Technische Universität Braunschweig

Institute of Operating Systems and Computer Networks

DTN-DHT: Bundle Protocol Naming Service

Free-Riding the BitTorrent DHT to Improve DTN Connectivity

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Bundle Protocol: DTN-Internet Convergence

- Standard Bundle Protocol convergence layers (TCP-CL, UDP-CL) use internet standard protocols as transport
- DTNs are used in fringe networks, which have localized and intermittent Internet connectivity
  - Intermittent 3G connection on a mobile device
  - Internet enabled sink node in sensing apps
- **Bad idea:** Use an application proxy at the border of the network to interface with “The Internet”
- **Good idea:** Use Bundle Protocol end-to-end

Bundle Protocol State of the Art

Routing

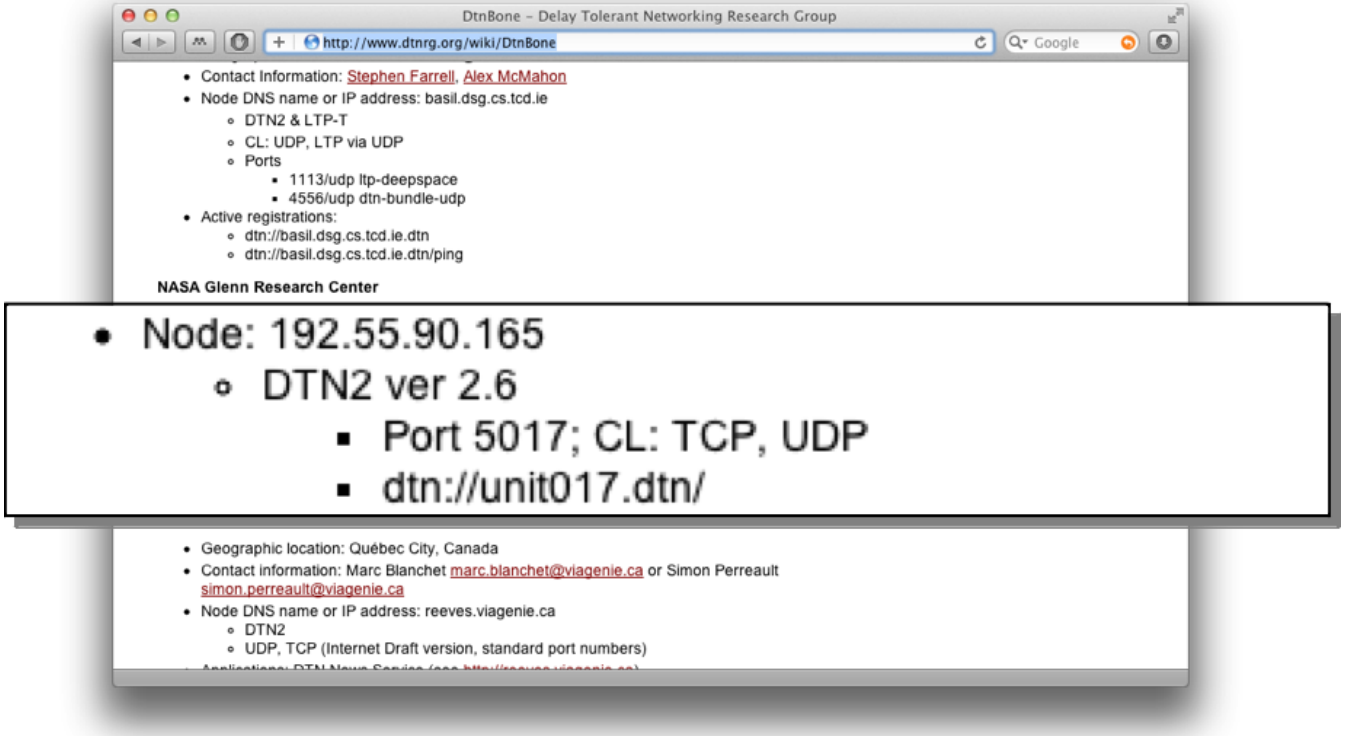
- Epidemic, PRoPHET, Direct-Contact, Static,...
- Decide what to transfer when meeting a *neighbor*

Neighbor (Discovery)

- Configure static contacts
- IP Neighbor Discovery (`http://tools.ietf.org/html/draft-irtf-dtnrg-ipnd`)
- DTN2 neighbor discovery

The Result: DTNBone “WNS”

“ *dtnbone* [...] denote[s] our effort to establish a worldwide collection of nodes running DTN bundle agents and applications.”



