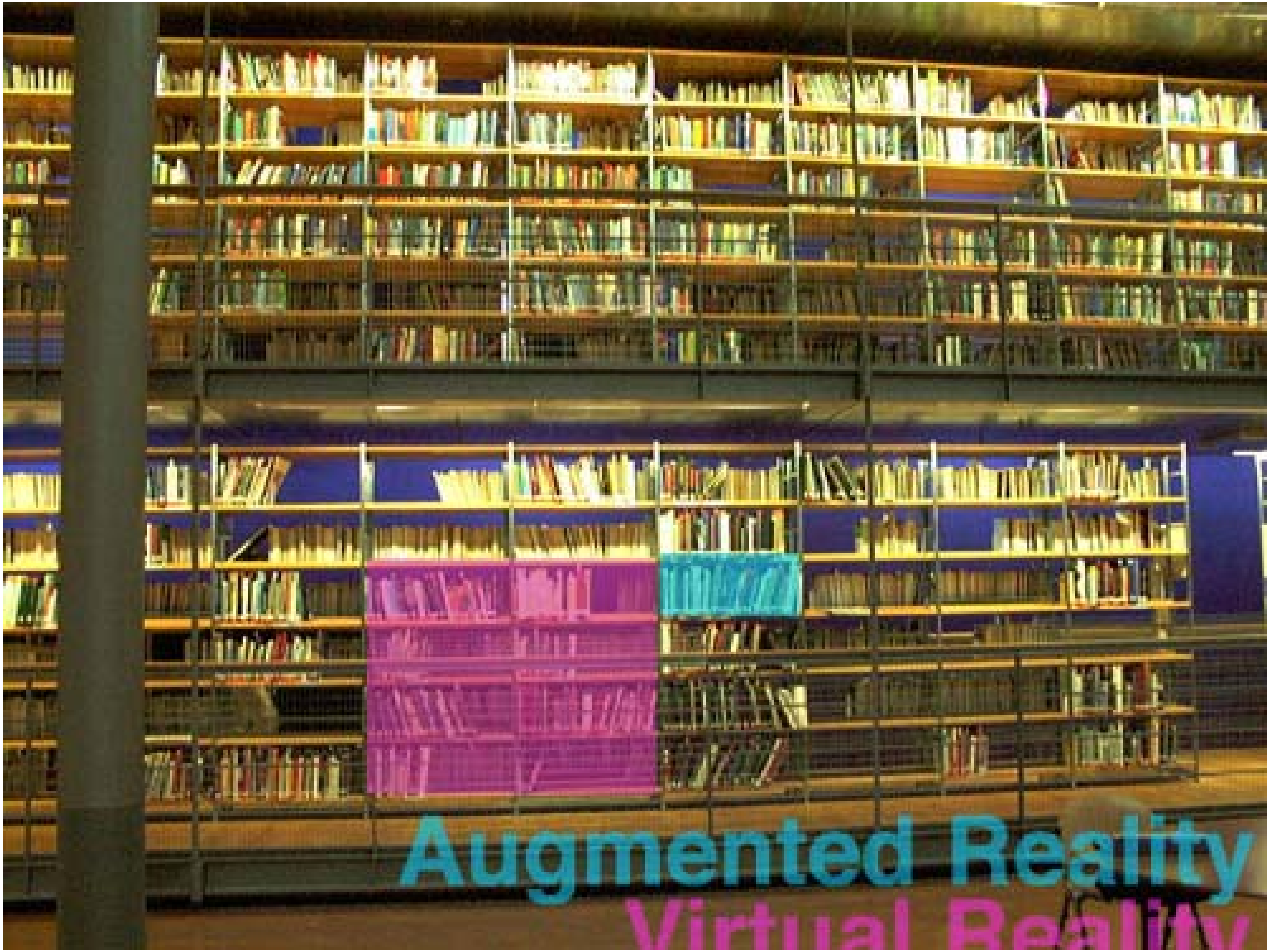
TU Delft

Delft University of Technology


Library
Entrance
base station
backbone
Mobile unit
UbiCom

Applications




Augmented Reality
Virtual Reality

Maintenance, assistance

UbiCom

TUDelft

