

Incorporate Social Information in Data Collection

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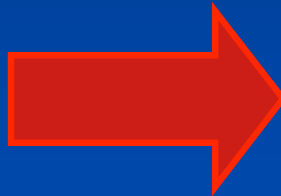
The 3-Step Pipeline of Systems Research

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1. Measure:
Gather data

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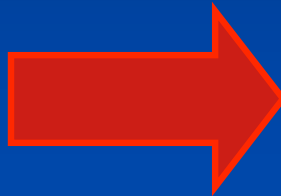
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2. Explore problem space
Build models + simulations

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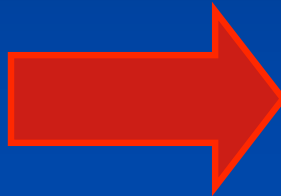
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Build, design, implement better systems

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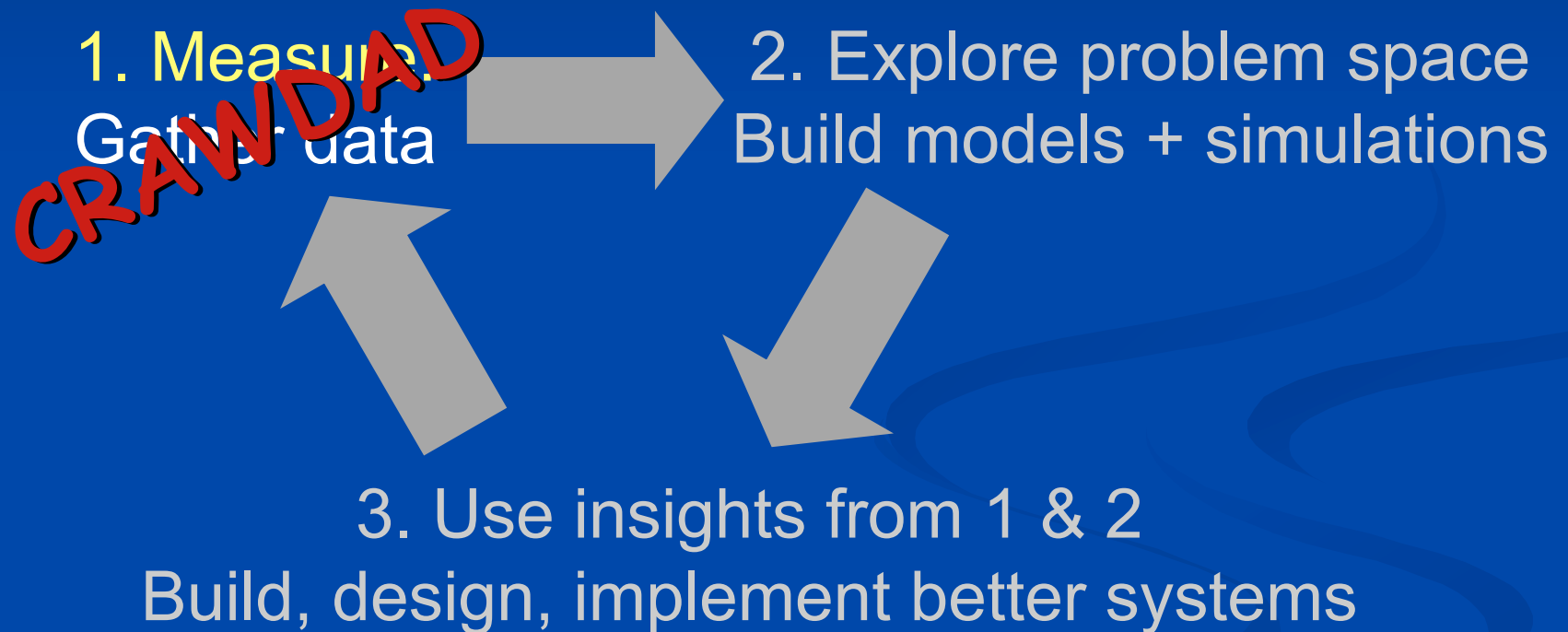


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The 3-Step Pipeline of Systems Research



Context of Today's Wireless Research

- How do you save power?
- How do you route in an ad-hoc, opportunistic, vehicular, sensor, etc... networks?
- How do you know your location?
- How do you build a mesh network?
- How do you view content on a small device?
- How do you secure your network?

