

Interaction and Infrastructure:

Bridging the Gap Between Human-Computer Interaction and Networking

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Some Background

Talk Overview



Networking



People



The Gap

A few motivating facts...

Although ~30
million US
households had a
home network by
the end of 2005...
[Parks Assoc. 2006]

A few motivating facts...

Although ~30 million US households had a home network by the end of 2001
[Parks Assoc. 2002]

Home networking gear is **the most returned** item at big box consumer electronics stores (20-30%)
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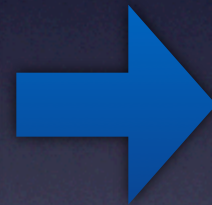
Consumers cite technical complexity as **the largest barrier** to home network [Jupiter 2007]

Half of all home users need help from others to set up a new device or service [Pew 2008]

A few motivating facts...

The image displays several overlapping screenshots of Linksys configuration interfaces. The most prominent is the 'linksys properties' window, which is divided into several tabs: Association, Authentication, Connection, and Wireless Network. The 'Authentication' tab shows settings for Network name (SSID) and Wireless network key. The 'Connection' tab shows settings for key for the following: Shared and WEP. The 'Wireless Network' tab shows settings for Use Windows and Available network. The 'General' tab shows settings for To connect to. The 'Advanced' tab shows settings for Router Name, Domain Name, Firmware Version, LAN IP Address, and WAN IP Address. The 'Password' tab shows settings for WEP key sizes and Session settings. The 'Status' tab shows settings for Packets needed to start key recovery. The 'Log' tab shows settings for port to listen on and Send decrypted packets back to the application. The 'Help' tab shows settings for 11333 port to listen on and Send decrypted packets back to the application. The 'Setup' tab shows a welcome message and a 'Setup' button. The 'Options' dialog box shows settings for WEP key sizes (64-bit, 128-bit, 152-bit, 256-bit) and Session settings (10000 packets needed to start a new session, 180 session start timeout (mins)). The 'WAN IP Address' dialog box shows settings for Router Name (C579739-A), Domain Name (@home), Firmware Version (1.12, Jan 17 2000), LAN IP Address (192.168.1.1), Subnet Mask (255.255.255.0), WAN IP Address (24.15.217.106), Subnet Mask (255.255.255.0), Default Gateway Address (24.15.217.1), and DNS (Required) (24.1.4.12).

The Internet has Come Home



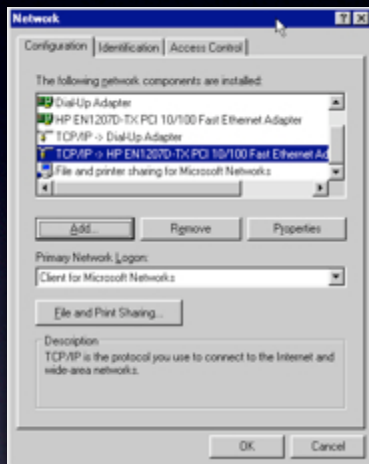
The Challenges of Networking in the Home

- Gap between what users **know** how to do and what they currently **have** to do: too high a barrier
- Gap between what users **want** to do and what they currently **can** do: too low a ceiling
- (Turned around) gap between the services offered by the network and the application requirements

