

The Digital Way Forward:

Delay Tolerant Networks

Browser Interfaces

Zero Installation Hardware

Presented by Marshall Denny

With slides stolen from:

Sanjit Biswas, Robert Morris, (MIT), Saurabh Gupta (WPI), Yao Zhao (Northwestern), et. al.

Who am I

- AI4CM, Extra Class, 23+ years licensed
 - Ecomm of both East and West coast
 - EC Bainbridge Island, 2013 – 2014
 - President BARC, 2013-2014
 - 160m aficionado
 - Tuned Feeder methods
- 20+ years of Unix/Linux server development
 - Optimization specialist, Amazon, Disney, AT&T
 - Radio protocol development, US Navy(contracting)
 - Simulation integration, US Navy(contracting)
 - Computer Science(BS,MS), Physics(BS)

Big Picture

- Look at the past, best of
- Top down feature selection
 - What do we need?
 - What do we want?
- Specifics
 - DTN
 - Browser Interfaces
 - Zero Installation Hardware

Picture before us

- Best of the past

- NTS

- Voice
- CW

Best of Digital, non Ham Radio

- TCP/IP

- WiFi
- Web Interface/REST
- Applications
- Email, Chat, FTP, Application Specific
- Across technologies, Dialup POTS, 10BaseT, etc

Interoperability

- Use internet to enhance but not for basic functionality
 - Design around RF only links
- Example
 - Functionality across multiple tech.
 - DSL
 - Fiber
 - Dialup
 - 300 baud acoustic coupled modem
 - 56k baud modem

Interoperability

- Common tools and protocols
 - Dstar/Drats
 - Winlink
 - AX.25
 - APRS
 - PSK31/Olivia, CRC32, ARQ
 - TCP/IP
- Make Ecomm software/hardware great for every day use.

Interoperability

- Gateways, automatic filters vs manual
- Who has Gateways
 - Simple for Anyone to use/configure
 - Simple for experts to tweak
- What hardware
 - Embedded ultra low power/Cheap
 - Laptop/Desktop
 - Cloud Server
- What software

What we need from you?

- Priority

- What features are useful to you?
- What features are most important?

Delay Tolerant Network/DTN

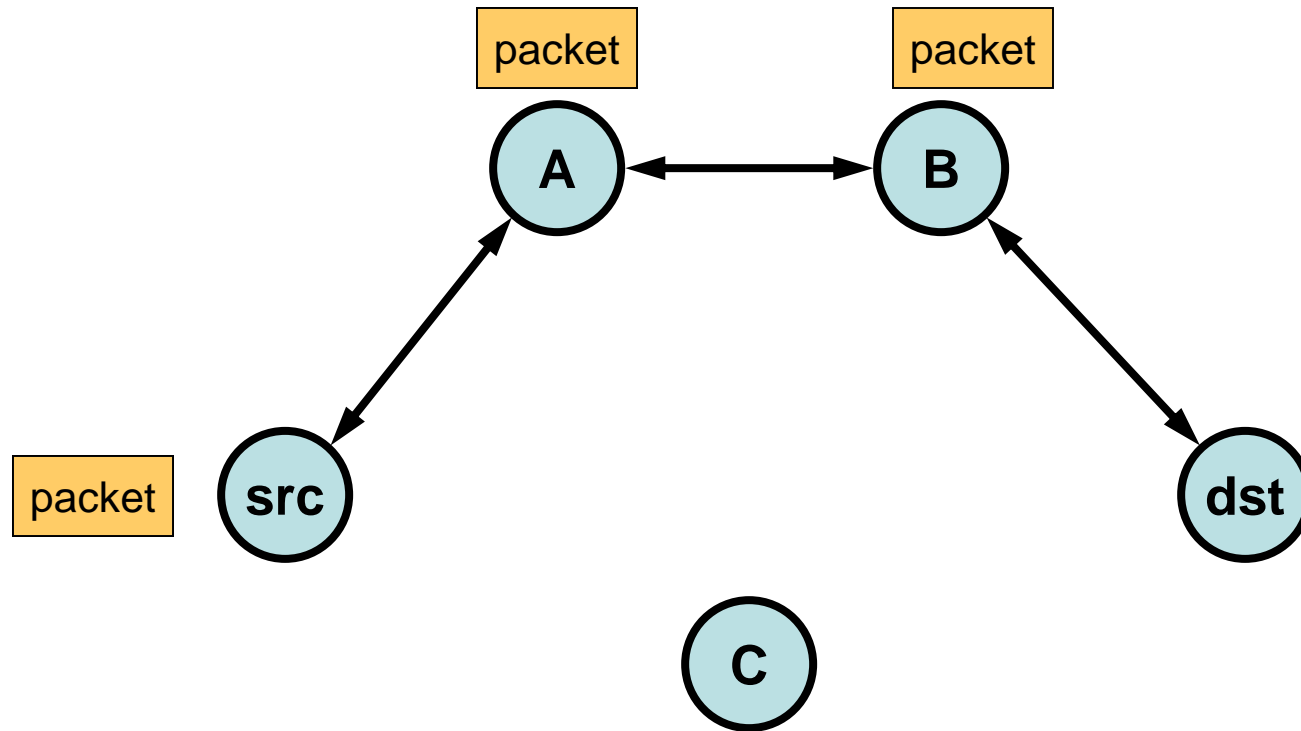
- What is a DTN?
- A completely new idea
- General protocol/tools
 - NTS Digital
- Addressing
 - Who vs where vs how
 - Grid square vs Zip
- Priority control of transmission
- Encapsulation, Email, Web access, APRS