Wiki **N**ame **S**ystem!

What is Needed?

Problem statement

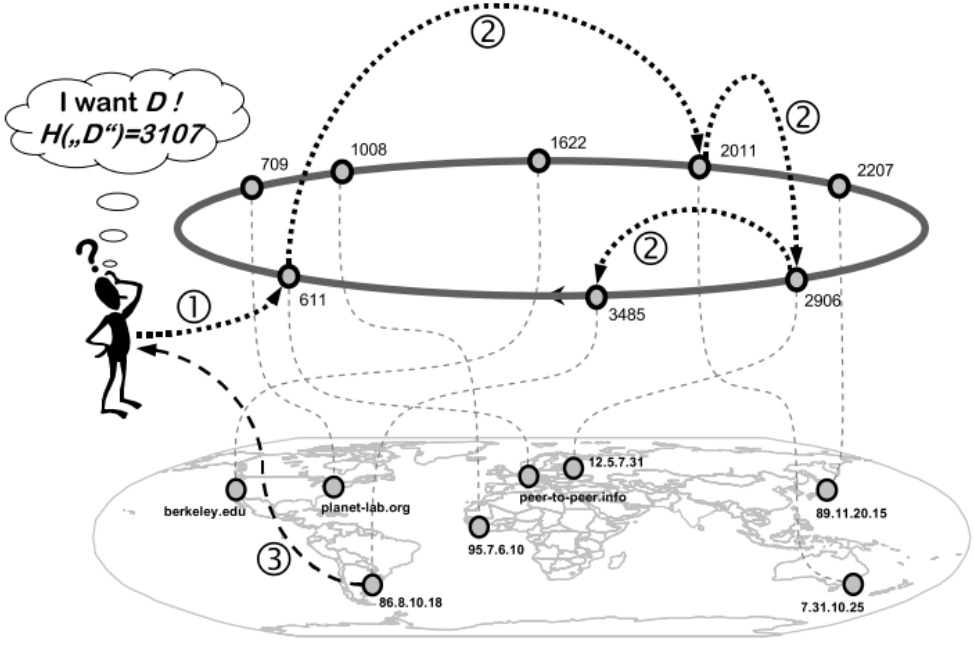
- We should be able to contact a Bundle Protocol DTN node by its *name*: the Endpoint Identifier (EID)
- This should work across the Internet

Requirements

- No additional restrictions: EIDs are URIs offering a flat namespace, as the BP specification imposes no further semantics
- No additional infrastructure: Nobody wants to operate or pay for a DNS-like infrastructure

Solution Outline

Use a Distributed Hash Table to store naming information.



Steinmetz, R., & Wehrle, K. (2005). Peer-to-peer systems and Applications

DHT=P2P, decentralized, scalable ($\sim O(log(n))$ node state and communication steps for retrieval)

Prequel: What we tried first

What has been done

- Build a custom DHT solution based on Kademlia
- Sophisticated timeout mechanisms
- High speed asynchronous change notifications