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Technical Challenges

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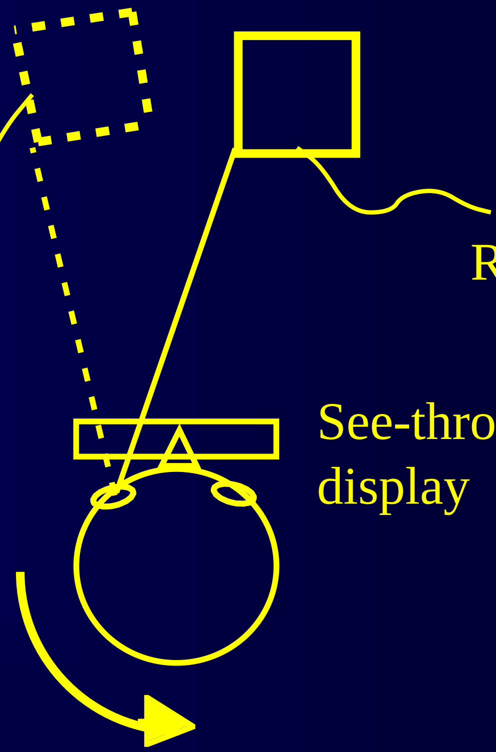
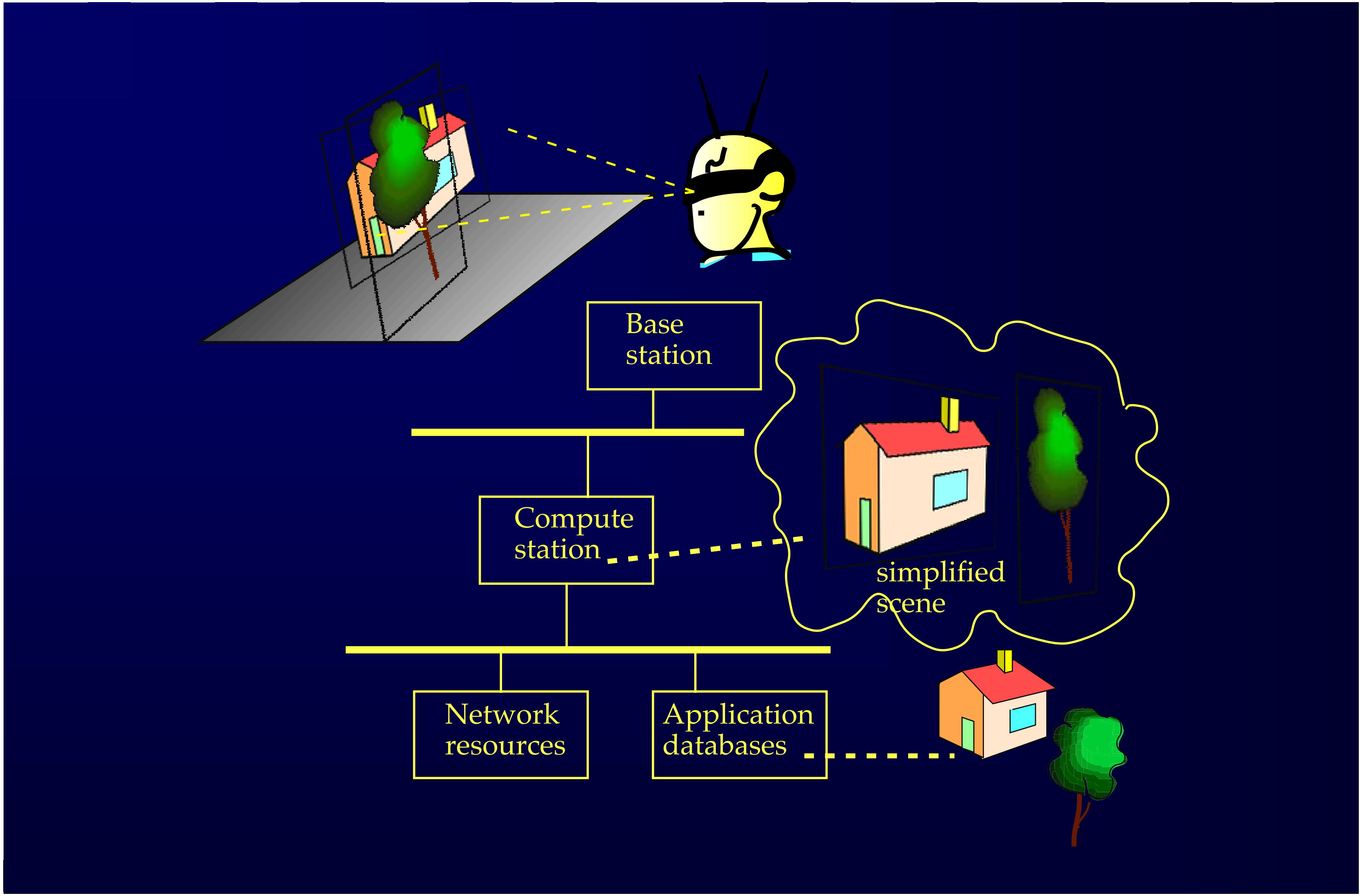
Latency in Optical AR



