

Networked Device Drivers

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- Motivation
- I/O Over the Network
- Architecture
- Demo

Small Devices



Zypad Wearable



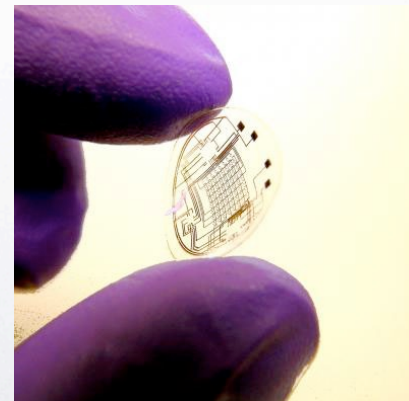
iPhone



Netbook



Nanotech



Contact Lens Display (UW)

I/O



Camera



Space Navigator



RFID



GPS



Microphone

Big Applications



Virtual Worlds



Maps



Augmented Reality

- Data/Computation Intensive, Context Dependent

The Cloud



We Propose a System Architecture For

- Cloud-based applications with a rich set of I/O devices
- User interaction with the cloud

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Current Network I/O

- T. Richardson, Q. Stafford-Fraser, K. Wood, and A. Hopper. Virtual network computing. *Internet Computing*, 2(1):33–38, 1998.
- T. Hudson, A. Seeger, H. Weber, J. Juliano, and A. Helser. VRPN: a device-independent, network-transparent VR peripheral system. In *Proceedings of the ACM symposium on Virtual reality software and technology*, pages 55–61. ACM New York, NY, USA, 2001.
- R. A. Baratto, J. Nieh, and L. Kim. THINC: A Remote Display Architecture for Thin-Client Computing. *Computing Science Technical Report CUCS-027-04*, Department of Computer Science, Columbia University, 2004.