ExOR

ExOR

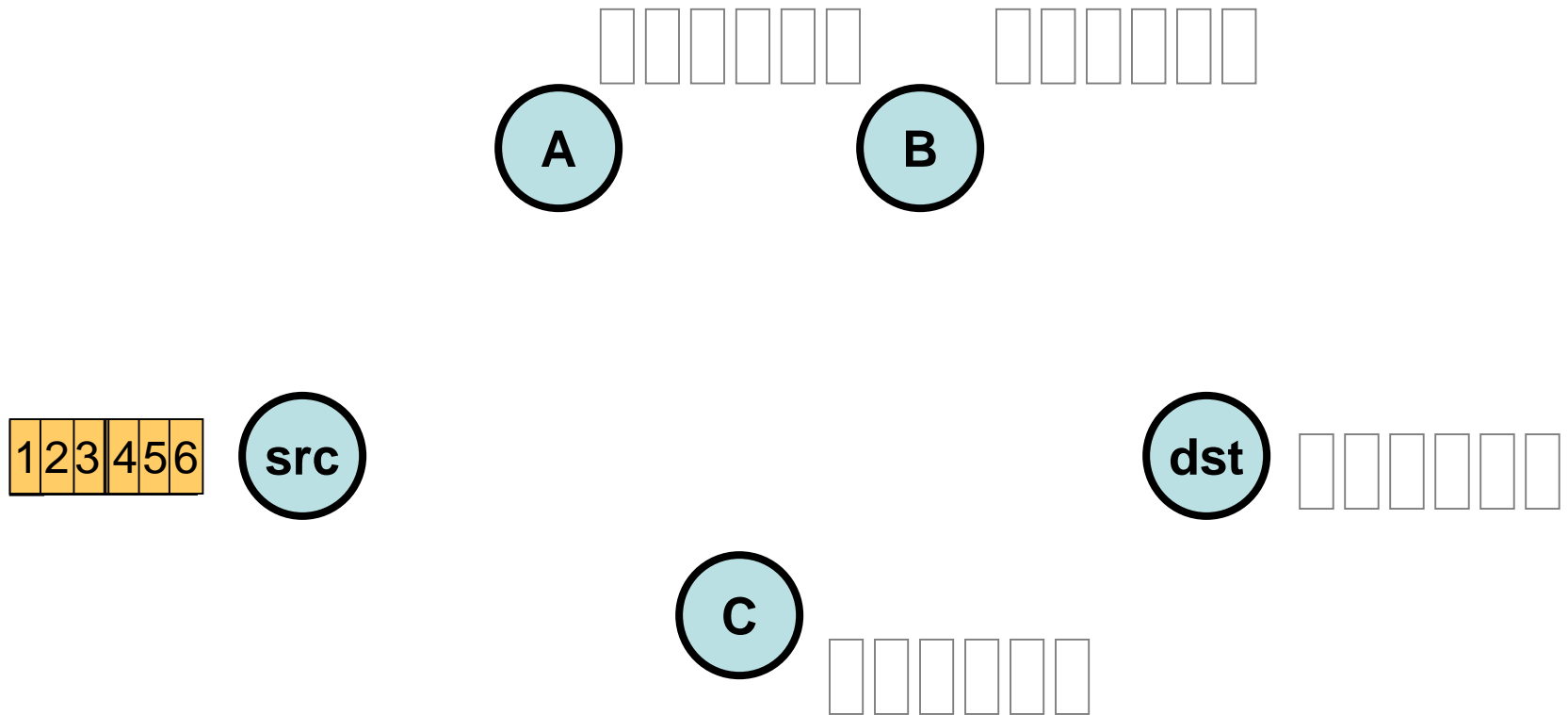
- ExOR vs defined routing
 - Extremely opportunistic routing