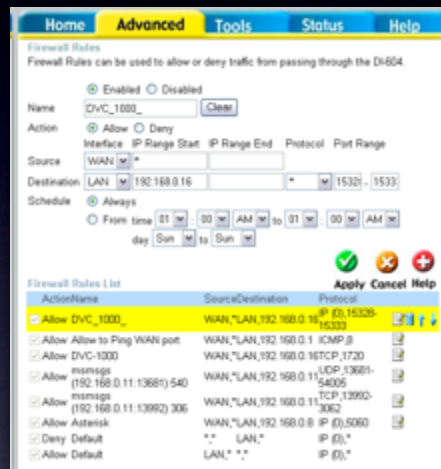


The Network

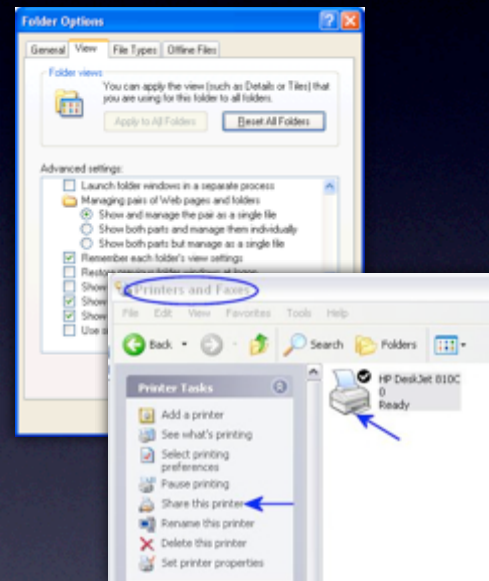
The Necessity of Configuration



Host



Network

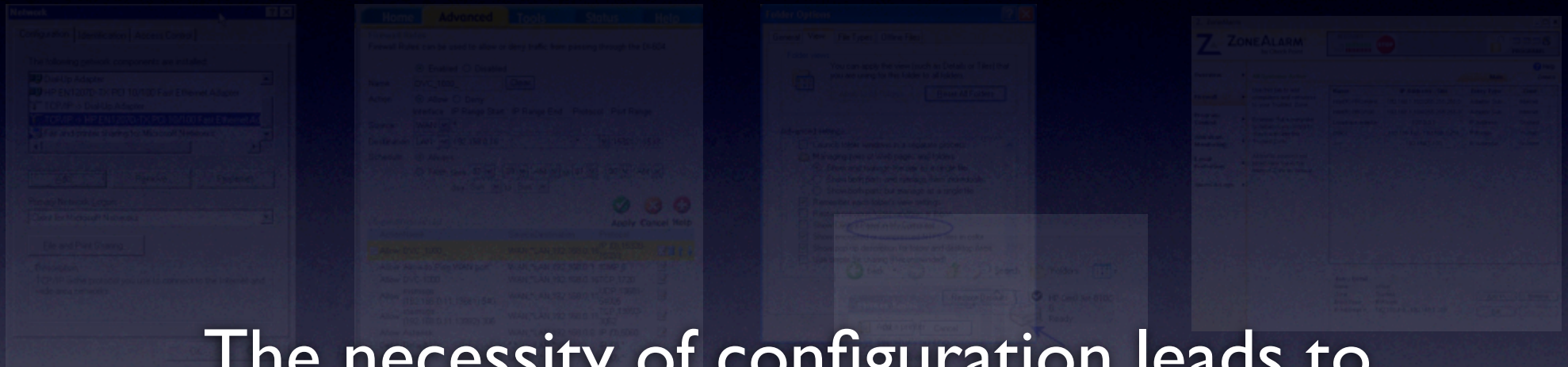


Application



Security

The Necessity of Configuration



The necessity of configuration leads to the potential for *misconfiguration*

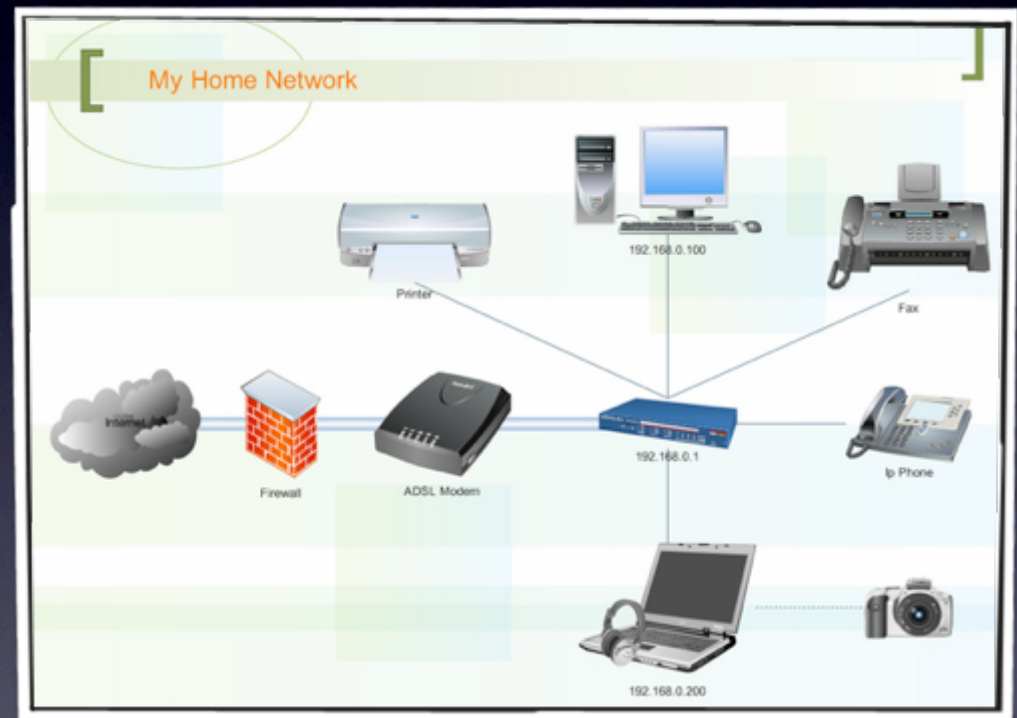
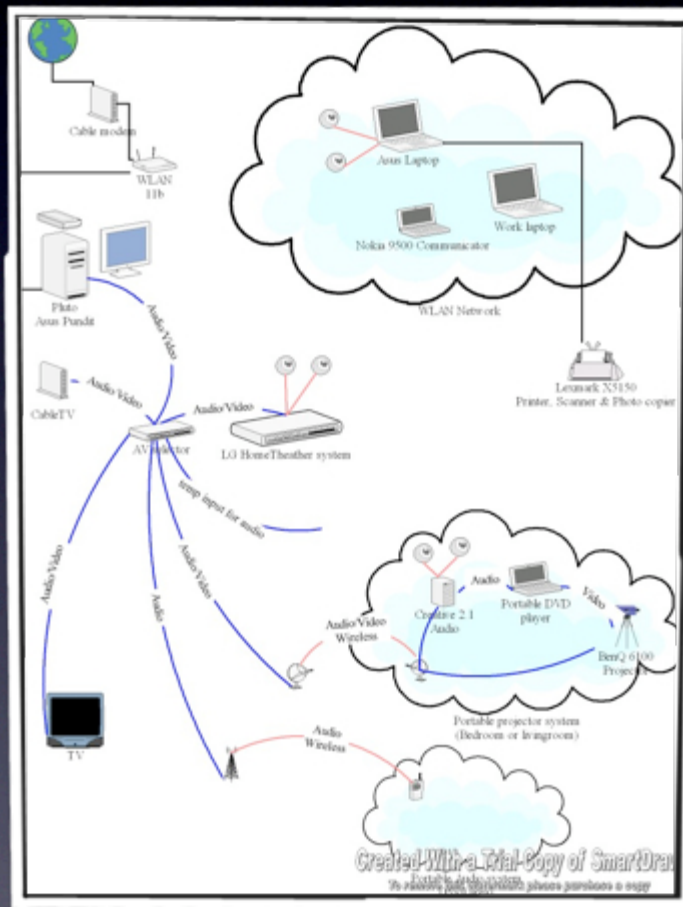
Host

Network

Application

Security

Topology



Topology

Topology shouldn't matter, but it does

- “Inside” versus “outside”
- Multiple DHCP servers
- Multiple subnets (breaks multicast discovery)

It's not just the end-user devices, but network core devices that users must manage

Security

"If you want security, you must be prepared for inconvenience."