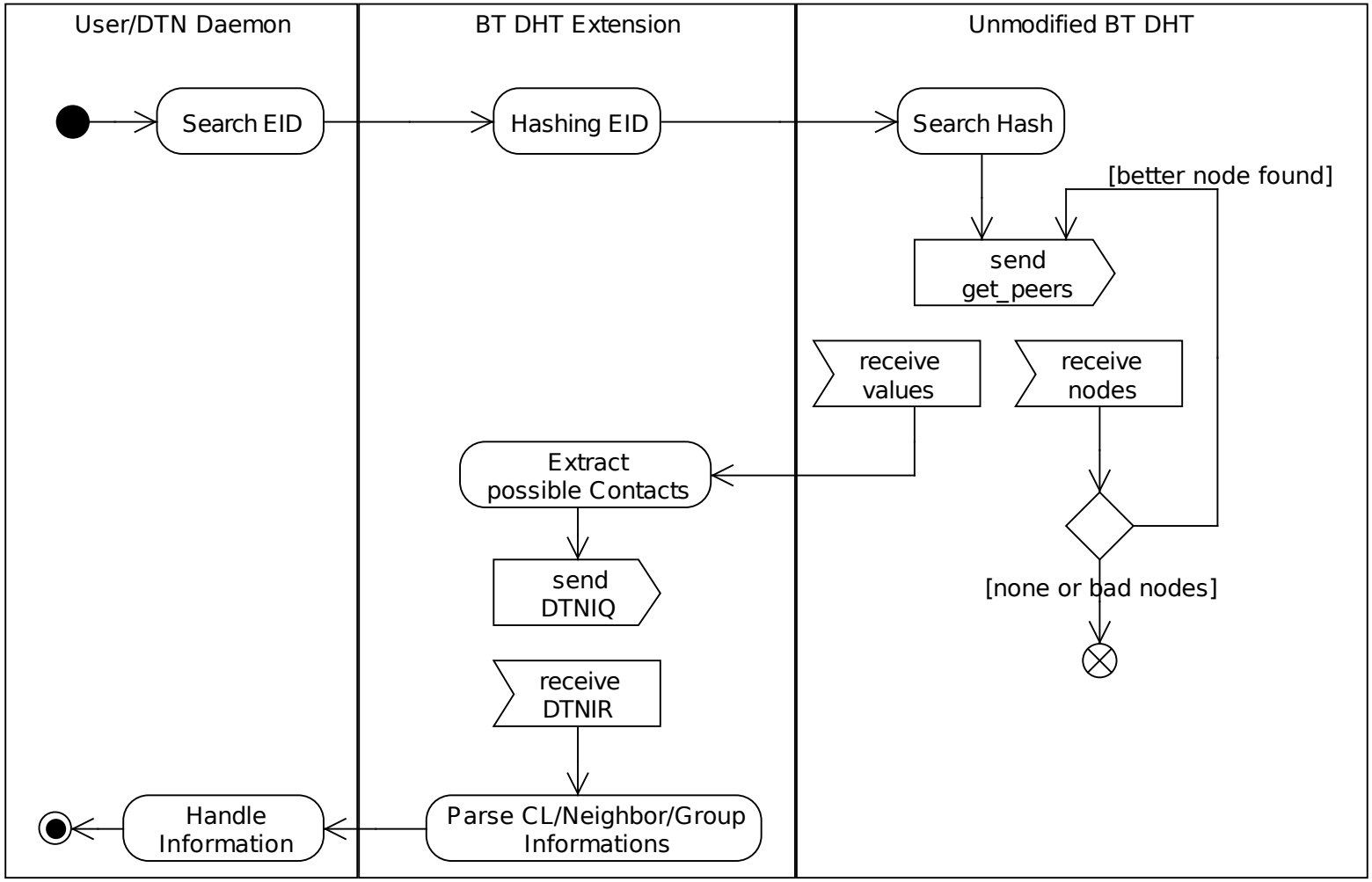
Problems

- Complex, lots of of dependencies, completely proprietary
- Chicken/Egg problem in deployment: How to reach critical mass?