The Traditional View



- Identify a route, forward over links
- Use link level retransmissions

How Radios Actually Work

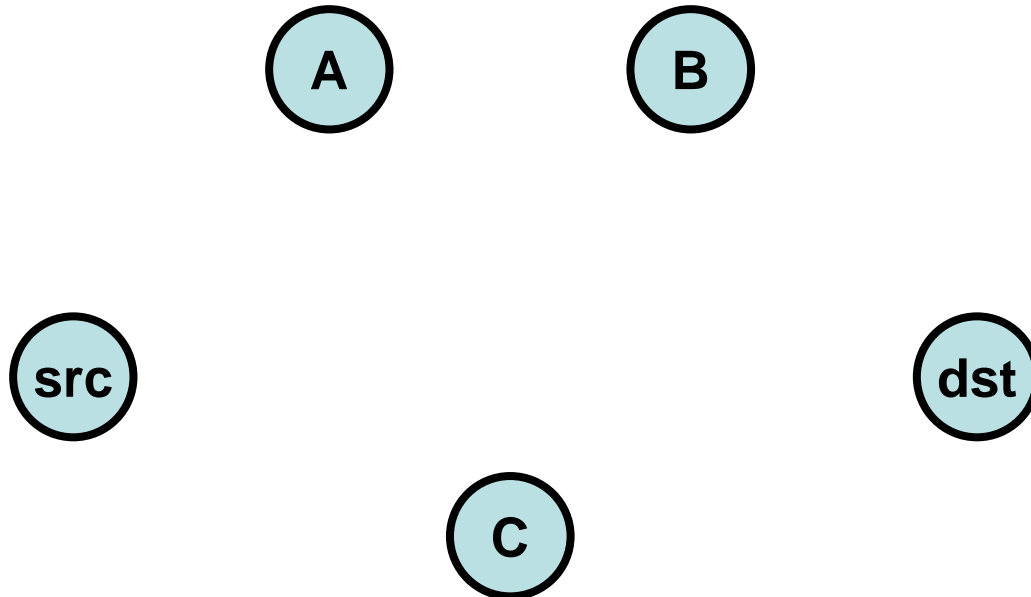


- Every packet is broadcast

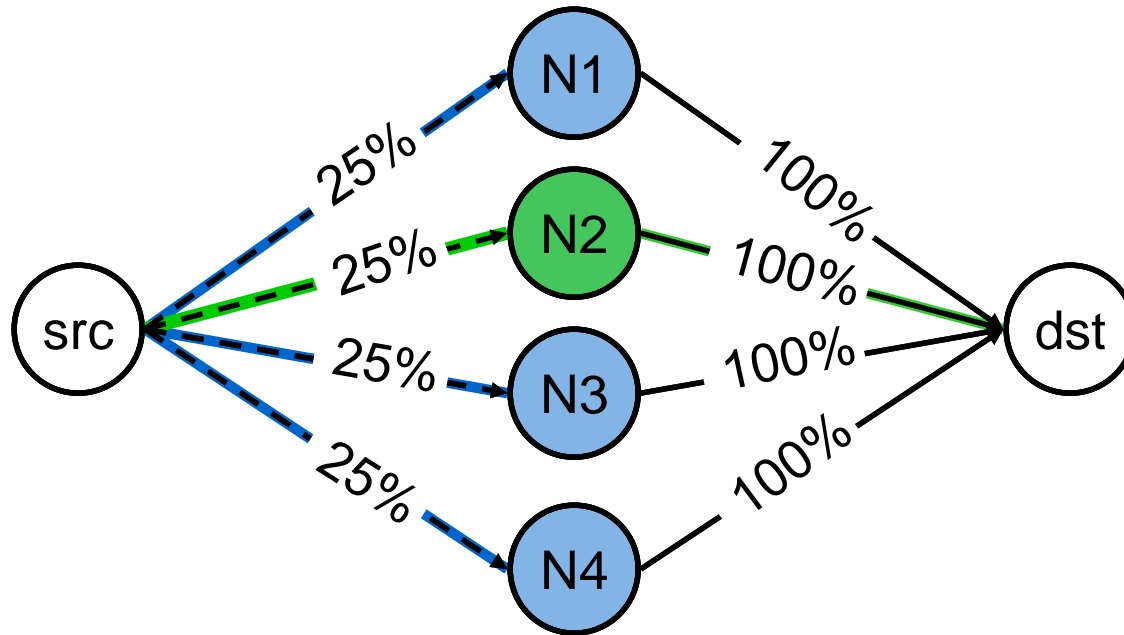
No such thing as a *link*