General B.W. Chidlaw
12 December 1954

- Conflated with topology
- Spread over multiple sites of activity (antivirus, host firewall, router firewall, ISPs)
- Default for most: NAT

This has let us get sloppy.



HACKERS CAN TURN YOUR HOME COMPUTER INTO A BOMB

... & blow your family to smithereens!

KABOOM! It might not look like it, but an Internet home computer like this one can be turned into a deadly weapon.

WASHINGTON — Right now, computer hackers have the ability to turn your home computer into a bomb and blow you to Kingdom Come — and they can do it anonymously from thousands of miles away!

Experts say the recent "break-in" that paralyzed the Amazon.com, eBay.com and eBay websites are tame compared to what will happen in the near future.

Computer expert Arnold Yabesson, president of the Washington-based consumer group National CyberCrime Prevention Foundation (NCCPF), says that as far as computer crime is concerned, we've only seen the tip of the iceberg.

"The criminals who knocked out those three major online businesses are the head of our armies," Yabesson told *Weekly World News*.

"There are brilliant but unscrupulous hackers out there who have developed technologies that the average person can't even dream of. Even people who are familiar with how computers work have trouble getting their minds around the terrible things that can be done.

"It is already possible for an assassin to send someone an e-mail with an innocent-looking attachment connected to it. When you receive downloads, the attachment, the electrical current and molecular structure of the central processing unit is altered, causing it to blast apart like a large hand grenade.

"An shocking as this is, it shouldn't surprise anyone. It's just the next step in an ever-escalating progression of horrors conceived and instigated by hackers."

Yabesson points out that these dangerous weapons have already:

- Handled FBI and U. S. Army websites.
- Broken into Chinese military networks.
- Cracked an 87-digit Russian security code that would have sent deadly missiles hurtling toward five of America's major cities.
- "As dangerous as this technology is right now, it's going to get much scarier," Yabesson said.

"Soon it will be sold to terrorist cults and fanatical religious fringe groups.

"Instead of blowing up a single plane, these groups will be able to patch into the central computer of a large airline and blow up hundreds of planes at once.

"And worse, this e-mail bomb program will eventually find its way into the hands of anyone who wants it.

"That means anyone who has a quarrel with you, holds a grudge against you or just plain doesn't like your looks, can kill you and never be found out."

Sickos can wreak death and destruction from thousands of miles away!

Arnold Yabesson.

Interactions Between Applications and the Network

- Does the network really stop at the “application layer”?
- Infrastructure doesn’t provide good abstractions for some functionality
 - Multiuser game?
 - Household visitor?
 - Share a directory of photos?

End Result?



- High pain barrier: even “simple” things are hard; hard things are nearly impossible
- High barriers, low ceilings
- Implications for future applications inhibited because of fundamental issues with the network:
 - Health
 - Entertainment
 - Ubicomp
 - Smart home
 - Smart grid
 - ...



People



Menu

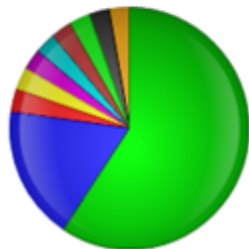
Dashboard

[Add Gadget](#) [Add Tab](#) [Restore Default](#)

Overview [Top Ten](#) [Perspective Status](#) [Network Traffic](#) [Wireless Network](#) [Syslog Event Logs](#) [Demo](#) [London Office](#)

Top 10 - Network Traffic: Endpoints [edit](#) [close](#)

cisco2801.jetstreamnetworks.local



IP Address	Hostname	Pkts	KB	Pct
192.168.1.6	cisco2801	7298	2,271.88	99.95 %
192.168.1.139	vista-business	2845	684.36	30.11 %
192.168.1.133	sweetey	369	116.72	5.14 %
192.168.1.123	perspective6	355	115.49	5.08 %
192.168.1.195	qa-xp-4	306	107.76	4.74 %
192.168.1.177	pt-soak-4	304	107.71	4.74 %
192.168.1.214	perspective2	293	107.10	4.71 %
192.168.1.91	mbazan-dt	285	106.96	4.71 %
192.168.1.154	float-dt	285	106.93	4.70 %
192.168.1.169	xp-pro-base	283	106.81	4.70 %

Top 10 - Network Traffic: Conversations [edit](#) [close](#)

cisco2801.jetstreamnetworks.local



Source	Destination	Port	Applk
192.168.1.139	vista-business	192.168.1.6	cisco2801 161 SNMP
192.168.1.133	sweetey	192.168.1.6	cisco2801 161 SNMP
192.168.1.123	perspective6	192.168.1.6	cisco2801 161 SNMP
192.168.1.91	mbazan-dt	192.168.1.6	cisco2801 161 SNMP
192.168.1.148	perspective1	192.168.1.6	cisco2801 161 SNMP
192.168.1.154	float-dt	192.168.1.6	cisco2801 161 SNMP
192.168.1.169	xp-pro-base	192.168.1.6	cisco2801 161 SNMP
192.168.1.122	perspective4	192.168.1.6	cisco2801 161 SNMP
192.168.1.140	andromeda	192.168.1.6	cisco2801 161 SNMP
192.168.1.143	2003-r2-ent-clt	192.168.1.6	cisco2801 161 SNMP