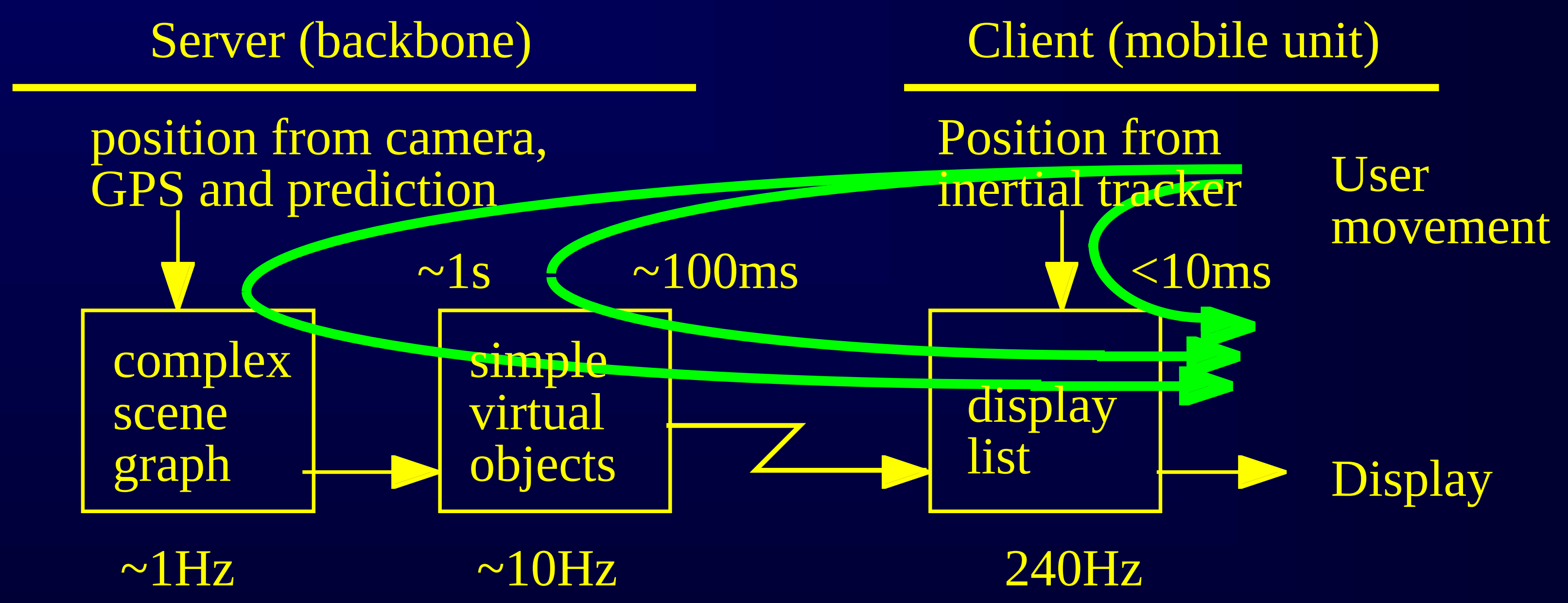
Alignment error=
Latency * Rotationspeed

For the applications targeted, 0.5˚ at 50˚/s seems acceptable =>10ms.