ExOR's Assumptions

1. Many receivers hear every broadcast
2. Gradual distance-vs-reception tradeoff
3. Receiver losses are uncorrelated

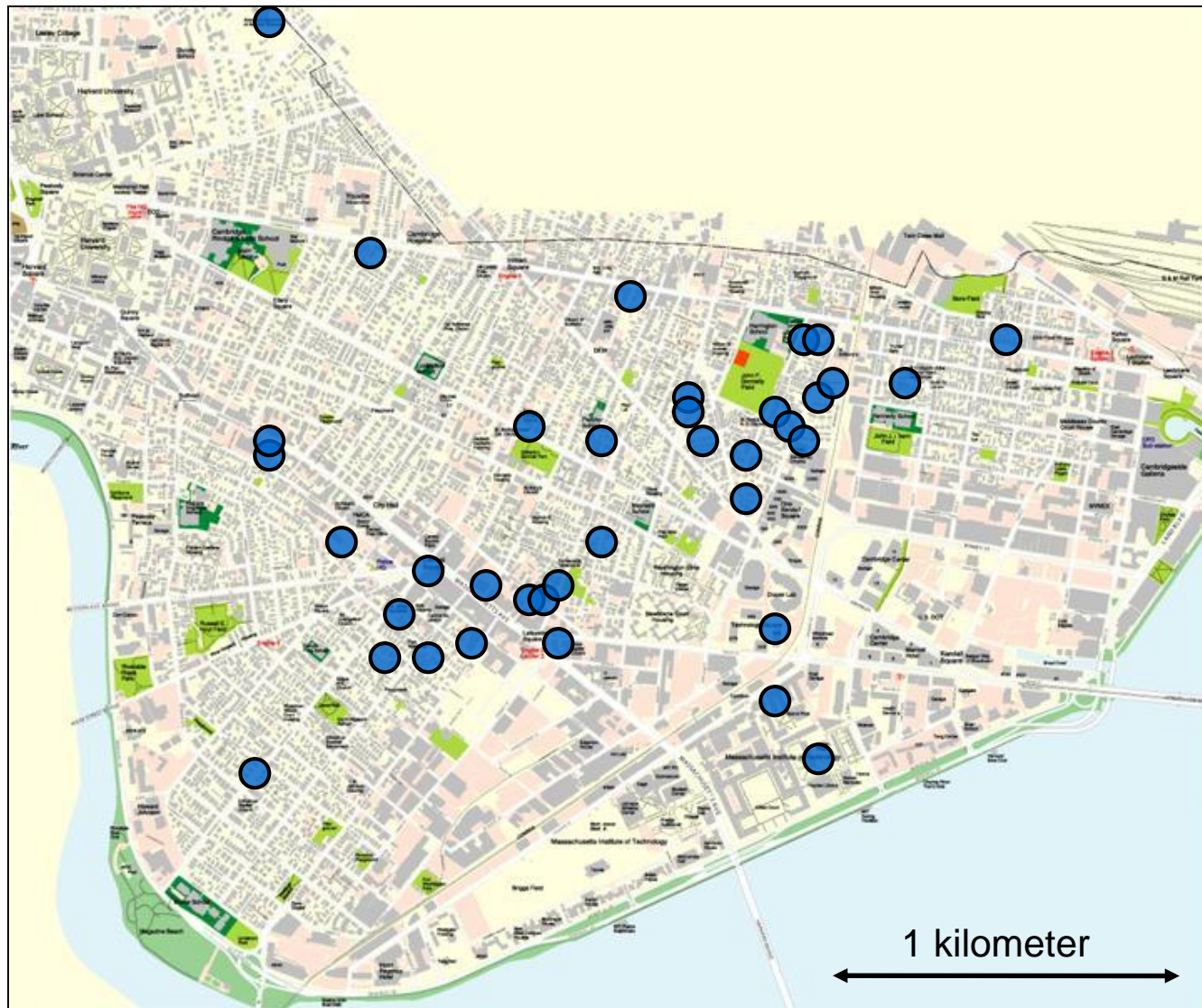


How ExOR might provide more throughput (contd..)