Network Interface List [edit](#) [close](#)

cisco2801.jetstreamnetworks.local

Interface	Transmit	Receive
FastEthernet0/0	5.53 Kbps	983.00 bps
Voice Encapsulation (POTS) Peer: 20004	0.00 bps	0.00 bps
Voice Encapsulation (POTS) Peer: 20005	0.00 bps	0.00 bps
Voice Encapsulation (POTS) Peer: 20006	0.00 bps	0.00 bps
Voice Encapsulation (POTS) Peer: 20003	0.00 bps	0.00 bps

Alerts In Process [edit](#) [close](#)

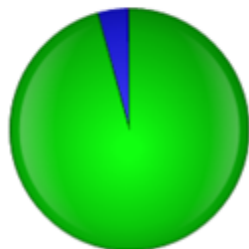
Multiple Targets

[Reset](#) [Reset All](#)

Date	Alert	Policy	Device	Actio
9/4/2008 9:49:43 AM	CPU High	Desktop Po...	192.168.1.154	No
9/4/2008 9:48:37 AM	CPU High	Desktop Po...	192.168.1.138	No
9/4/2008 11:00:05 AM	Desktop Po...	Desktop Po...	192.168.1.93	n/a
9/4/2008 10:59:59 AM	Desktop Po...	Desktop Po...	192.168.1.91	n/a
9/4/2008 10:58:59 AM	Server Poli...	Server Poli...	192.168.1.178	n/a
9/4/2008 10:58:34 AM	Server Poli...	Server Poli...	192.168.1.160	n/a
9/4/2008 10:57:17 AM	CPU runnin...	Server Poli...	192.168.1.122	n/a
9/4/2008 10:57:07 AM	Server Poli...	Server Poli...	192.168.1.122	n/a
9/4/2008 10:52:54 AM	Server Poli...	Server Poli...	192.168.1.27	n/a
9/4/2008 10:51:08 AM	Server Poli...	Server Poli...	192.168.1.3	n/a
9/4/2008 10:50:42 AM	Server Poli...	Server Poli...	192.168.1.2	n/a
9/4/2008 10:50:37 AM	Networkin...	Networkin...	192.168.1.163	n/a
9/4/2008 10:50:22 AM	Networkin...	Networkin...	192.168.1.254	n/a
9/4/2008 10:49:21 AM	Network A...	Networkin...	192.168.1.14	n/a
9/4/2008 10:45:21 AM	Desktop Po...	Desktop Po...	192.168.1.252	n/a
9/4/2008 10:45:05 AM	Desktop Po...	Desktop Po...	192.168.1.118	n/a
9/4/2008 10:43:48 AM	Desktop Po...	Desktop Po...	192.168.1.154	n/a
9/4/2008 10:43:28 AM	Desktop Po...	Desktop Po...	192.168.1.150	n/a
9/4/2008 10:43:08 AM	Desktop Po...	Desktop Po...	192.168.1.141	n/a
9/4/2008 10:42:42 AM	Desktop Po...	Desktop Po...	192.168.1.138	n/a
9/4/2008 10:42:32 AM	Desktop Po...	Desktop Po...	192.168.1.125	n/a
9/4/2008 10:42:22 AM	Desktop Po...	Desktop Po...	192.168.1.114	n/a
9/4/2008 10:09:43 AM	CPU High	Desktop Po...	192.168.1.116	No
9/4/2008 10:06:10 AM	CPU High	Desktop Po...	192.168.1.107	No

Top 10 - Network Traffic: Applications [edit](#) [close](#)

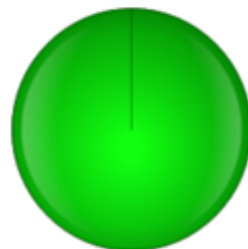
cisco2801.jetstreamnetworks.local



Application Name	Port	Prot	Pkts	KB
SNMP - Simple Network Management Protocol	161	UDP	5505	2,165
ICMP FCHO	2048	ICMP	1587	91

Top 10 - Network Traffic: Domains [edit](#) [close](#)

cisco2801.jetstreamnetworks.local

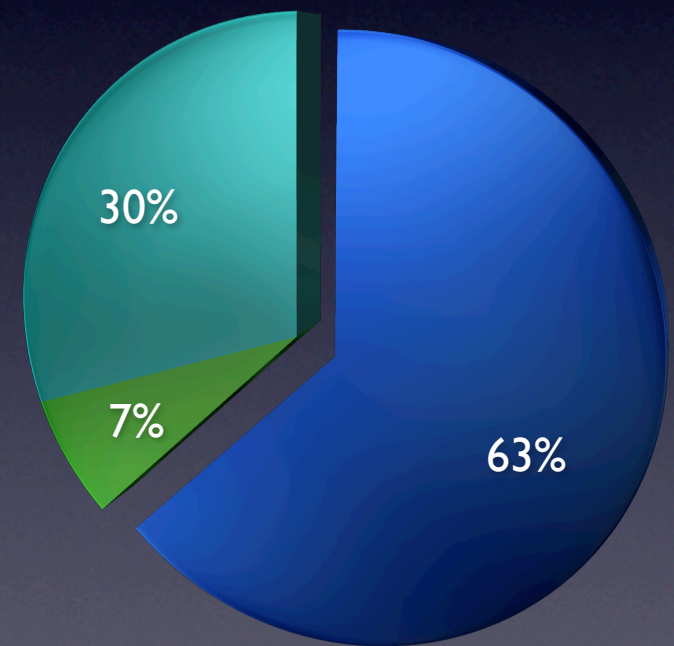
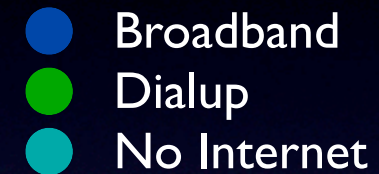


Domain	Pkts	KB	Pct
jetstreamnetworks.local	7319	2,272.96	100.00 %
unknown	13	0.81	0.03 %

Motivation

- **People want the Internet.**
- **They just don't want the network.**

“We want the Internet. Unless you have something better.”