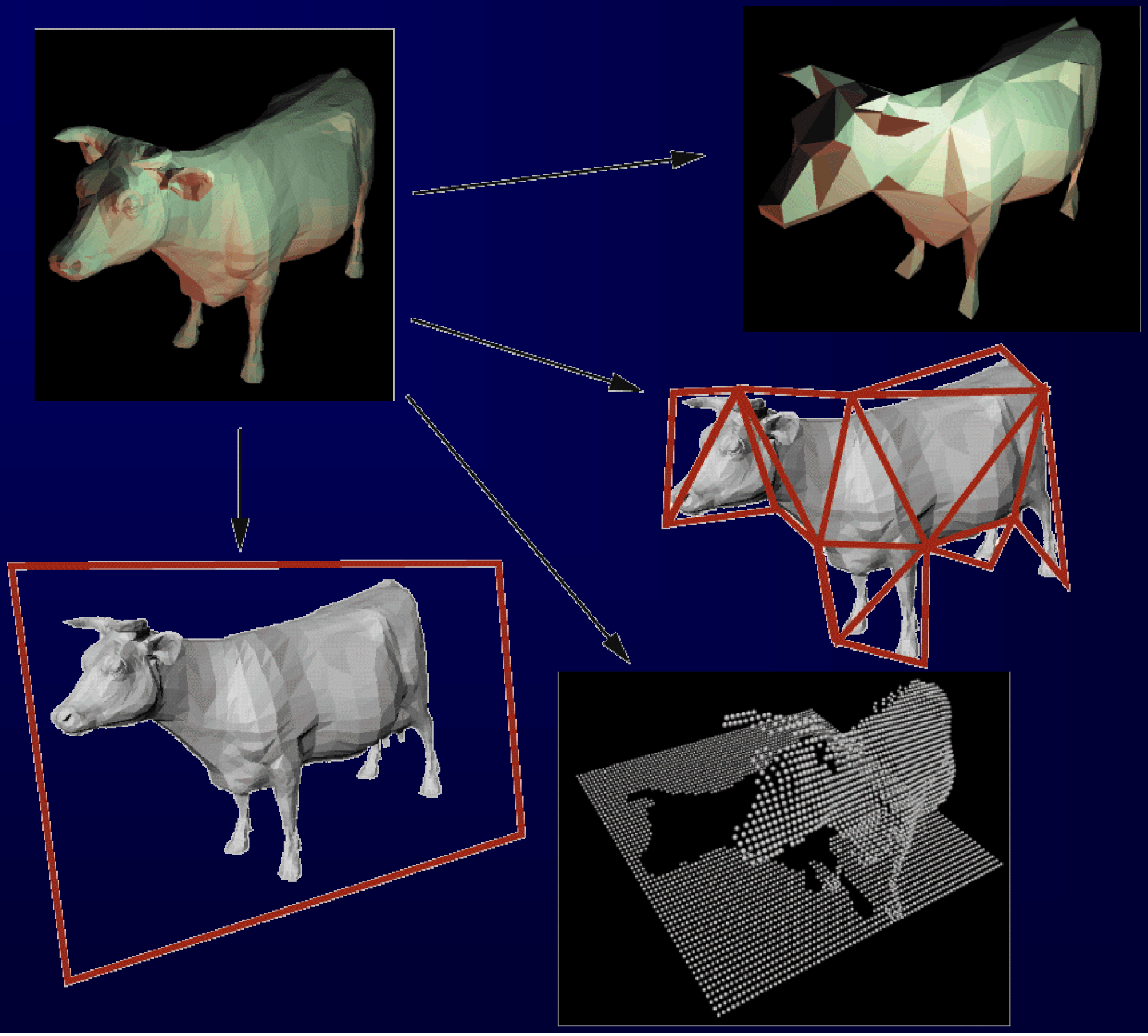

Base station
Compute station
Network resources
Application databases
simplified scene