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- **Bottom line**: we're making wireless networks work

**Collecting wireless data today
means gathering traces**

Context of Tomorrow's Wireless Research

- How can I share personal content captured by my cell?
- How do I share a photo with the people appearing in it?
- How do I make sure I don't appear in somebody's picture?
- How can I know whether I've met person X?
- How can I retrieve the contact info of somebody I have met 6 months ago?
- How do I know whether I have been at place X at time Y?
- Who else was at that place and time?

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- **Bottom line:** build apps exploiting the wearability and pervasiveness of wireless
 - Wireless networks will become more important than the Internet!

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+

social data

Examples of Social Data

- What are the relationships btw. people carrying devices?
 - Are they friends, strangers, familiar strangers?
- Do they belong to a common group or organization?
- How does the relationship change over time?
- What was the context in which a relationship was formed
 - Temporal, social, geographical

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social data

Your Possible Reactions

Why should I buy all of this?

Social data? Give me a break!

We build systems! We want to hear about performance!

Exploiting Social Interactions in Mobile Systems

Andrew Miklas, Kiran Gollu, Kelvin Chan,
Stefan Saroiu, Krishna Gummadi, Eyal de Lara

University of Toronto
Google
Max Planck Institute

Main Question

Can we build better mobile systems
by exploiting social information?

Examples

- When routing in a mobile DTN should messages b/w friends be routed differently than messages b/w strangers?
- Can we slow down a mobile worm by firewalling based on social relationships?

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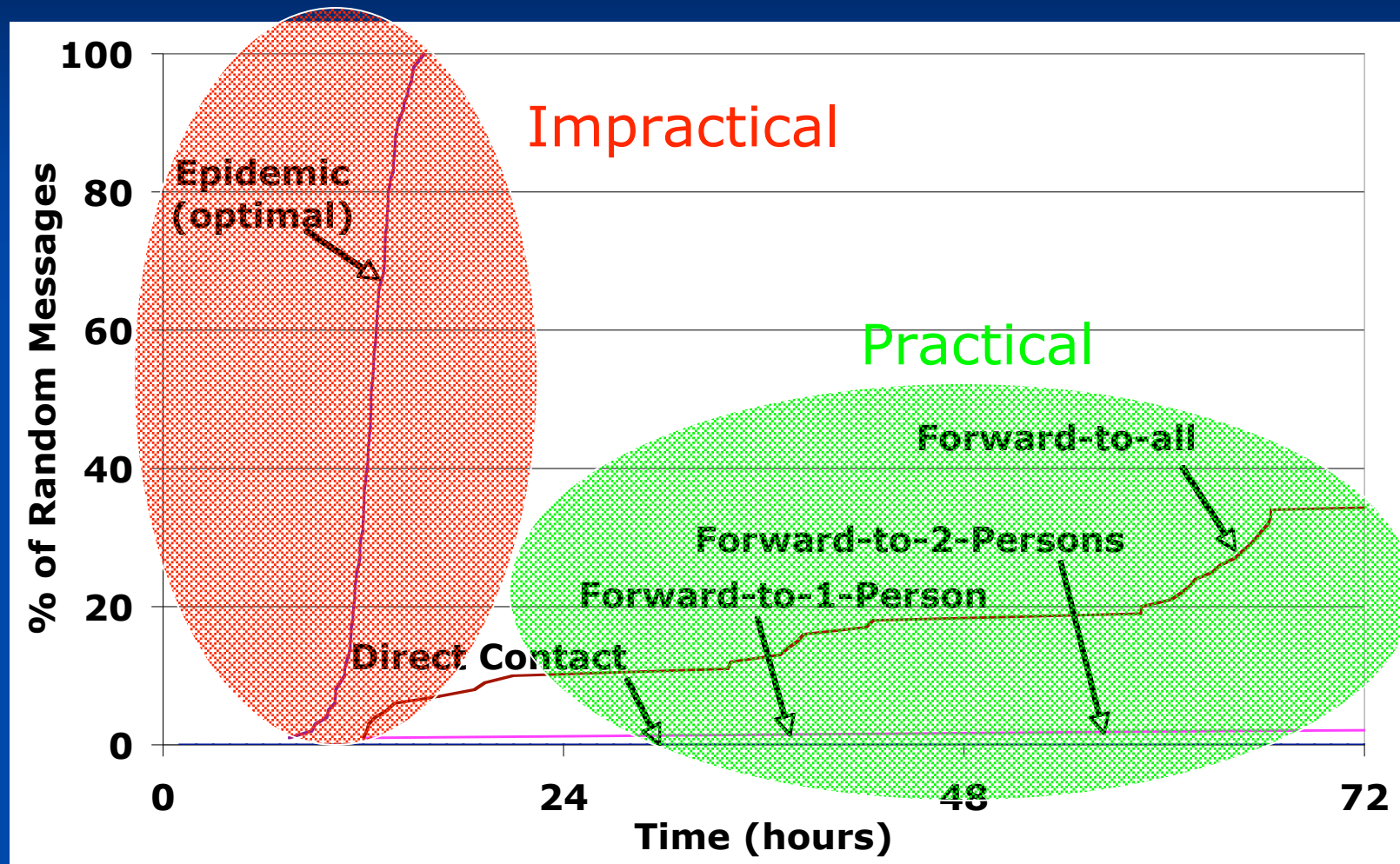
Primer on DTN Routing

