Digital Life and Computing in 2025

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FX PAL

2003 SIGMM Retreat

Strategic discussions about SIGMM community and future research directions (Grand Challenges)

Make authoring complex multimedia titles as easy as using a word processor or drawing program

Make interactions with remote people and environments nearly the same as being there

Make capturing, storing, finding, and using digital media an everyday occurrence

Some progress, but still more improvements possible

Predicting the Future is Hard

Think about changes since 2000

Note: 2001-2013 is approximately same time as 2013-2025

Delivered in 21ˢᵗ Century

FX PAL

Devices
- Apple iPod (2001)
- Apple iPhone (2007)
- Amazon Kindle (2007)
- Google Nexus One (2010)
- Apple iPad (2010)

Cloud Services
- Wikipedia (2001)
- Pandora Radio (2003)
- Flickr (2004)
- Google Docs (2005)
- Youtube (2005)
- Box.net (2005)
- Twitter (2006)
- Amazon Web Services (2006)
- Netflix Streaming (2007)
- iHeart Radio (2008)
- Groupon (2008)
- Dropbox, Evernote (2008)
- Instagram (2010)

Communication
- 3G Cellular Networks (2001)
- Vonage VoIP Service (2001)
- Skype (2003)
- HDMI (2003)
- 4G WiMax (2006)
- MOOCs (2007)
- 4G LTE (2009)

Hardware
- USB thumb drives (2000)
- Dual Core Processors (2001)
- Roomba (2002)
- Kinect (2010)
- Leap Motion 3D Gesture (2012)

Games
- 2ⁿᵈ Life (2003)
- World of Warcraft (2004)
- Angry Birds (2009)
- Words with Friends (2009)
- FarmVille (2009)
- Candy Crush (2012)
- Threes! (2014)

Social Networks
- Facebook, Myspace (2003)
- LinkedIn (2003)
- Twitter (2006)
- Foursquare (2009)
- Pinterest (2009)
- Instagram (2010)
- Snapchat (2011)

Software/Programming
- Picasa Photo Editor (2002)
- Ruby-on-Rails (2004)
- Google Map/Reduce (2004)
- Apache Hadoop (2005)
- HTML5 (2005)
- Unity 3D Game Engine (2005)
- Github (2008)

Business Models
- Netflix Subscription (2000)
- Apple iTunes Store (2003)
- Freemium (2006)
- Apple App Store (2008)
- Kickstarter (2009)

Mobile/Cloud Computing Environment

Mobile devices

Laptops (?), tablets, and smart phones

Always connected vs Intermittent connection

Cloud computing

Storage (e.g., Dropbox, Box, etc.)

Computation (e.g., AWS, Azure, OpenStack, etc.)

Apps (e.g., Facebook, Google Docs, Salesforce, Github, etc.)

Public vs Private cloud

Mobile/Cloud Computing Environment

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Cloud computing

Storage (e.g., Dropbox, Box, etc.)
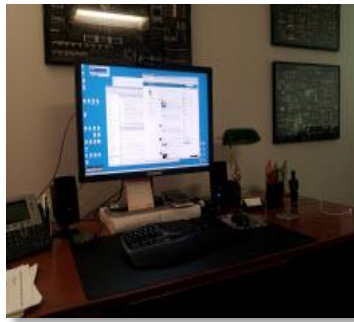
Computation (e.g., AWS, Azure, OpenStack, etc.)

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Public vs Private cloud

Ubiquitous Computing is the Future

Computing resources available everywhere and invisible

My Digital Life (2014)

Dropbox   gDrive

Desktop at Work

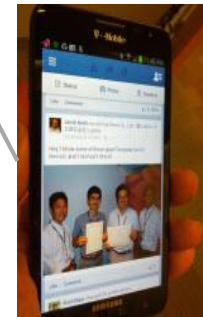Tablet (iPad)

Desktop at Home

FXPAL

Cell Phone (Android)

Laptop

Context is difficult to manage

Synch'ing apps, configurations, and data

Separate work-life, personal-life and winery business

Want to access apps and data everywhere without effort

Applications

Accessing documents and files sort of works

Problems with music and movies

Email works reasonable well

Need better apps on tablets and smart phones

Contacts & calendars are difficult to manage

Different lists and usage + synch across devices and apps?

Mobile input is problematic

Pen input/apps still not easy to use (pen ergonomic issues?)

Voice recognition ok in limited contexts

Why is audio response to an email not supported?

> **I am suspicious about mobile apps that every organization is creating because they are accessing my personal data**

But Larry, use Apple/MS/Google/…

By choosing an eco-system, synch'ing and cloud integration can be "solved"

But problems remain…

You only get services and apps available in eco-system

Nobody has solved app/life context problems, yet

Companies are spending big money to win this battle and more competitors entering (e.g., Amazon, Samsung, Lenova, etc.)