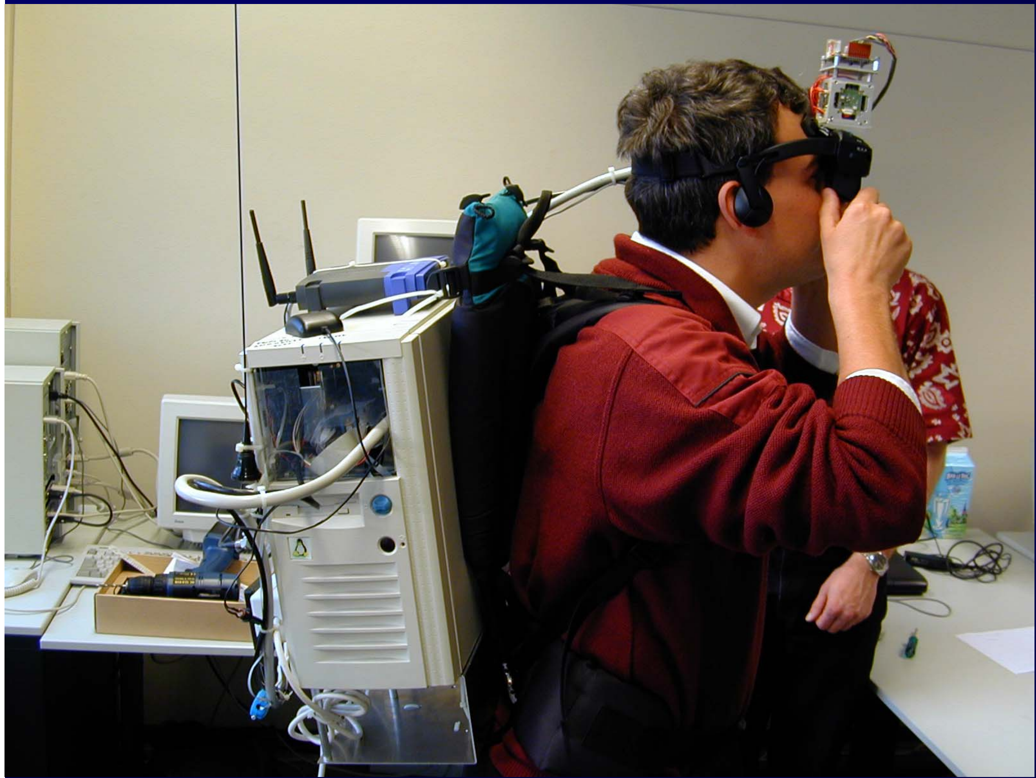
Latency Layering

Limited resources on mobile, 250–400 polygons w. textures



Dynamic Simplification





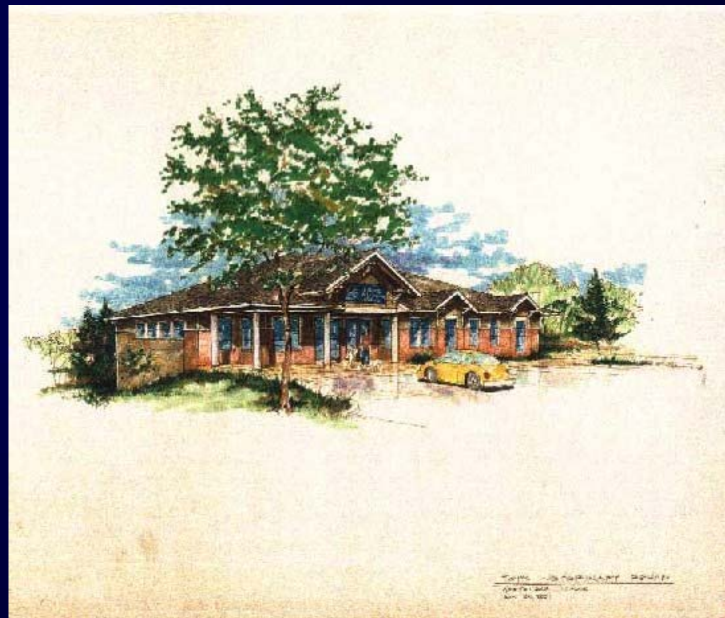
NISHE

Augmented Reality with Large 3D Models on a PDA

Introduction

- AR with large models on PDA

Application area picked: supporting architects



VR is getting more popular for this.
But modeling of environment is cumbersome

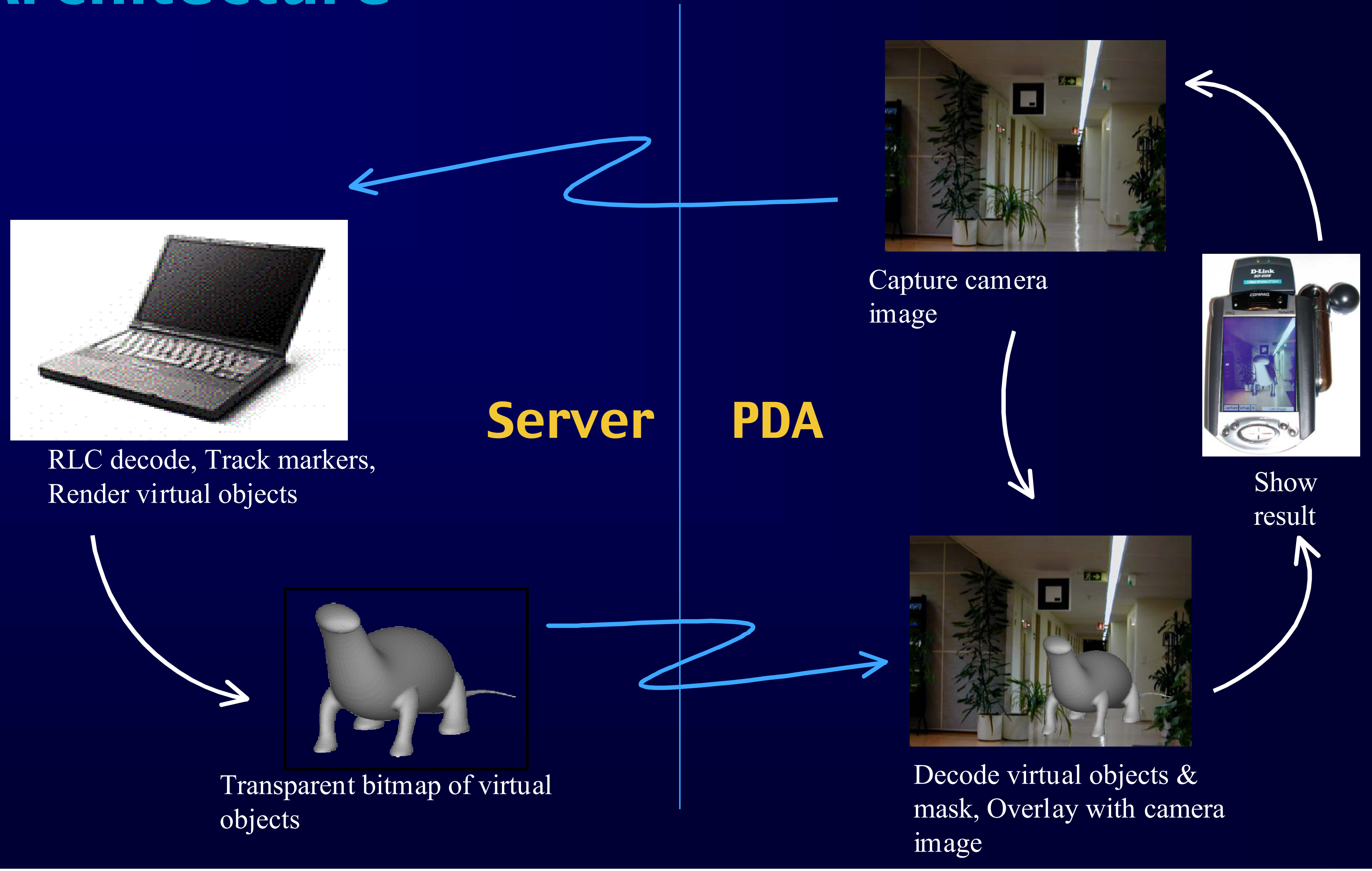
--> often modeled quickly with large grey blocks