- Two classes of protocols
 - Assume no knowledge about network
 - Epidemic routing: optimal delivery, very costly
 - First Contact: works poorly since contact is random
 - Assume some knowledge
 - Compute shortest path given knowledge
 - e.g., average waiting times until next encounter, topology

Our Approach + Methodology

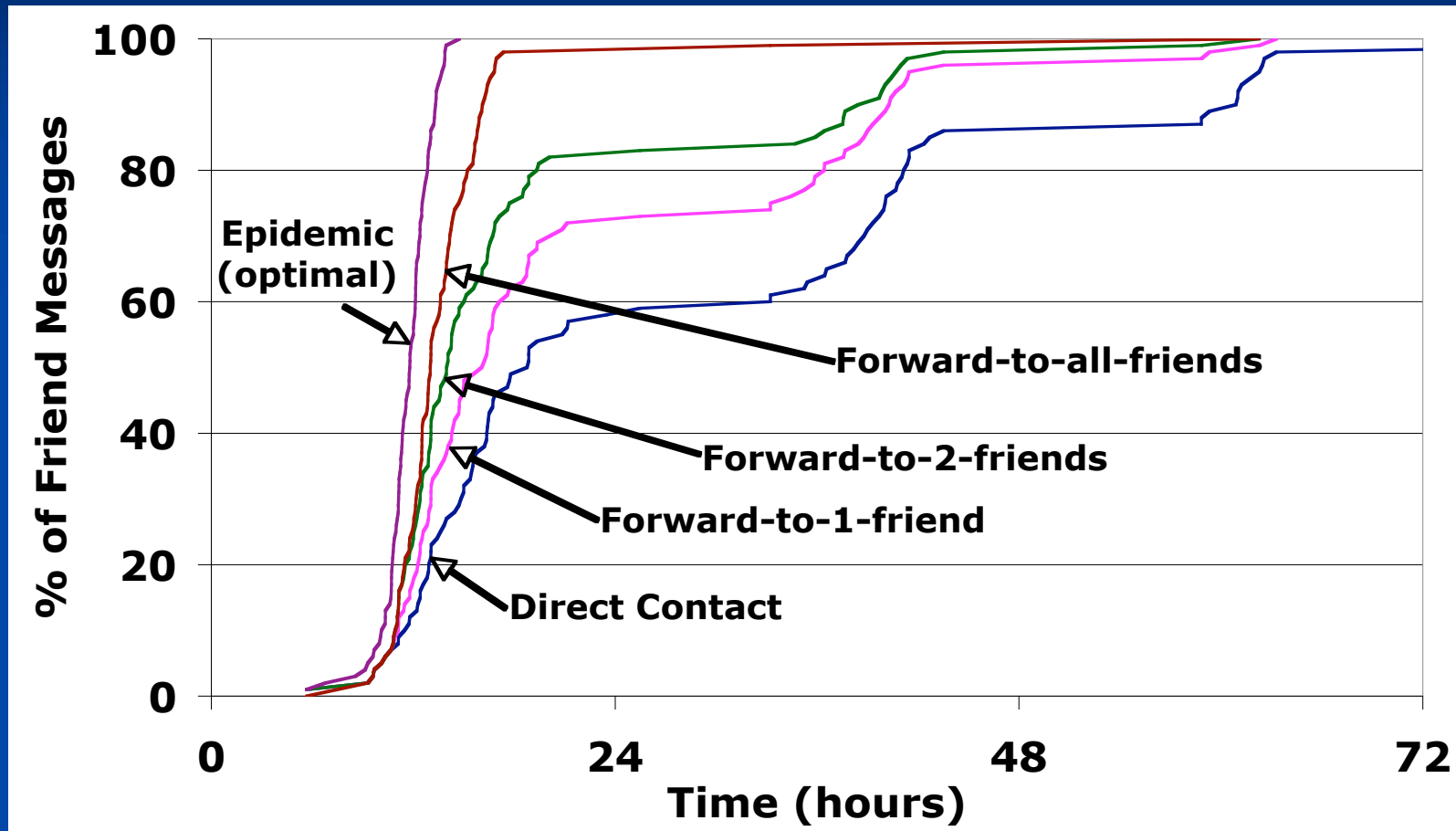
- Don't forward to strangers when routing b/w friends
- Four protocols evaluated:
 - Direct contact: no forwarding allowed
 - Forward to k-persons: k intermediaries allowed
 - $K = 1, 2, \infty$
- Measure delivery times for 100 pairs of...
 - Friends + random people

Practical Protocols Don't Work



Flooding: full delivery in 15.7h, Forward-to-All: 34% delivery in 72h

Practical Protocols w/ Social Info Work



**Direct contact: 50% of messages delivered in 19 hours
(only 7 additional hours over optimal)**

DTN Conclusions

- Messages between friends can be routed efficiently and quickly using practical protocols

Examples

- When routing in a mobile DTN should messages b/w friends be routed differently than messages b/w strangers?
- Can we slow down a mobile worm by firewalling based on social relationships?