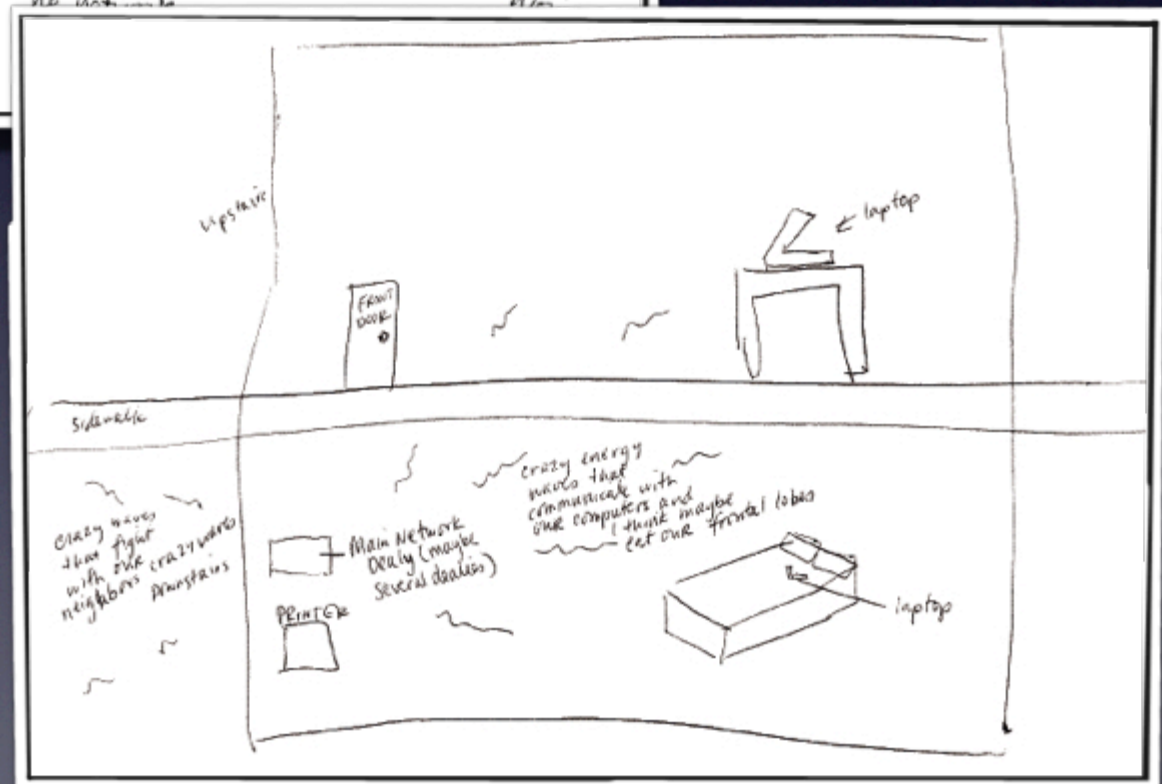
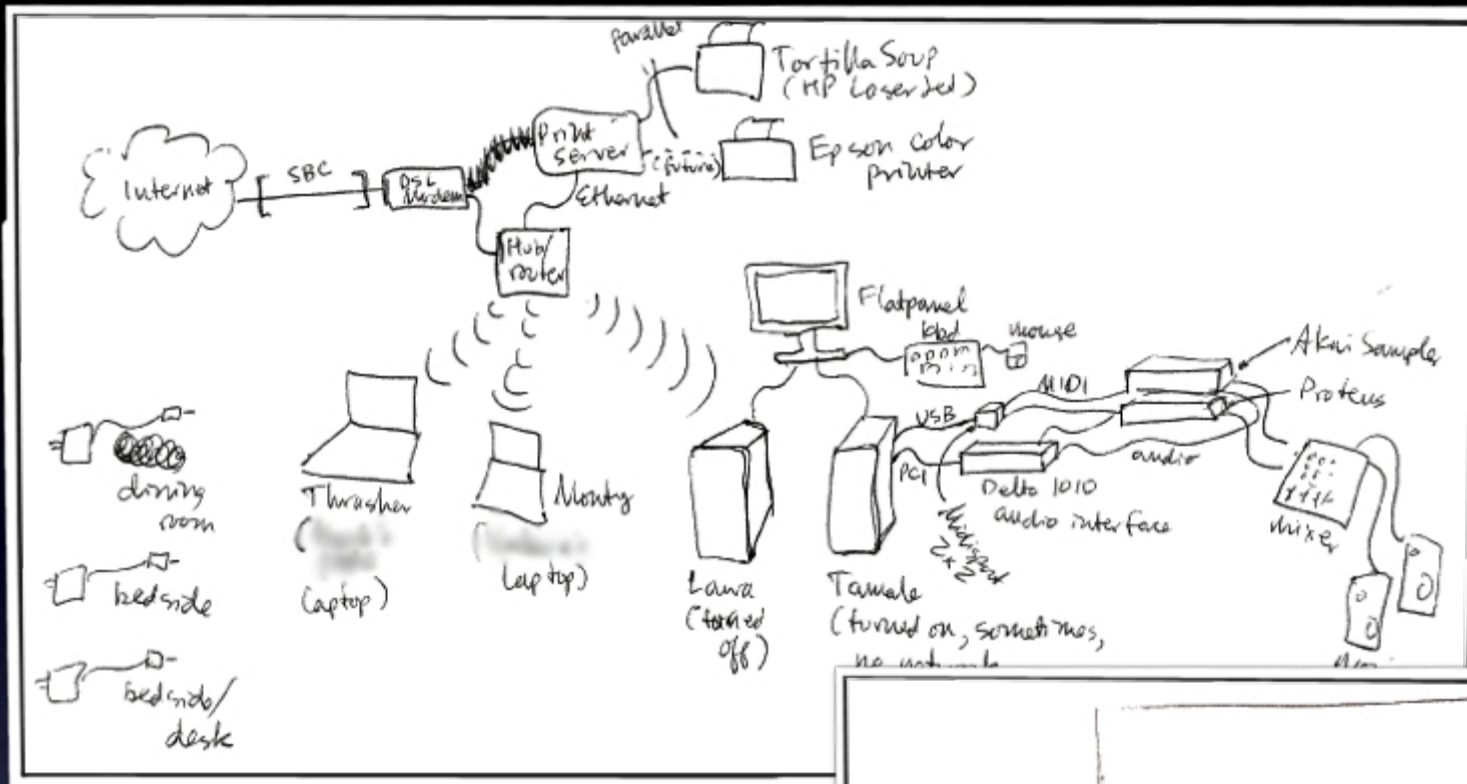
US Internet Adoption, April 2009
Source: Pew