- Traditional routing: $1/0.25 + 1 = 5$ transmissions
- ExOR: $1/(1 - (1 - 0.25)^4) + 1 = 2.5$ transmissions
- Assumes independent losses

65 Roofnet node pairs



25 Lowest throughput pairs

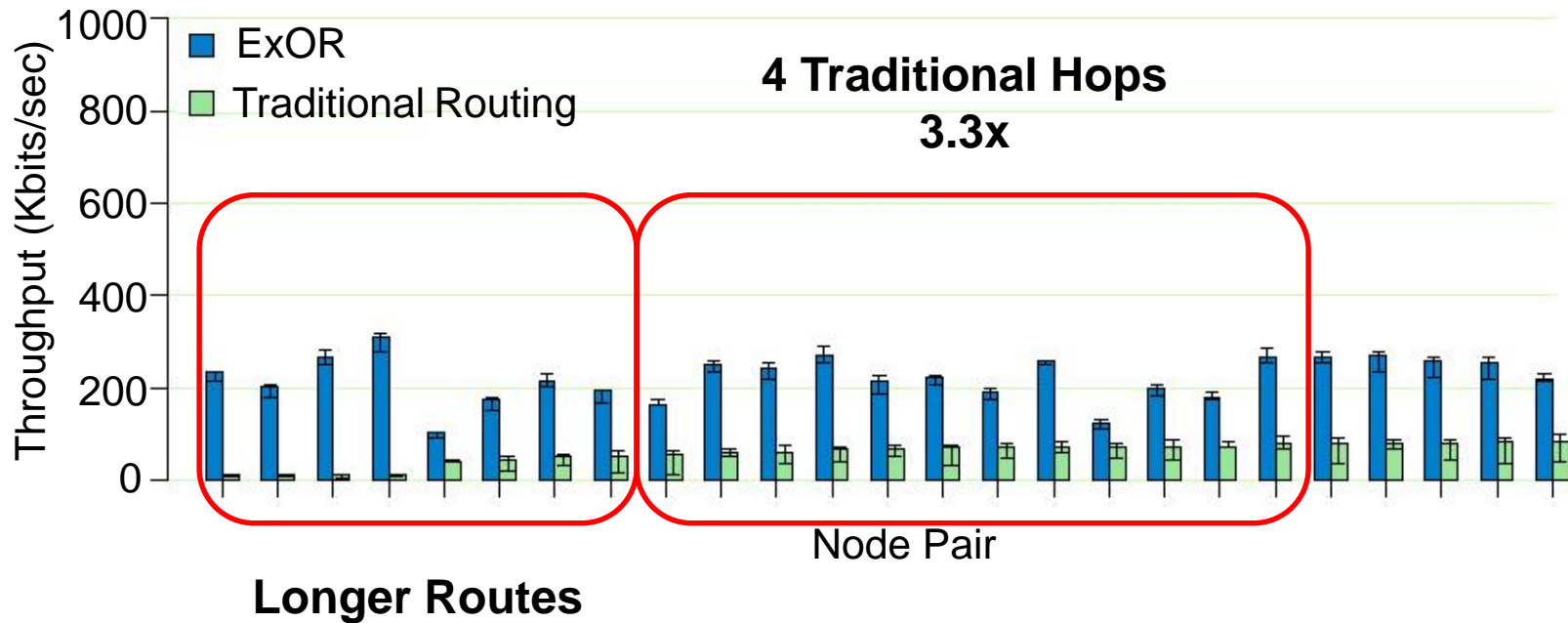
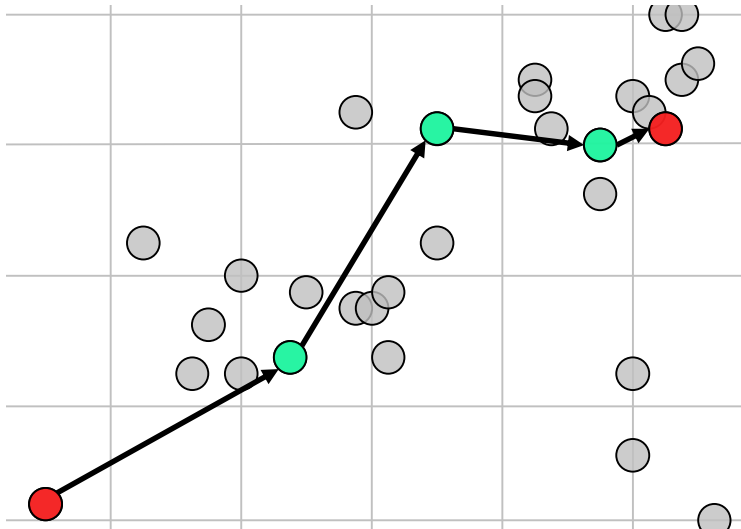