AR is making its way

–hand work: placing building at right location, proper lighting, occlusion, ...
– still picture

AR on PDA seems useful for such situations.

Architecture



Hardware:

PDA: iPaq H3800, Camera 640x240, display 240x320

206MHz StrongARM

Server: Dell Latitude, GeForce4 440 Go, 1.8GHz P4

Links tested: WLAN, USB, GPRS

Tracking

ARToolkit
Multimarking tracking: spanning large area with multiple
Markers 76cm wide for tracking up to 10m distance

ARToolkit adaptations:

- using low resolution 320x240 bitmap
- bitmap from link, not from camera
- Disable rendering

The Test Scene

Real scenes:

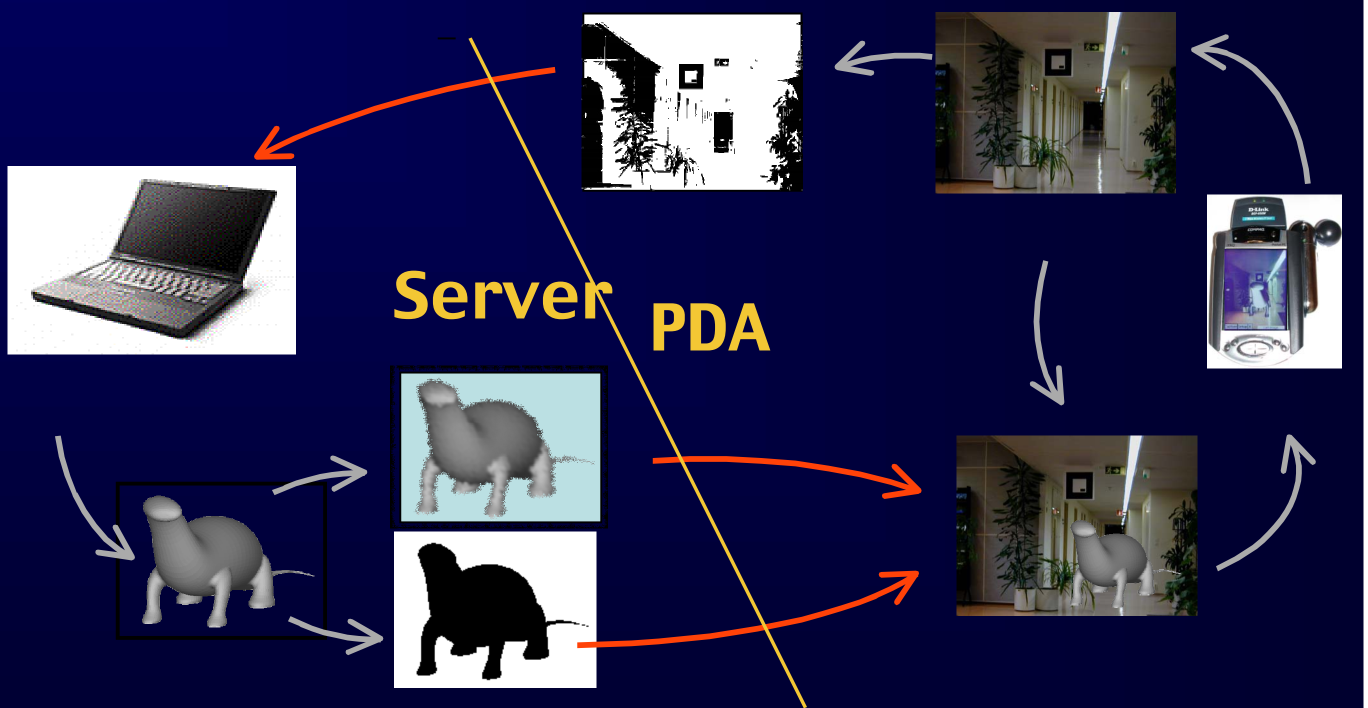
- outdoor parking place with snow, −20˚C, bright
  enhanced with few 76cm markers
- Lobby at entrance of the first floor
  enhanced with 40cm marker or
  with smaller markers as needed