Poor Conceptual Models



*“The Work to Make a Home
Network Work,”
ECSCW 2005*

*“Reflecting on the Invisible:
Understanding End-User Perceptions of
Ubiquitous Computing”
[UbiComp 2008]*



“The Work to Make a Home Network Work,”
ECSCW 2005

“More than meets the eye: transforming the
user experience of home network management,”
DIS 2008

Broken Expectations

March, 1922

**Wireless music
for home entertainments**

ENTERTAIN your friends with radio concerts, enjoy the fascination of radio as a hobby, make wireless a profitable part of your business, get news and market reports before they are published, take public speeches off the air. With a simple receiving set and a Radio MAGNAVOX you can do all this, and more, too, in your own home or office. The front cover of this magazine shows how easy it is, with a Radio MAGNAVOX.

Practically every variety of vocal and instrumental music from jazz to grand opera, news reports in plain English, and many other special features are radio broadcasted daily, free to anyone with the simple equipment to receive and reproduce them. Read the article in this issue.

The Radio MAGNAVOX will reproduce them for many people at the same time. Without the MAGNAVOX only the speaker wearing a head set can hear. Simply substitute the MAGNAVOX for the head set, hook up with a Magnavox Power Amplifier, and an audience of one or one thousand may hear perfectly. This MAGNAVOX equipment enables everything received by radio to be carried in volume to the full amount necessary for any occasion, without using even the most delicate tone modulations at a single bit of the original clearness and distinctness. It makes a radio set adaptable for office, store or factory use, and the use of radio music practical for home entertainments, concerts and dances. It adds to any set the final touch of up-to-the-minute completeness and multiplies its scope and usefulness many times over.

You yourself can operate the MAGNAVOX the very first day without any previous training or experience. The look-up is easy, and there are no adjust screws. The few instructions necessary are included free with each radio. The radio cost no more than the price of a good photograph.

Any first class radio dealer will install it for you, and give you any further assistance required.

The Magnavox Company are world winners by the development of sound amplifying apparatus. It was MAGNAVOX apparatus used by the U. S. Navy and the U. S. Signal Corps to perfect their communications during the Great War. It is MAGNAVOX apparatus now being used by the majority of prominent speakers for addressing large assemblies. The facilities and experience which developed this apparatus are back of each piece of equipment bearing the MAGNAVOX trade mark, and are available to you now in making radio receiver, news amplifier and news reproducer. Write us a letter or mail the coupon below to our nearest office for FREE Magnavox folder.

RADIO MAGNAVOX

THE MAGNAVOX CO., General Office - 614 HAYES - CHICAGO, ILL.
Please send me without cost an information card, name, address, telephone, and city, state, and zip code. I am interested in the following: (check one)
[] I am interested in the following: (check one)
[] I am interested in the following: (check one)
[] I am interested in the following: (check one)

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

This card good on all of our products. Please send to: Magnavox Co., 614 Hayes, Chicago, Ill.

Popular Science
March 1922

*“At Home with Ubiquitous Computing:
Seven Challenges”
[Ubicomp 2001]*

*“The Ins and Outs of Home Networking:
The Case for Useful and Usable Domestic
Networking”
[TOCHI 2009]*

Deeply Personal, Deeply Personalized

- Is a one-size-fits-all network even possible?
- High variance may make automating some aspects difficult
- May argue against “outsourcing”

“Home Networking and HCI: What Hath God Wrought?”
[CHI 2007]

*“How Smart Homes Learn: The Evolution of the
Networked Home and Household”*
[UbiComp 2007]

End Result?