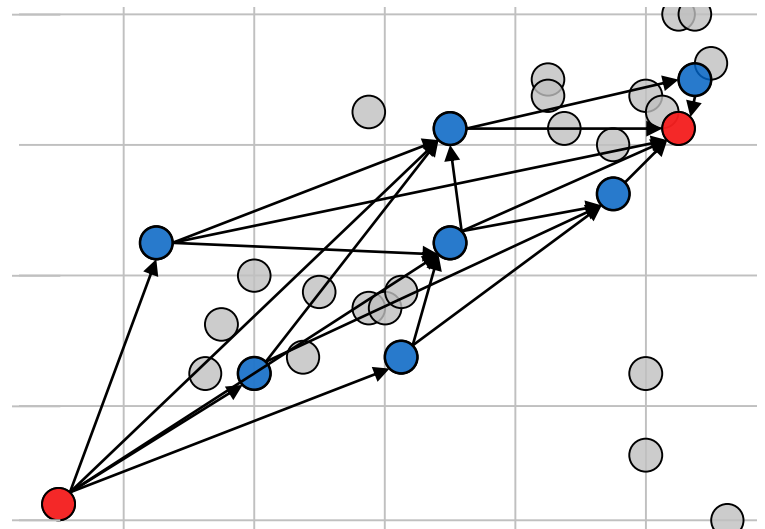
Figure 10: The 25 lowest throughput pairs. The bars show each pair's median throughput, and the error bars show the lowest and the highest of the nine experiments. ExOR outperforms traditional routing by a factor of two or more.

- As number of node pairs increases along a route, the likelihood of increased choice of forwarding nodes and multiple ways to 'gossip' back batch-maps, increases
- With greater routing length ExOR is able to take advantage of asymmetric links also

ExOR uses links in parallel



Traditional Routing
3 forwarders
4 links



ExOR
7 forwarders
18 links

Browser Interfaces

Browser Interfaces

- Cross platform
- Zero installation
- Network
 - Direct, on same machine
 - Local network
 - Internet server
- Integrate Documentation with functionality