Where is the open source, portable eco-system?

Mozilla?

{Discuss how this problem was resolved with programming languages, operating systems, network technology, database systems, etc.}

Important App: Presentations

Well-known rules about giving presentation elsewhere

Assume least common denominator facility

Carry everything with you (laptop with apps and data)

Laptop connected by wire to display device

Display/projector is a single computer screen

User carries everything needed to give presentation
➔ only safe way to be sure it will work

Common problems…

Cannot find right dongle to connect to wire
(e.g., hdmi/dvi, thunderbolt, usb, vga, etc.)

Image will not displayed (Fn+F7?)

Connect to house audio system?

Internet access?

Unexpected popups (e.g., SMS "Lunch?", "Update …", etc.)

Switch to next speaker …

Universal solution: Find A/V guru!

Technologies to Solve Problems

User-centered interface to control A/V system

- Show user what wire is receiving (no image or image)
- Show format negotiation between computer and projector
- Etc.

Wifi connection to projector (ATV, WiDi, Miracast, etc.)

- Much simpler connection protocol
- Get Internet access for free

Permanently installed presentation computer

- May need multiple computers (e.g., Apple, MSWin, etc.)
- Re-think how you do presentation (e.g., use portable VM, screen cast presentation and demos from cloud or home computer, build mobile/local computer app, etc.)

Use multiple displays!

Presentation Software

Reasonably good apps

PowerPoint, Keynote, etc.

Need good mobile presentation app with convenient authoring capability

Mobile & cloud will change situation

Smart phone will carry context, provide computation, and support Internet access

Presentation software might run on cloud, presentation computer, or mobile device

Time to change standard facility configuration

Multiple Displays Research at FXPAL

Mist Research (2001)

Room Update (2005)

Use of Multiple Displays

Schedule & Presentation (2010)

Presentation, Video, & Schedule (2007)

Berkeley Professor setup three projectors in lecture hall and ran PPT on each using a custom-authored presentation

He synchronized the presentations by manually executing "next slide" command on each laptop as per presentation design

Multiple Display Presentation Software

ModSlideShow (2003): Gesture UI and pen annotation for multiple display presentations

> Define group of displays with spatial relationship between them, use touch gestures to go to next/prev slide and move copy of slide to another display
>
> P. Chiu, et.al., Manipulating and Annotating Slides in a Multi-Display Environment, Interact '03, pp. 583-590.

ePic (2004): authoring tool and playback system for multiple display presentations (permanent display computer for each display)

> Author PPT slides, extract slide images, author slide/display binding and timing (e.g., next slide changes …)
>
> H. Zhang, et.al., A Presentation Authoring Tool for Media Devices Distributed Environments, IEEE ICME 2004.

MultiPresenter (2008): playback system for 2-displays with pen annotation (runs on laptop)

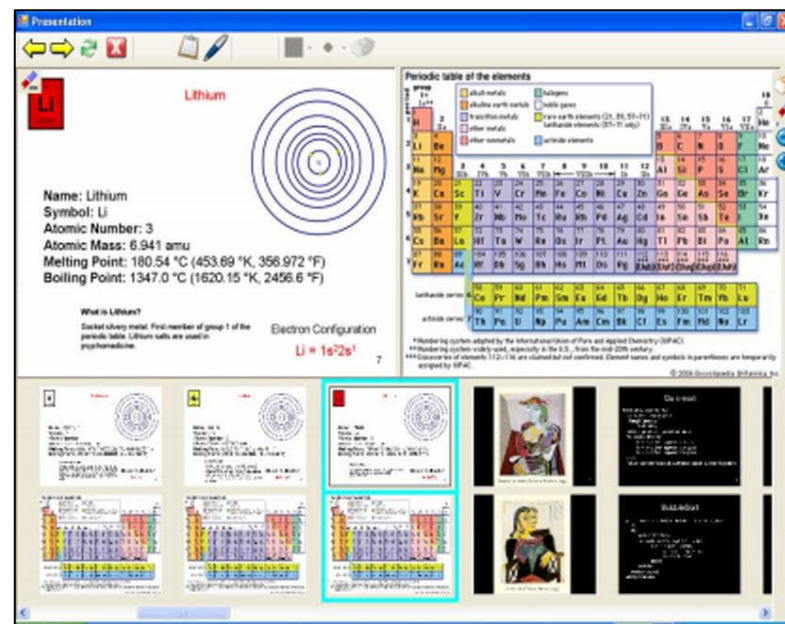> Author PPT slides, extract slide images, dynamically bind slide to display using GUI and annotate slides with pen
>
> J. Lanir, et.al., MultiPresenter: A Presentation System for (Very) Large Display Spaces, ACM Multimedia 2008.
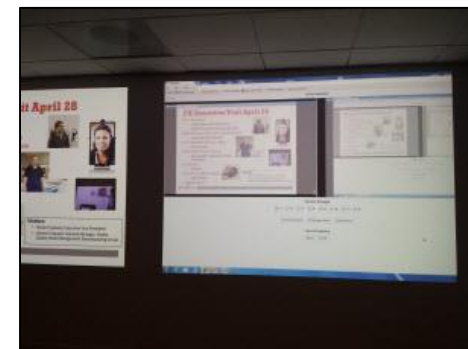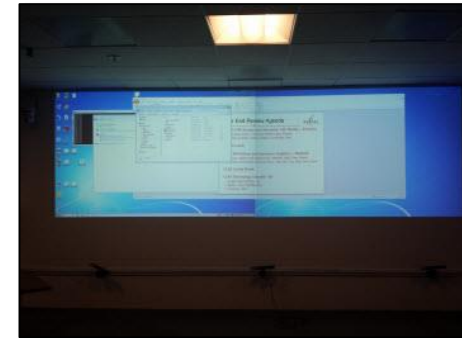
MultiPresenter