Firewalls

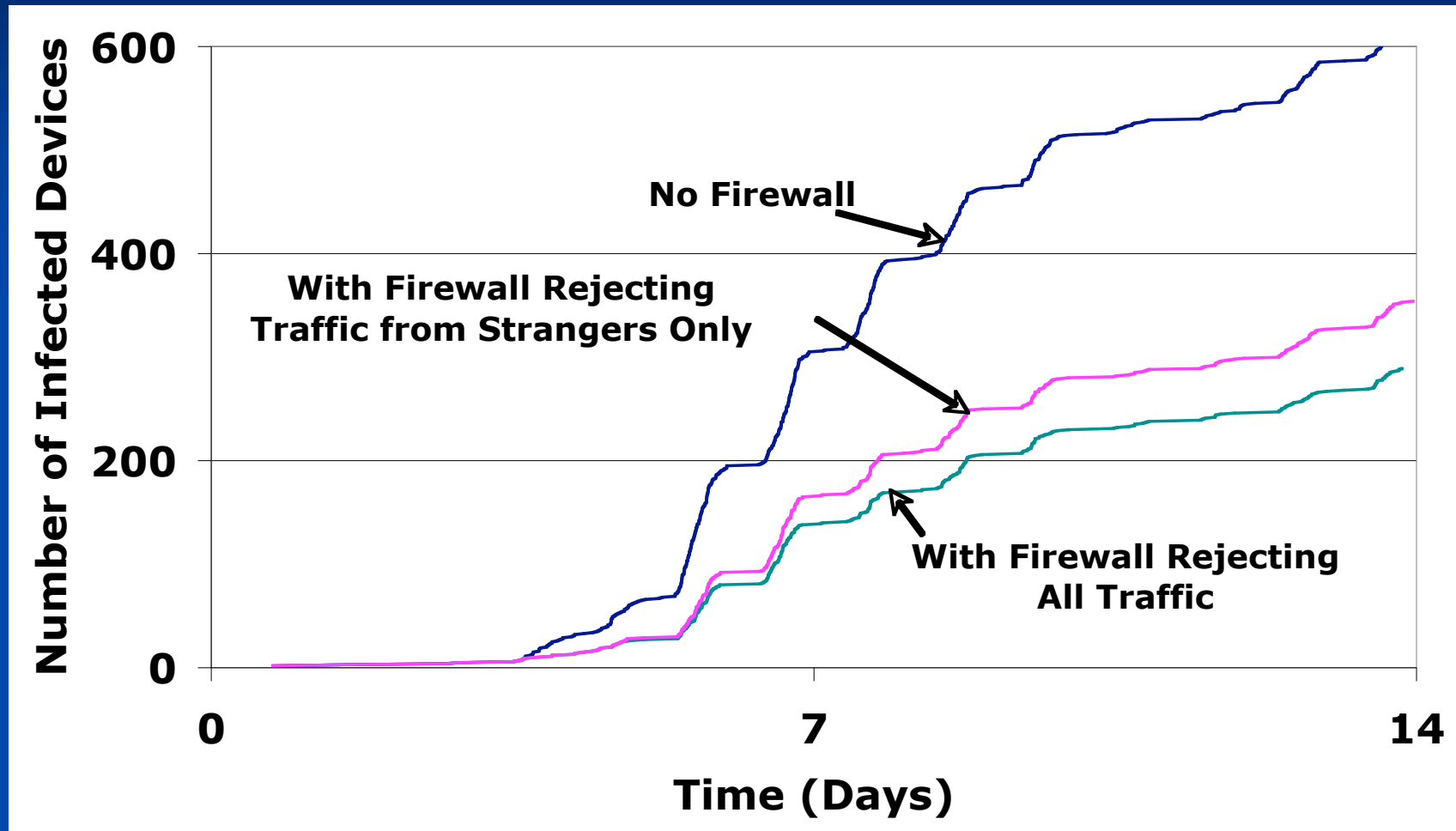
- Firewall devices during worm outbreak
 - Very effective solution (turn off BT)
 - Unappealing -- no network applications work
- Our solution: build *social firewall*
 - Turn off receiving traffic from strangers
 - Allow traffic from friends
 - Can still run chat or sharing files with friends

Methodology

- 5% of 20K nodes vulnerable
- 30% vulnerable nodes have firewall
 - Fully opaque: reject all incoming traffic
 - Social networking: reject strangers only
- One “seed” node

- Measure speed of infection

Social Firewalls are Effective



Full Firewall: 289 infections after 14 days
Social Firewall: 354 infections after 14 days (22% more)

Bluetooth Worm Conclusions

- Social firewalls are attractive:
 - Slow down propagation rate in the early stages
 - Buys time to develop and deploy patch
 - Allow some apps to work

Final Conclusions

- Social information: new type of information to use when building mobile systems
- Exploiting social structure leads to substantial performance gains for DTN routing protocols
- Social networking firewalls offer attractive solution against worm infections

**We can improve mobile systems
by using social information**

Incorporate Social Information in Data Collection

Questions?

- Thank you for your attention!
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- stefan@cs.toronto.edu