New Idea: BitTorrent DHT

- Profit from (large) existing BT network
- Remain compatible with BT DHT
- Base implementation on Transmission BT DHT code
- 2 phase design: After discovery of a suitable IP address use added DHT RPCs for DTN specific Handshake

DTN-DHT Architecture and Operation



DTN DHT RPC Extension

Additional DHT RPC, syntactically based on BEP 5[1]. Will be ignored by standard BT DHT implementations

DTN Information Query (DTNIQ)

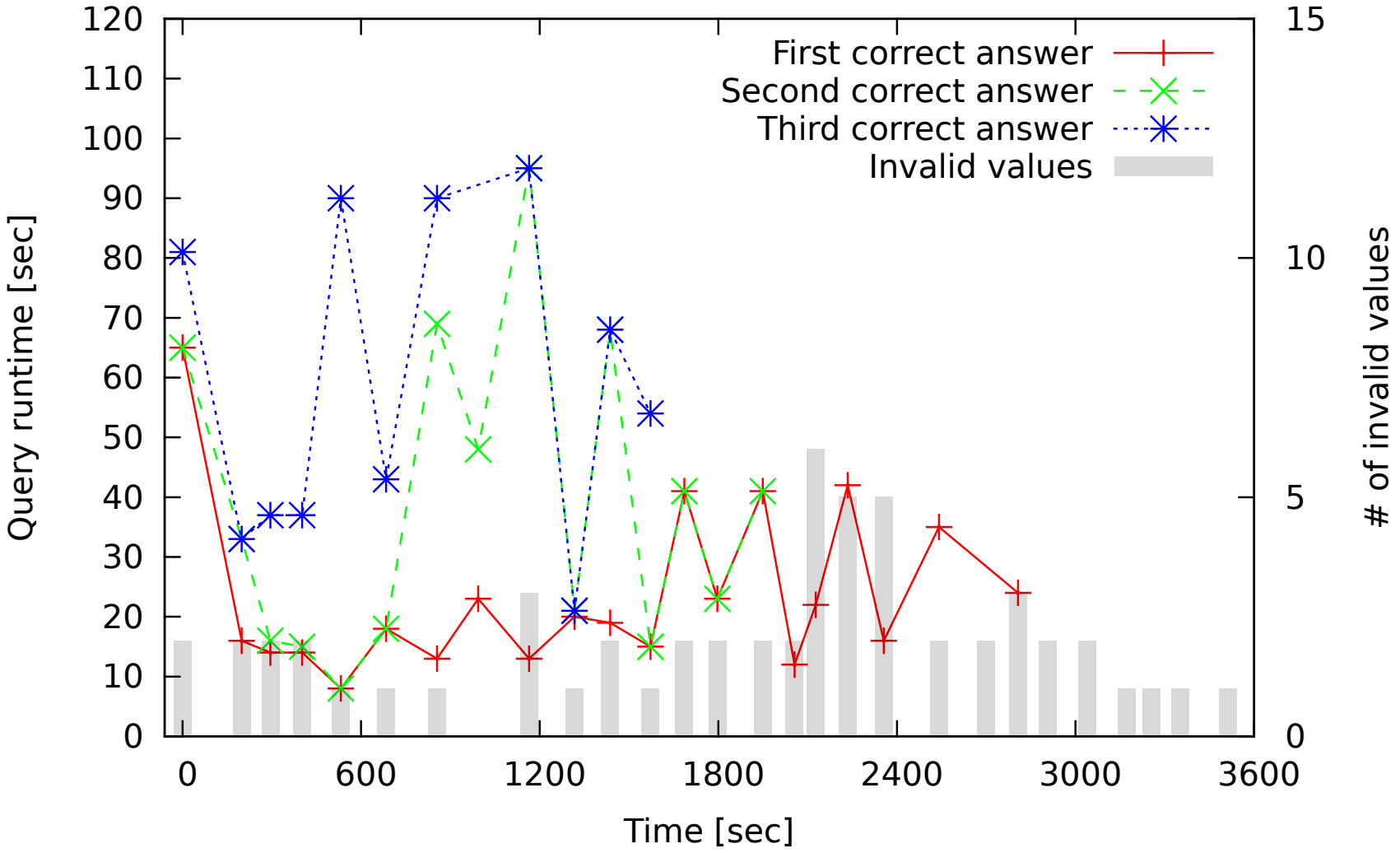
```
"t":"<transaction id>", "y":"q", "q":"dtn",}
"a":{"eid" : "dtn://my_hostname"}
```