Virtual scenes: VRML

- Simple scene (flower) not filling screen
- Itäkeskus building, 60k polygons w. texture
  60m wide, 15m high, more than screen filling

Compression Opportunities

1. Compressed B&W bitmap the camera image to the ser
2. Video compress the overlay image to the PDA
3. Compressed Transparency mask to the PDA



- B&W bitmap the camera image to the server

- RGB to B/W: 24x compression
- RLE coding: using Elias Gamma code: 5x compression

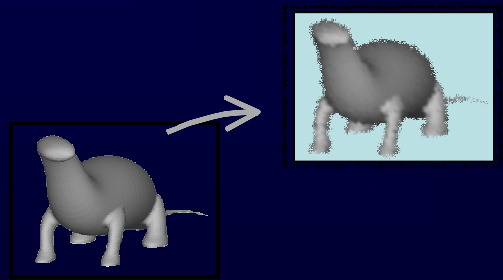
Cam image size:

Original 320x240	: 230 kbyte
B/W	: 9.6 kbyte
RLE coded	: 1.9 kbyte

2. Video encode the overlay image to the PDA

Using Motion Vector Quantization (MVQ)
Commercial coder, developed at our VTT group

- Very light decoding:
  - using motion vectors and lookup tables,
  - not using DCT
  - typically 50ms for full 320x240 image on PDA
- Large motion vectors up to 64 pixels,
  - suits shaky cam movements and low frame rates



Optimizing MVQ Coding Modes

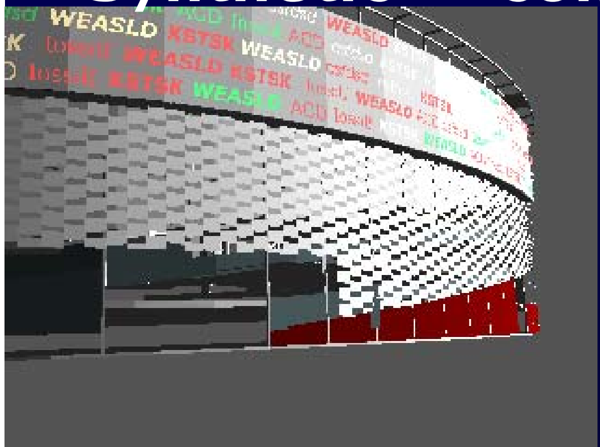
Optimization for Modem (4kb/frame) and Wavelan (30kb)

“Offline” = Best but 510ms/frame (10.8/15.3dB)

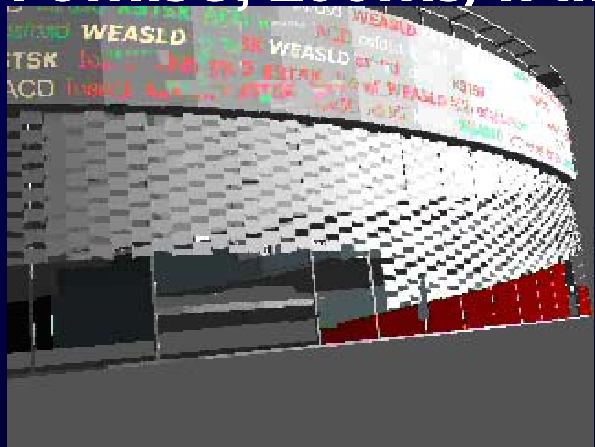
“Online” = Fast 160ms/frame but not so good (9.8/15.2dB)

Optimize for synthetic images with large smooth shaded areas

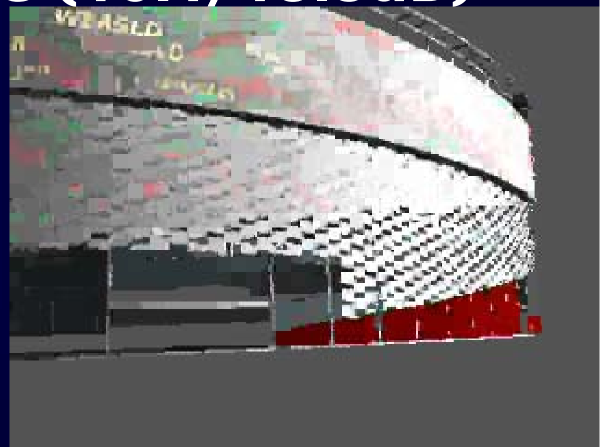
“Synthetic” = compromise, 200ms/frame (10.1/15.3dB)



