MobiDesk: Mobile Virtual Desktop Computing

Ricardo A. Baratto, Shaya Potter, Gong Su, Jason Nieh
Network Computing Laboratory
Columbia University

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Problem: Growing PC management complexity
Solution: MobiDesk
**Issue: Interoperability**

*Installed Base + Investment in place*

Unmodified applications, operating system kernels and network infrastructure
Virtualize Everything

display

user session

network

Operating System
Benefits
Simplified management

management goes here
Ubiquitous access
High-availability
Outline

• MobiDesk Architecture

• Virtualization
  • Display
  • Operating System
  • Network

• Related Work

• Experimental Results

• Conclusions
MobiDesk Architecture
Virtualization

Session environment decoupled from underlying physical infrastructure

PC

user session

OS  Display  Net

MobiDesk

user session

virtualization + translation

OS  Display  Net

session environment decoupled from underlying physical infrastructure
Display Virtualization

high-level requests

raw pixels

applications

window system

device driver

framebuffer
Display Virtualization

- applications
- window
- system
- virtual device
- framebuffer
- display updates
- input events
Operating System Virtualization

user session

namespace

syscall interposition + private fs namespace

operating system namespace
Virtualization Example

session A

pid 10

MobiDesk

pid 10

OS 1

session A

pid 10

MobiDesk

pid 30

pid 10

OS 2
Session Migration

checkpoint → applications
namespace

storage infrastructure

applications
namespace
restart
Session Migration (cont)

- Application state saved in kernel independent format
- Use high-level application description
No changes to outside world
Session Network Virtualization

```
MobiDesk
Host A 2.2.2.2
```

```
MobiDesk
Host B 3.3.3.3
```

```
session A 1.1.1.1
Transport
```

```
session A 1.1.1.1
session B 1.1.1.1
```

```
Host A 2.2.2.2
```

```
Host B 3.3.3.3
```
Related Work

- Thin-client computing
- Virtual machines
- Network mobility
- On-demand services
Thin-client computing

For example:
• Citrix Metaframe
• Virtual Network Computing (VNC)
• SunRay

Problem:
• Sessions tied to server
• Remote display not designed for WANs
  – Network latency becomes an issue
Virtual Machines

For example:
- VMware ESX Server

Problem:
- Applications tied to OS, even if OS needs to be brought down
Network Mobility

For example:
• MobileIP
• Rocks
• M-TCP

Issues:
• Simplicity
• Transparency
• Low-overhead
• Reusable session addresses
On-demand Web Services

- Akamai
- IBM's Oceano
- Webmail

Problem:
- Application specific solutions which depend on the statelessness of web services
Experimental Results

- Prototype
  - Linux 2.4 kernel module and X device driver
Remote Display Performance

User-perceived performance on popular applications
- Web browsing
- Video playback

across different network environments
- LAN
- WAN

and compared to existing commercial systems
Web Browsing Performance

• Latency: average time for a web page to be displayed by the client
Web Browsing Latency

![Graph showing web browsing latency for different platforms and network conditions.](image)

- **LAN**
- **WAN - 66ms**
- **WAN - 120ms**

**Platforms:**
- CITRIX
- VNC
- SunRay
- MobiDesk
- PC
Video Playback Performance

- Video quality: playback time and frames displayed at the client

Example: 50% video quality
- Twice as long to play the video, or
- Half of the frames were not displayed
Video Quality

![Bar chart showing video quality for different platforms and network conditions.](image)
Session Migration
Session Migration Cost

Subsecond checkpoint and restart times:
- 0.85s checkpoint
- 0.94s restart

- 35MB image (8MB compressed)

- Across Linux kernel versions: 2.4.5 to 2.4.18
Conclusions

• Hosting infrastructure simplifies management

• Virtualized session environment provides ubiquitous access, session independence from underlying infrastructure, and user isolation

• Works with unmodified applications, operating system kernels, and network infrastructure, while being low overhead and providing efficient remote access
More information...

http://www.ncl.cs.columbia.edu