DTN Information Reply (DTNIR)

```
"t":"<transaction id>", "y":"r",
"r": {"eid":"dtn://my_hostname" ,
      "cl" : ["name=TCP;port=4556","name=UDP;port=4556"],
      "nb" : ["neighbor1_EID","neighbor2_EID", ... ],
      "gr" : ["group1", "group2", ...]}
```

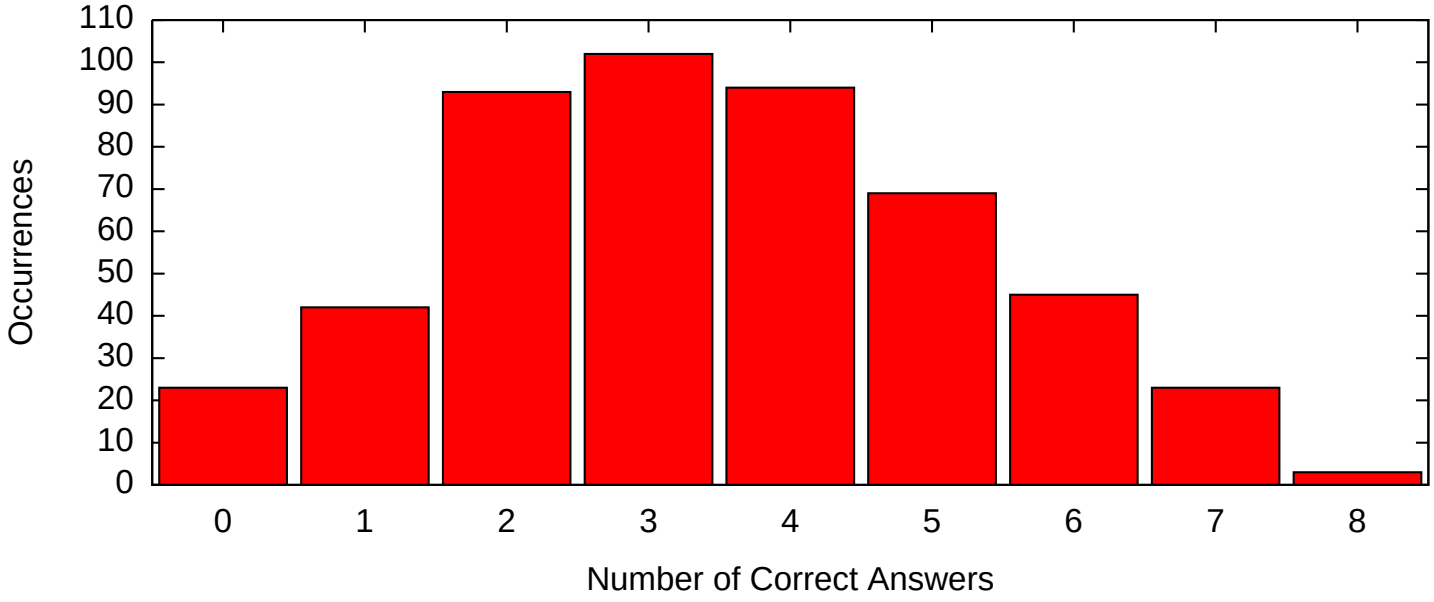
[1] http://www.bittorrent.org/beps/bep_0005.html