- We've made networking a deeply confusing affair
 - “Scary” upgrades, reboot-and-pray troubleshooting, blinky light user interfaces
- One-size-fits-nobody
 - Neither sufficiently understanding nor addressing the routines in the household that impact the network

Some Reflections on the Gap

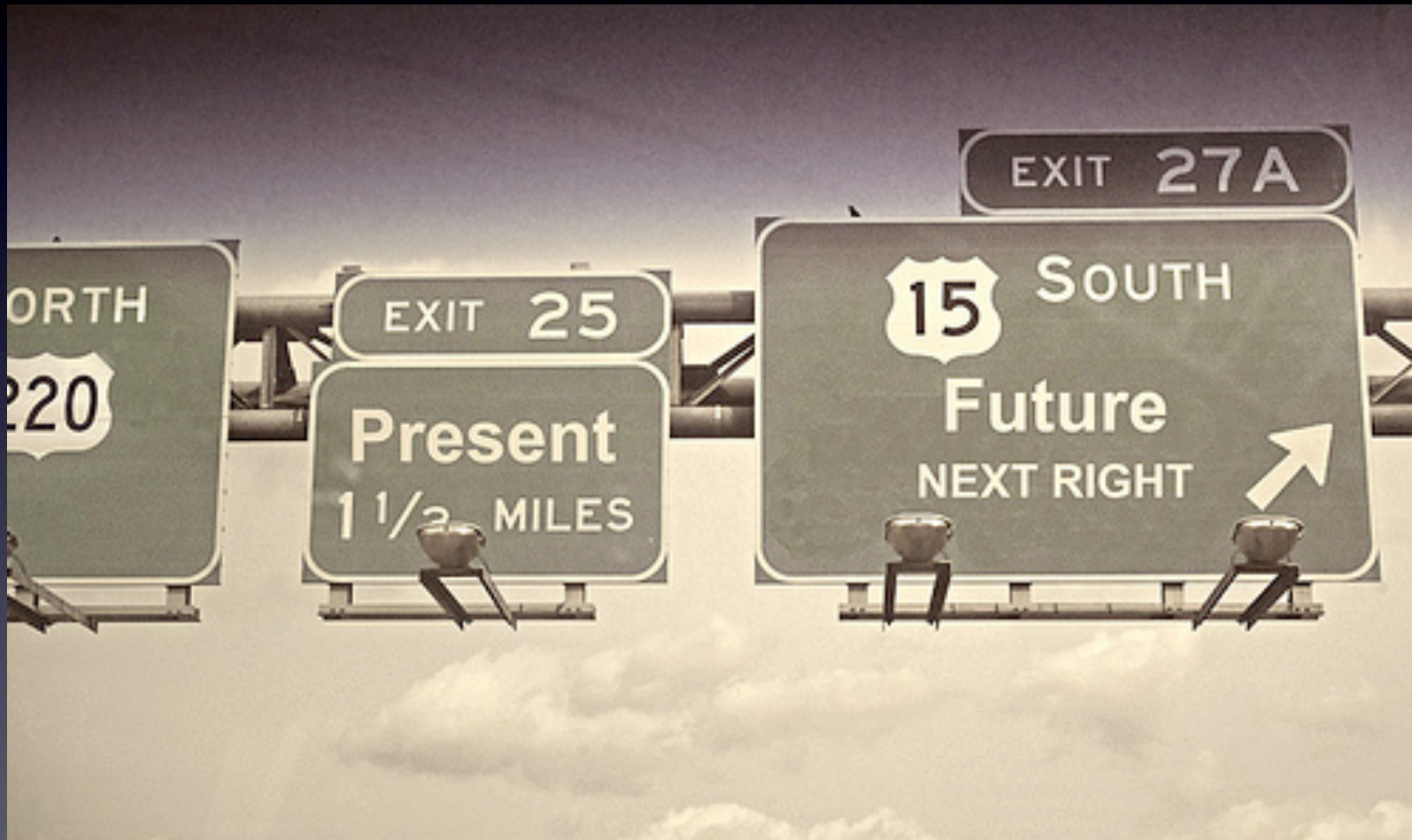


The Disciplinary Divide



- The usual: different language, goals, methods, value systems, conferences, ...
- Neither discipline reaches far enough, or has the right tools to allow it to sufficiently integrate with the other
 - A humble critique of HCI
 - A humble critique of networking

