



Complexity of Home Networks

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Home Network Complexity:

What are the causes and the cures?



Home Networks \cong Operating Systems – 20 years

“**Unix Air:** Each passenger brings a piece of the airplane and a box of tools to the airport. They gather on the tarmac, arguing constantly about what kind of plane they want to build and how to put it together. Eventually, they build several different aircraft...”

If Operating Systems Were Airlines – David Norris, 2002

```
gif0: flags=8010<POINTOPOINT,MULTICAST> mtu 1280
stf0: flags=0<> mtu 1280
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST>
    ether d4:9a:20:b7:c9:16
    inet6 fe80::d69a:20ff:feb7:c916%en0 prefixlen 64 scd
    inet 10.32.241.72 netmask 0xffffffff broadcast 10.32
    media: autoselect (100baseTX <full-duplex>)
    status: active
fw0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST>
    lladdr d4:9a:20:ff:fe:b7:c9:16
    media: autoselect <full-duplex>
    status: inactive
en1: flags=8823<UP,BROADCAST,SMART,SIMPLEX,MULTICAST> mtu 15
    ether f8:1e:df:db:d9:8c
    media: autoselect <unknown type>
    status: inactive
vmnet8: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTI
    ether 00:50:56:c0:00:08
    inet 172.16.62.1 netmask 0xffffffff broadcast 172.16
vmnet1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTI
    ether 00:50:56:c0:00:01
    inet 172.16.168.1 netmask 0xffffffff broadcast 172.1
```



FORWARDING

Port forwarding can be used to set up public services on your network. When users from the Internet make certain requests on your router, they will be redirected to the specified IP.

Service Port Range	Protocol	IP Address
80 ~ 80	Both	192.168.1.10
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0
0 ~ 0	Both	192.168.1.0

**Well-known Ports
(Commonly Used Ports)**

- 7 (Echo)
- 21 (FTP)
- 23 (TELNET)
- 25 (SMTP)
- 53 (DNS)
- 79 (finger)
- 80 (HTTP)
- 110 (POP3)
- 119 (NNTP)
- 161 (SNMP)
- 162 (SNMP Trap)

Port Triggering

Apply Cancel Help

Causes of Complexity

(incomplete list)

- Users required to describe low-level configuration rather than high-level objectives
- Distributed systems harder than centralized ones
Hence hard to draw lessons from many CE devices
- UIs designed by engineers
- Wireless just plain flaky
- Conflict between usability and security
Often worst of both worlds
- “Mental models” problems – users lack good ones, devices don’t help

Approaches to the problem

- Don't leave UI design in hands of amateurs*
 - The iPod story
 - Study mental models
 - Study users, but don't just ask them what they want
- Systems vs. boxes
- Value vs. price
- Detailed config vs. reasonable defaults
- Rethink system boundaries
- More central control?
- New network architectures may support users expressing intention directly
 - See CCN/NDN, OF, etc.

*Network engineers are amateurs in this field

Summary

- Building good consumer devices is hard, building good consumer **systems** even harder
But some hope based on past experience...