Query time and entry lifetime



Lookup Success

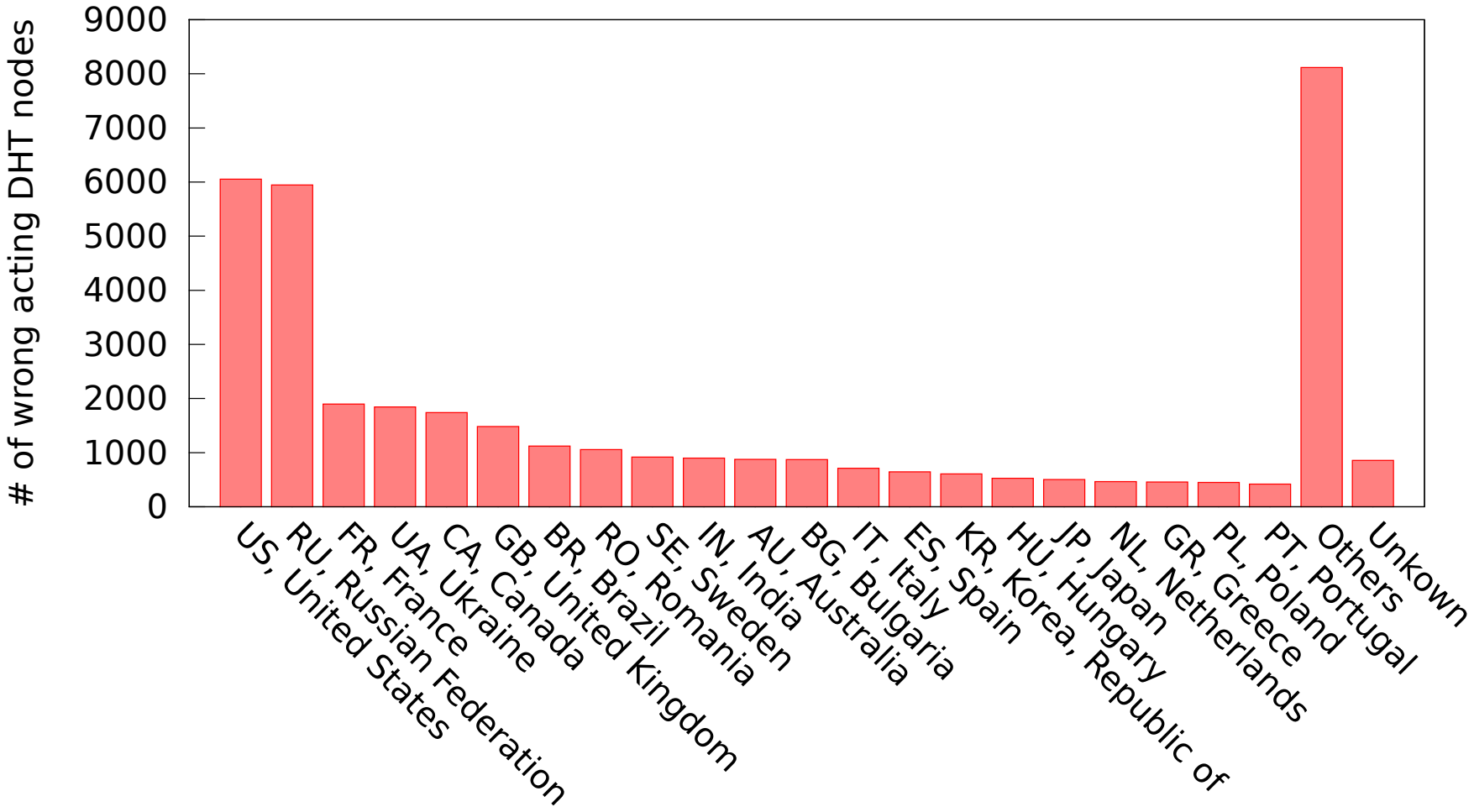
Lookup of 500 previously stored EIDs. The DHT Library tries to store a key 8 times.



The ~ 5% failures are not a problem in real world scenarios, as the searches as well as the announcements will be repeated.