Audience View of Presentation

Presenter view of laptop

FXPAL Media Wall Conference Room

2 Projectors plus hardware to display screens on the wall at different locations and window sizes

Input source can be wire, wifi projection device, permanent presentation computer, or remote computer screen cast.

Future Presentation Applications

MultiPresenter++: multiple screens showing presentation or app (e.g., demo, web browser, etc.)

- Must adapt to facility and support intuitive mobile app for operation and control

Multiple person serial presentations

- Schedule of speakers
- Click on speaker ➔ configures presentation for that person
- Dynamic commands "put copy of slide here", "open web browser", etc.

Multiple person collaborative work

- Work together with different users displaying different screens and modifying content

The End

Existing hardware inadequate

Cannot drive multiple displays/projectors from one computer with multi-headed display graphics card
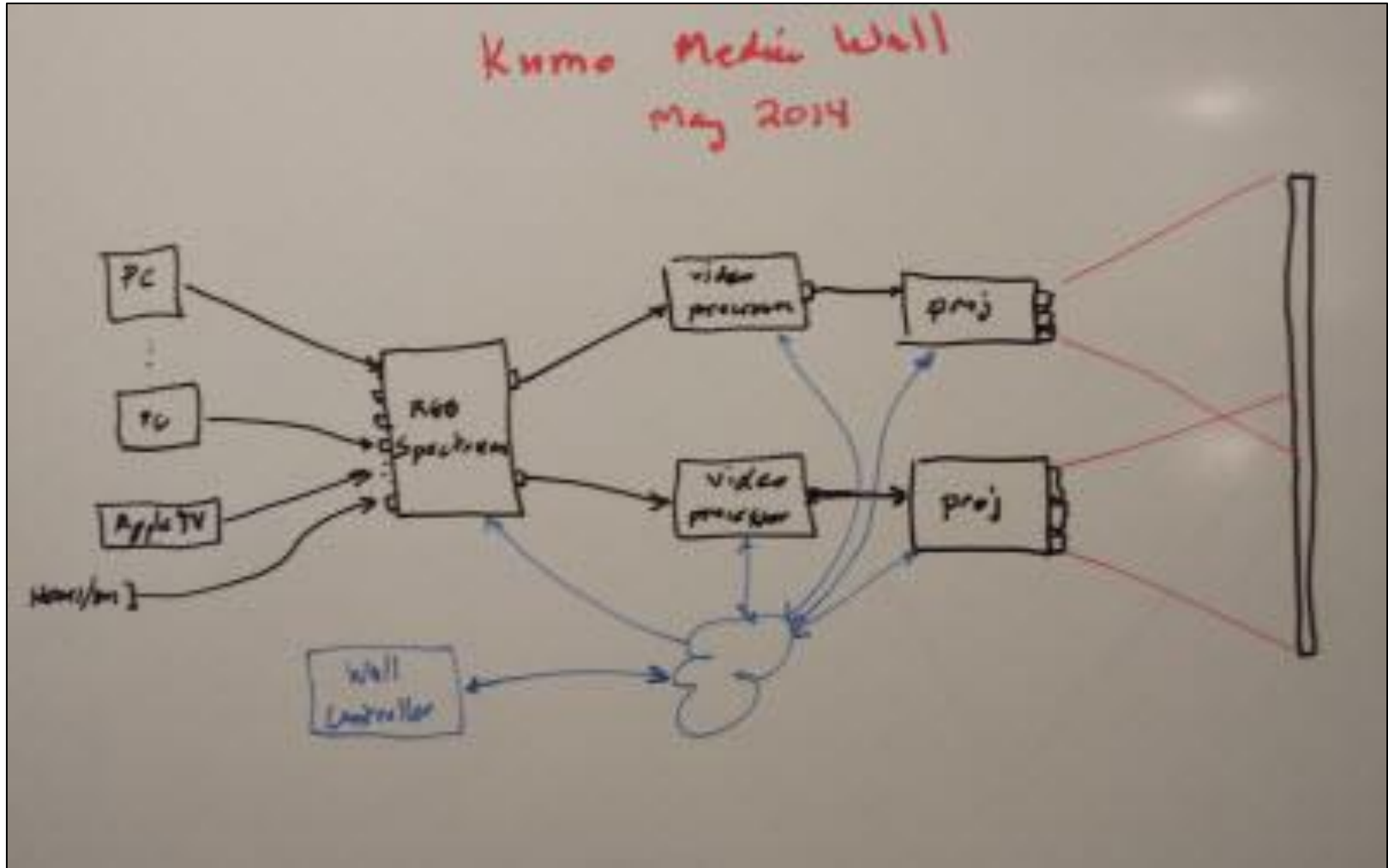
Custom hardware not flexible or dynamic enough