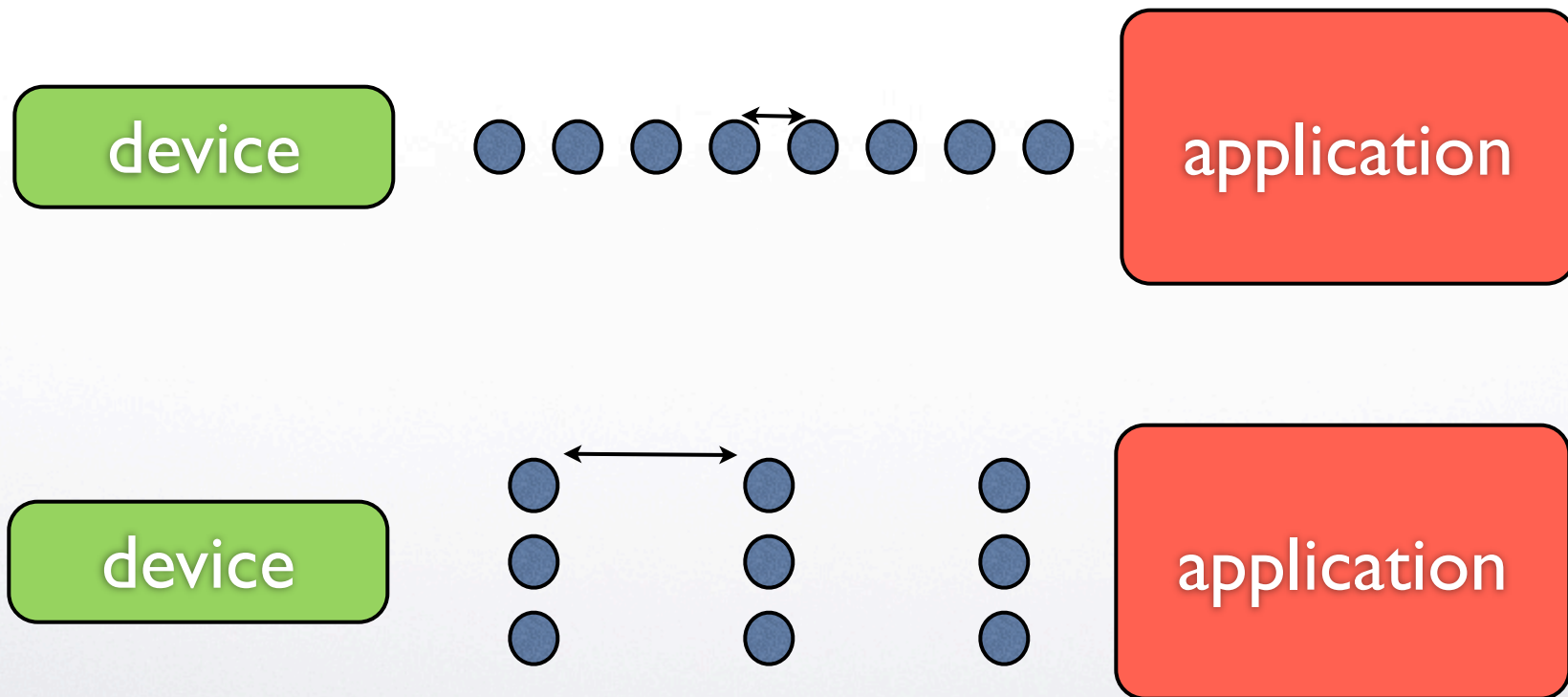
I/O Devices

- Camera
- Microphone
- Mouse
- Accelerometer
- GPS
- Temperature sensor
- Light sensor
- RFID
- Barcode reader
- Keyboard
- Biometric sensors
- Touch sensor
- Sound card
- Video card