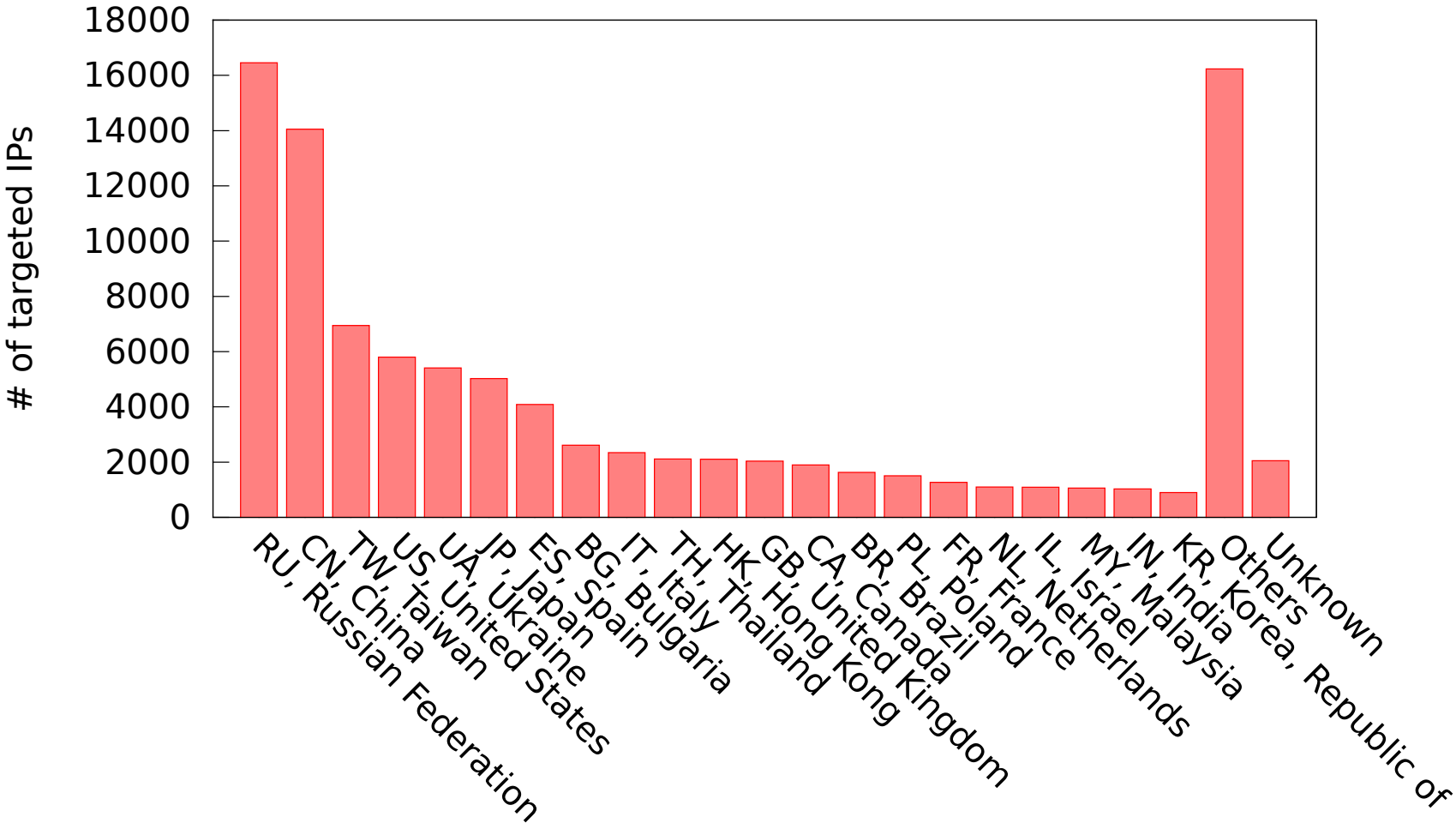
Wrong Answers: Malicious Node origin

Looking up 10000 random keys



Wrong Answers: Target IP Location

Looking up 10000 random keys



Conclusion

- Practical Naming System for Bundle Protocol DTNs
- Fully compatible with BitTorrent DHT:
  → Profit from a large number of nodes
  → A good BT citizen: Does not disrupt normal BT DHT operation
- Lightweight self-contained implementation as ANSI C Library

- Should be trivial to port to DTN2.
  → Contact us if you are interested and need help
- Available as part of IBR-DTN $\geqslant$ 0.8
  → `http://www.ibr.cs.tu-bs.de/projects/ibr-dtn`

One more thing...

Get hands-on with the fresh IBR-DTN distribution for Android (no rooting required) using Whisper and Talkie

Tomorrow 16:15 at the Mobicom Demo Session