Many opportunities for improved software

Cannot use existing portable VM software for desktop access to cloud as initiation time is too slow

Need "room operating system" and scripting language for performing actions

Presentations are important and ready for disruption
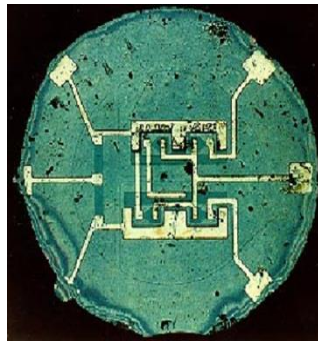
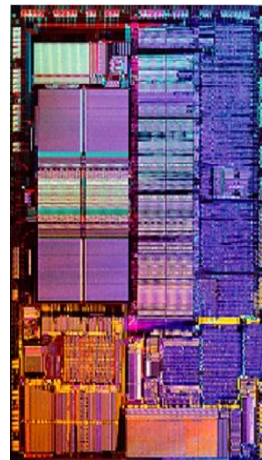# Kumo Media Wall Architecture

Predicting the Future is Hard

What causes computing to change?
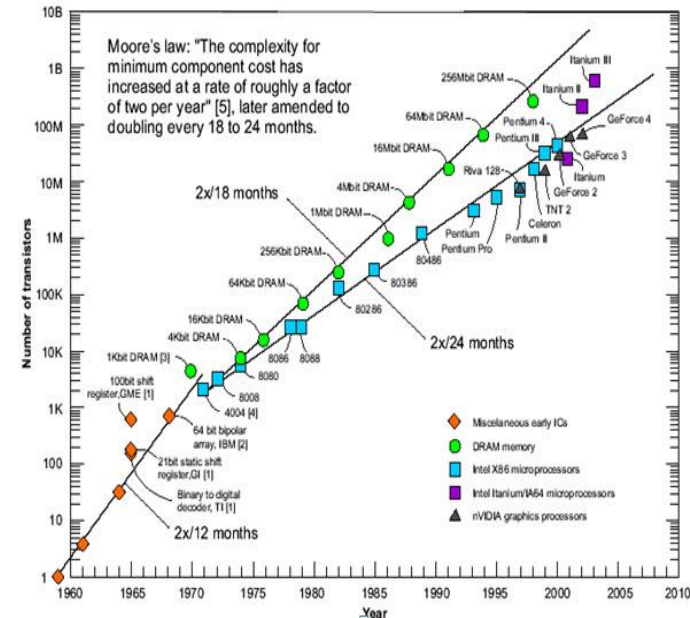
Improved Integrated Circuit Technology

Rapid decline "integrated circuit" feature size and cost

1960 IC
(4 transistors)

1990 IC
(1M transistors)

Compare desktop computer – 1970 to 2012

	1974	**2012**	**Improvement**
Processor	8080 (2 MHz)	i7 (4 * 3.4 Ghz)	1700 times
Transistors	6K	1.4B	230K times
Memory	4 Kbytes	10 Gigabytes	2.5M times

Impact on Computing/IT

Centralized versus decentralized computing

Over time computing has moved from data center (centralized) to office (decentralized) to data center to office … to portable

Distributed and parallel computing

Computer networks allow computation to be partitioned between client (e.g., desktop, mobile) and server (e.g., data center)

Software on 10K processors can do more than if it runs on 1 processor

Smaller and low power is better

Mainframe to minicomputer to microcomputer to mobile devices

Software improves user productivity

Computing and communication resources allow larger and more complex software to solve user problems