Original



SNR 15dB

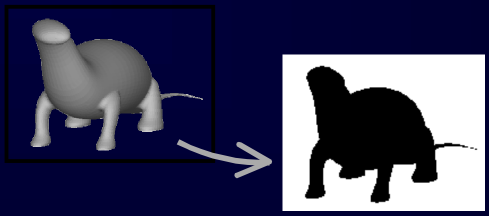


SNR 10dB

3. Compressed Transparency mask to the PDA

- RLE coding: using Elias Gamma code:
  now 9x compression (less noise than natural imgs)

320x240 mask compresses about 1 kbyte.



Some Performance results

Without optimizations, “offline” MVQ compression,
half-screen object, USB1 : 0.28 fps

With optimizations, worst case full screen object
using USB1 and “online” : 0.9 fps
using WLAN and “synthetic”: 1.25 fps
using GSM and “synthetic” : 0.2 fps

Much more details in the paper.

Usability

- WLAN 1fps good for architecture. GSM is bit slow but convenient and always ready for demo
- Architects appreciate on-site experience of presence
- Need for markerless tracking
- ARToolkit has some tracking problems with certain marker orientations
- iPaq screen bit dim, especially when sunny
- Our system can be run even on mobile phone now.

Videos

- AR on PDA “digitalo”. (1:30)
- AR “indoors” (1:10)

Conclusions

- AR with video mixing was implemented on PDA/Mobile Phone.
- For mobile AR with optical mixing and for gaming latency is more critical. For such situations the UbiCom approach still seems the way to go.

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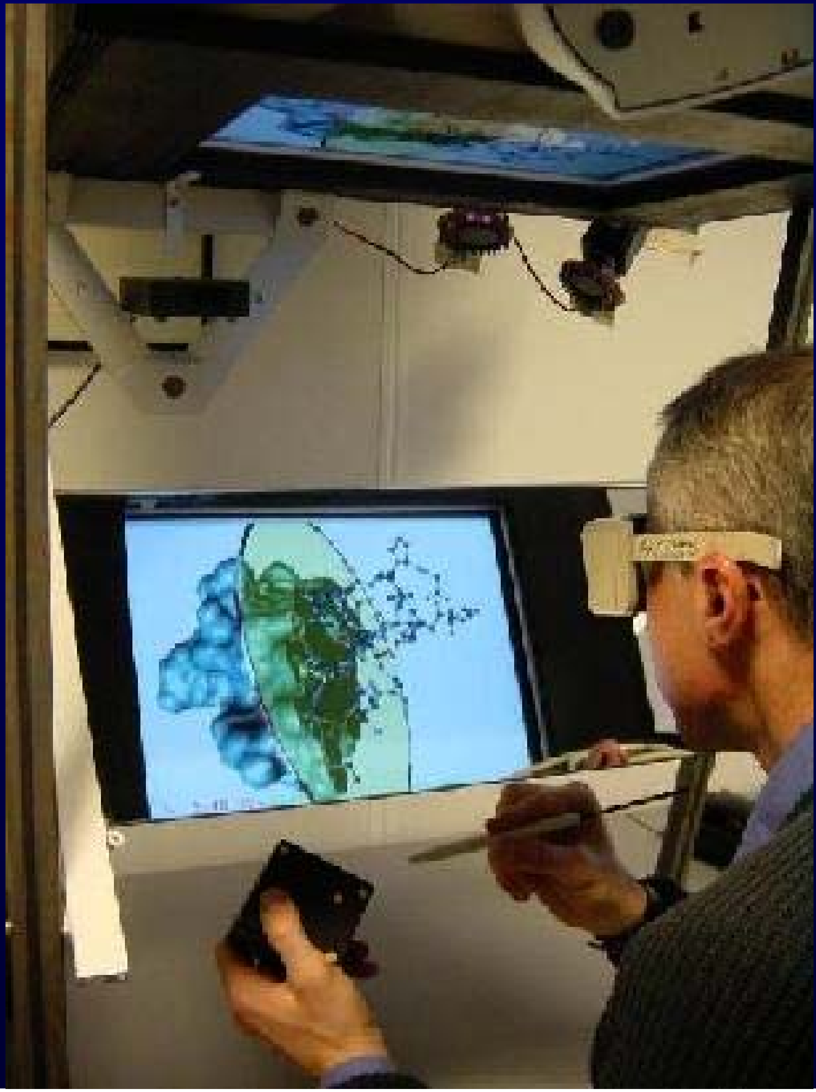
Desktop systems



Personal Space Station
Van Liere et al. 2002