Questions for Research

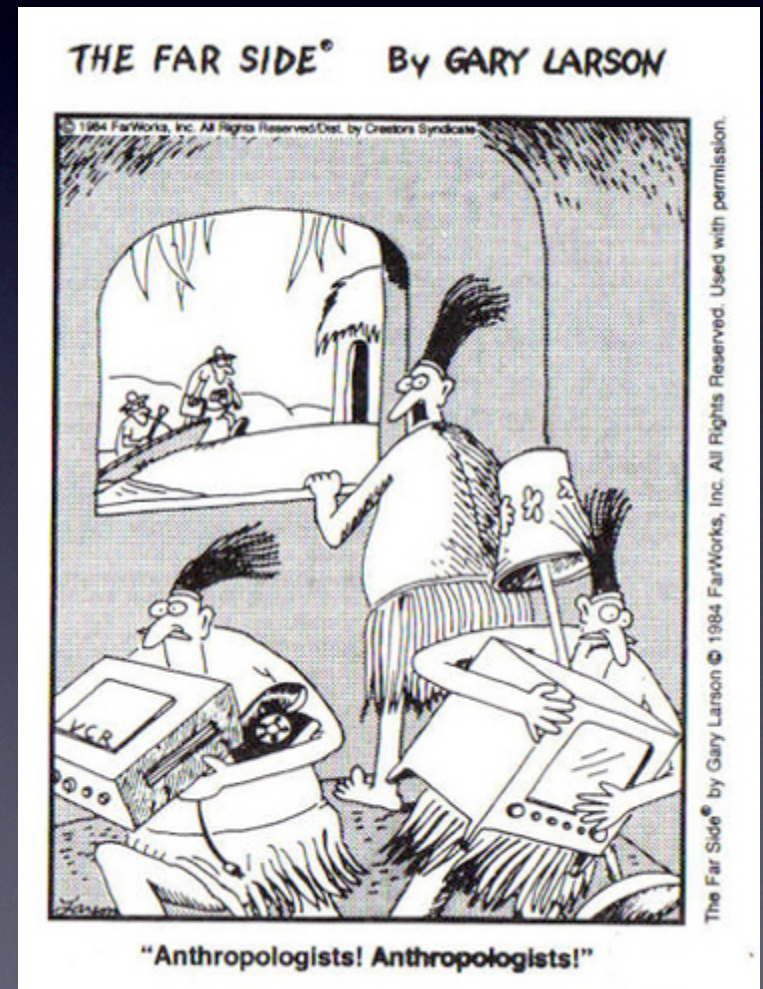


The Need for New Methods

- For evaluation
- For design

“In theory, there’s no difference between theory and practice. In practice, there is.”

- variously attributed



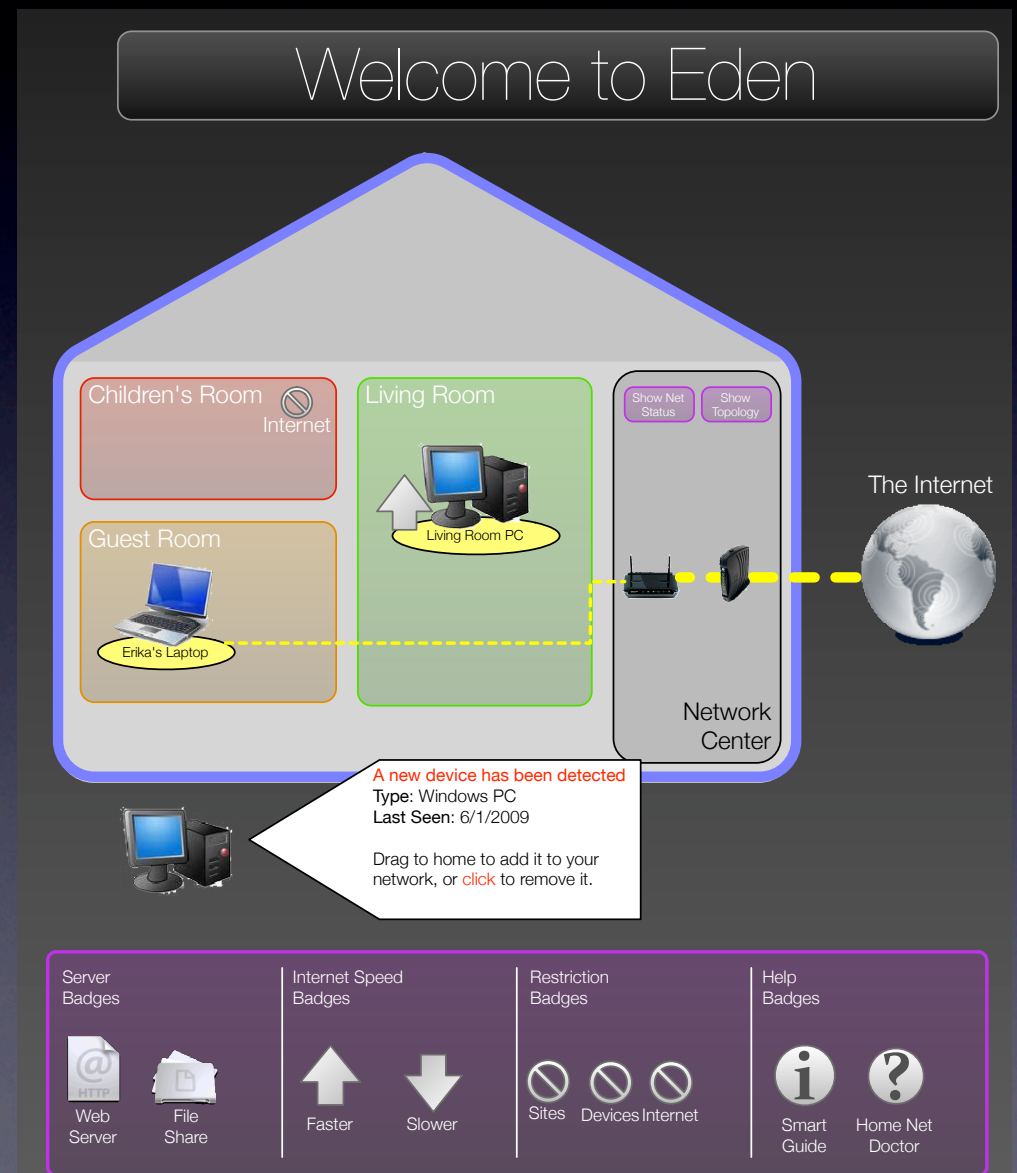
Helping the Network Help Itself

- There will always be some aspects of networking that require human agency or control
- But for everything else, *can we make it just work?*
- Calls for courageous (yet correct) design

“Moving Toward the Middle: The Case Against the End-to-End Argument in Home Networking,”
[HotNets, 2007]

Helping People Help Themselves

- What's the equivalent of the desktop metaphor for networking?
- Not *just* a UI problem. Also may require support from the network in order to do it well.



Helping People Help Each Other

- Collaboration is key
- How do we support with tools?
- Deep questions around personalization and privacy

The Georgia Tech HNI Team

Keith Edwards



Beki Grinter



Nick Feamster



Erika Poole



Marshini Chetty



Jeonghwa Yang



Umayr Hassan

Thank you!

Microsoft




CISCO