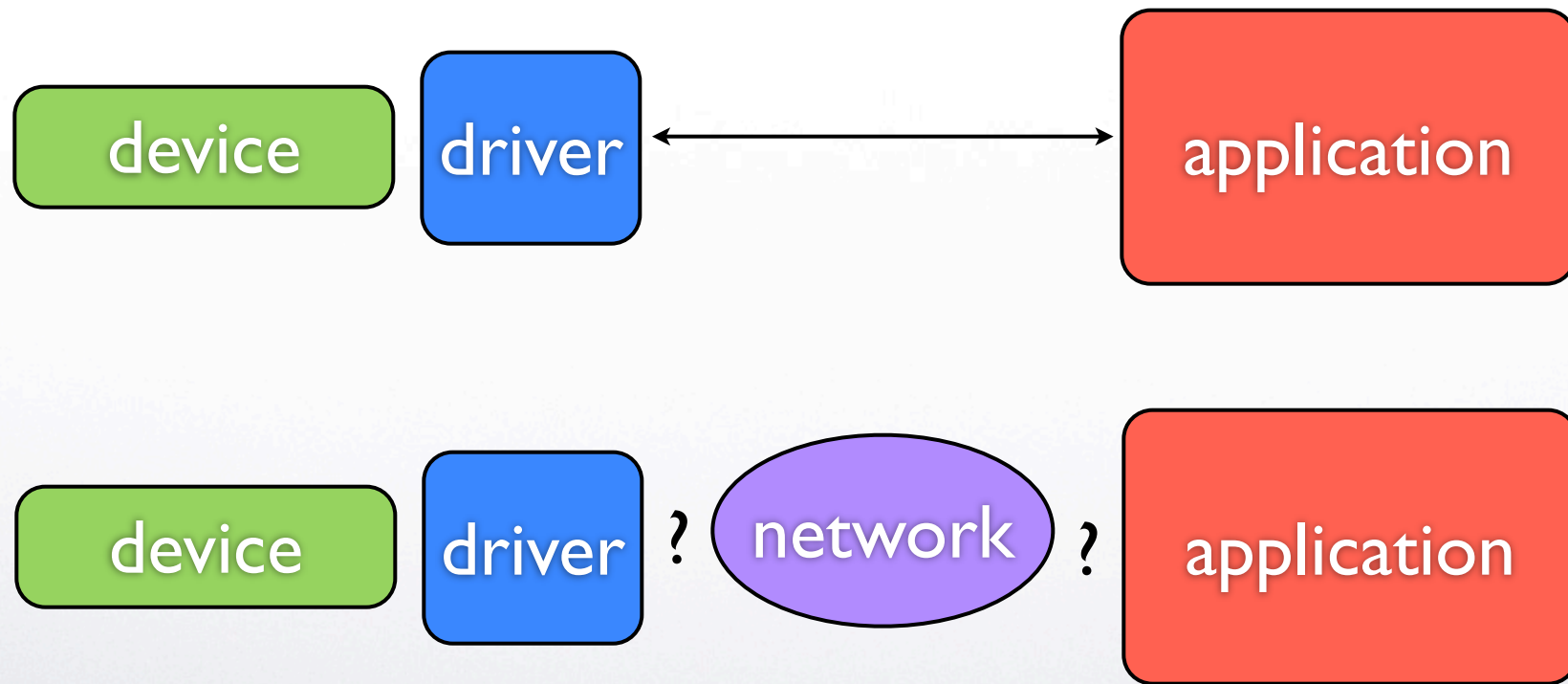
We Need a Generic System for Remote I/O

- Flexible
- Easy to extend/edit
- Performance Sensitive

I/O Performance



I/O Architecture



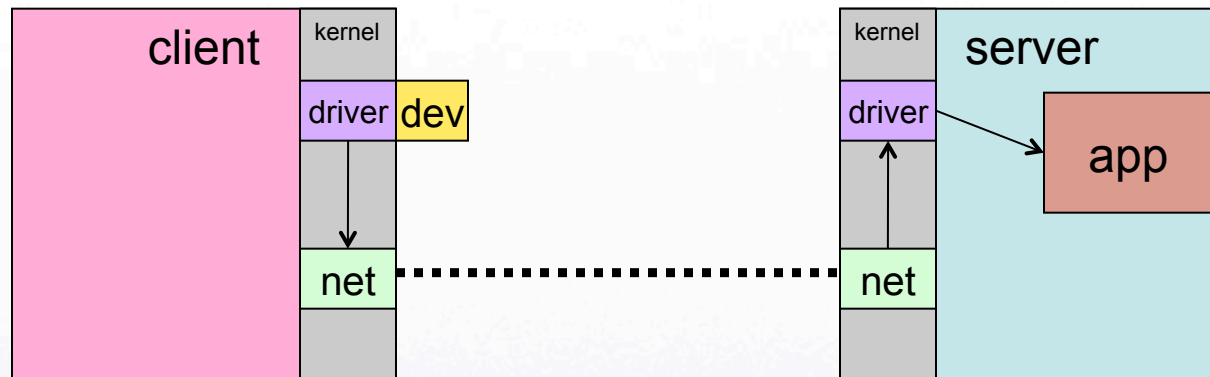
Problem Statement

Once we move applications across the network, we must figure out how to connect the device to the application, taking into account:

- Heterogeneity of devices
- Transparency to applications
- Minimizing latency
- Supporting real-time constraints
- Supporting mobility

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Architecture



functions

- Caching
- Polling
- Buffering
- Encrypting
- Compressing
- Synchronizing Multiple Datastreams
- Transforming
 - Adding Timestamps
 - Averaging
 - Discarding Non-Recent Updates
 - Predicting Future Updates

Architecture



Functionality

- Functionality needs change on an application-device basis
- Device designers, application designers and users may all have different functionality needs