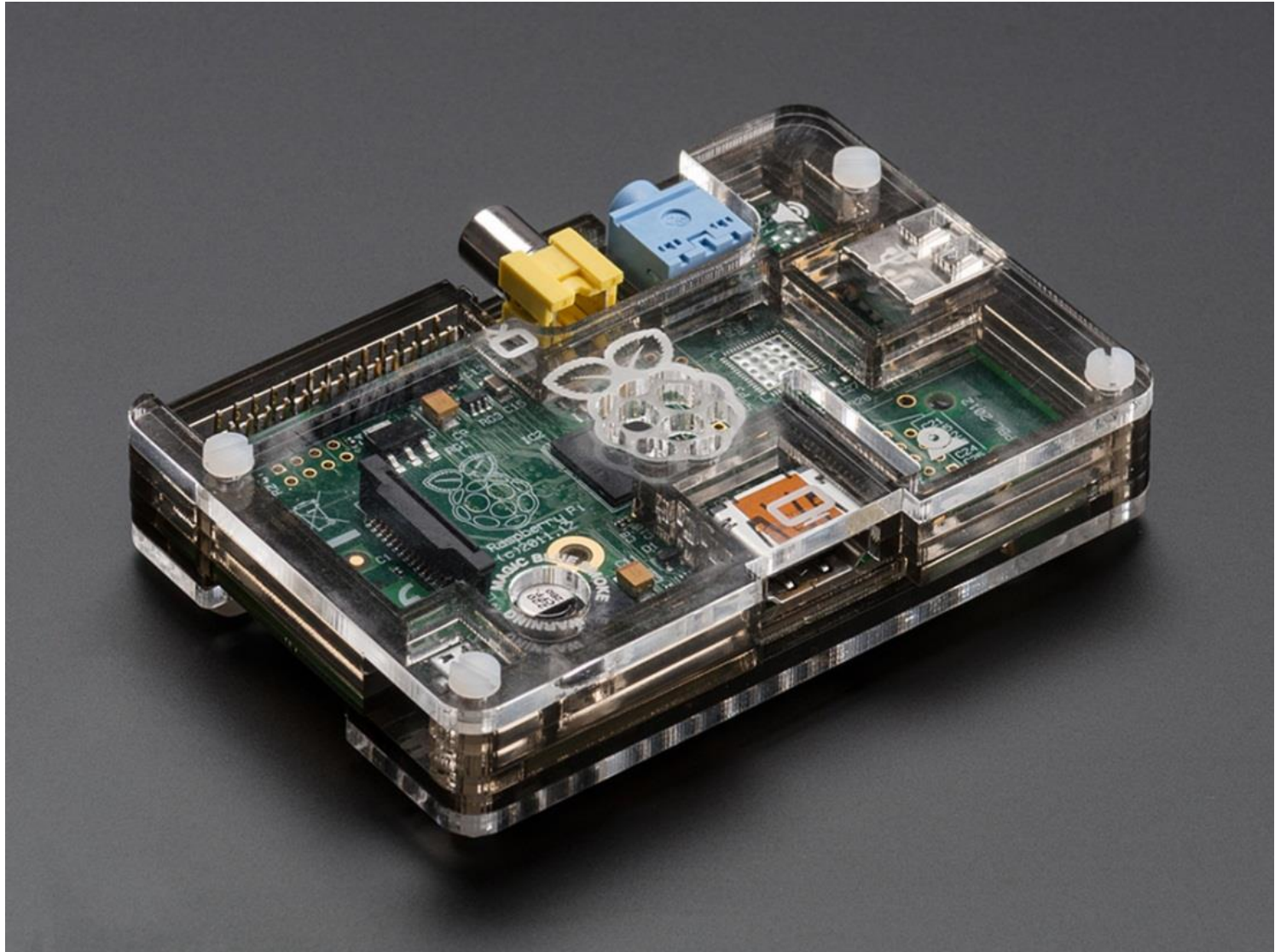
Zero Installation Hardware

- Disaster hardware failure
 - Installing software in emergency situation
 - Upgrade by version of windows
 - Needing newer version of library
- Duplicate HW, with Linux CD
 - Very hardware specific

Zero Installation Hardware



Zero Installation Hardware



Zero Installation Hardware

- Maintainable in the field
- Non-experts
- Quick switching

Summary

- Take a broad view of Ecomm
 - Priority not functionality
- Top down view of feature selection
- What do we need/want
 - No just what we have
- We need your help
- Ecomm focus, general use capable
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