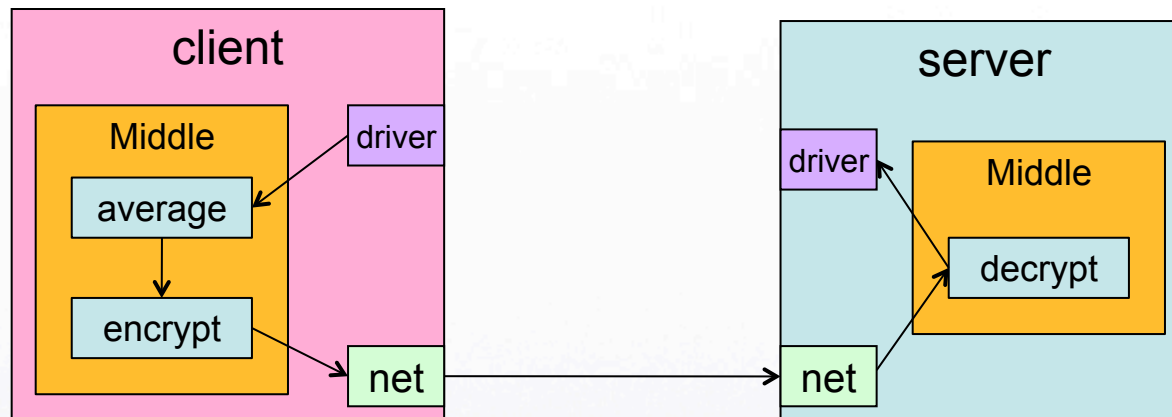
Automatic Customization

- Application Developer
- Device Developer
- User

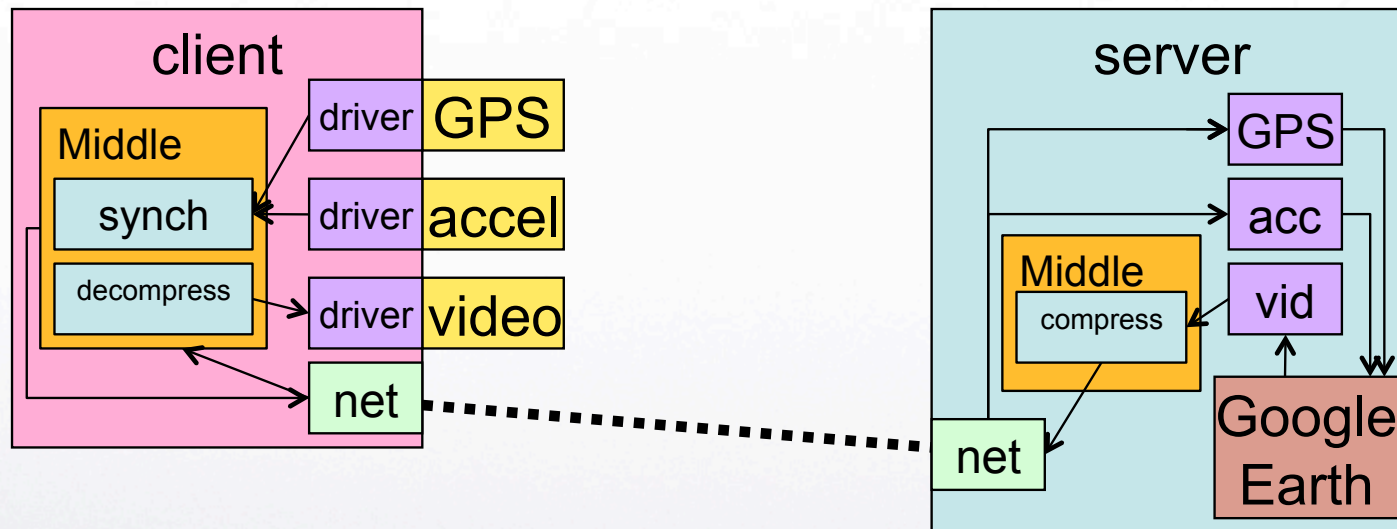
Architectural Features

- Driver on Client is unchanged
- Middleware code added
- Add Networking functionality
- Modify driver on Server to use network instead of device

Middleware Example



Google Earth

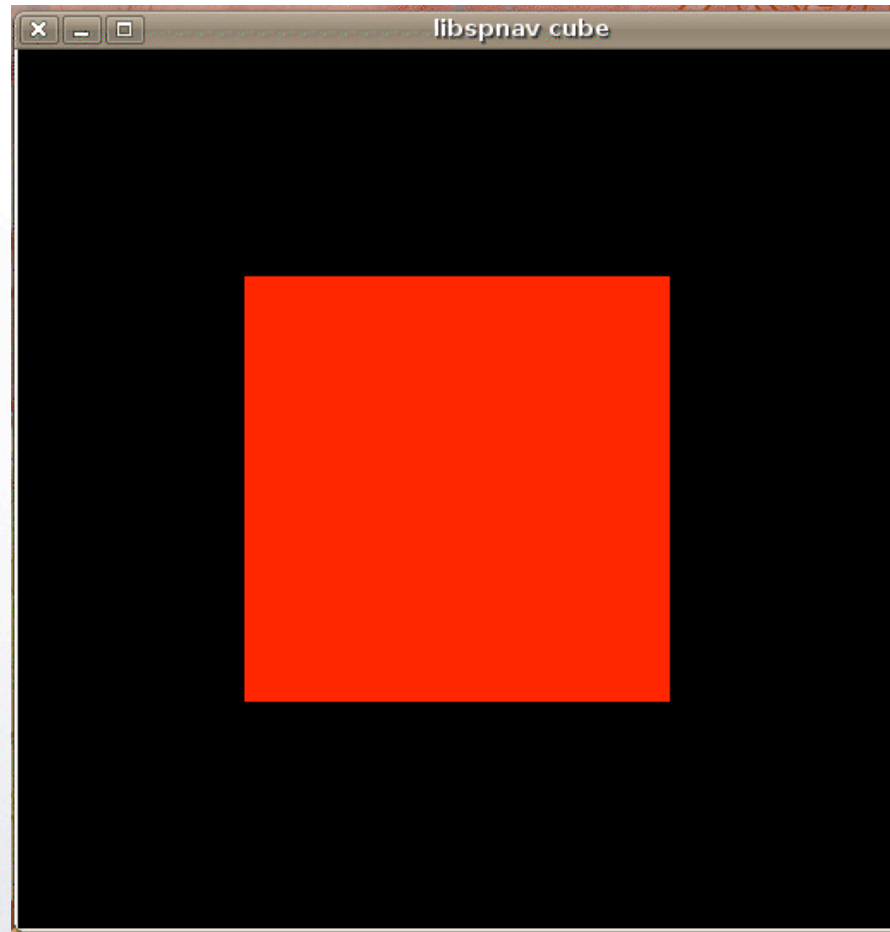


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- Preliminary Experiment

Preliminary : Space Navigator



Preliminary - Local



Preliminary - Remote

Summary

- New generation of I/O devices
- The Cloud
- We propose a new architecture to support remote I/O

Questions?