
August 15–16
2015
I2P
GETI2P.NET
HackLab
1266 Queen Street West,
Toronto, Ontario
Canada
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What's the buzz about HORNET?

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You've probably all seen the news…

- "Internet-scale anonymity"
- "Without sacrificing security, the network supports data transfer speeds of up to 93GBps"
- "can be scaled at little cost"
- "a better, faster Tor"

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You've probably not read the abstract...

"We present HORNET, a system that enables high-speed end-to-end anonymous channels by leveraging next generation network architectures. HORNET is designed as a low-latency onion routing system that operates at the network layer thus enabling a wide rangeof applications. Our system uses only symmetric cryptography for data forwarding yet requires no per-flow state on intermediate nodes. This design enables HORNET nodes to process anonymous traffic at over 93 Gb/s. HORNET can also scale as required, adding minimal processing overhead per additional anonymous channel. We discuss design and implementation details, as well as a performance and security evaluation."

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HORNET: High-speed Onion Routing at the Network Layer

- Low-latency onion routing network
  - Leverages the existing Sphinx onion routing protocol
- Geared towards speed and scalability
  - Use next-gen network gear instead of building an overlay

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Desired properties

- Path information integrity and security
  - e.g. no tagging attacks
- No cross-link identification
- Session unlinkability
- Payload secrecy and end-to-end integrity
  - Adversary can only learn packet length and timing

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Claims

- Better speed than existing onion routing networks
  - Tor, I2P
- Better security than existing (proposed) network layer anonymity networks
  - LAP, Dovetail

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Speed

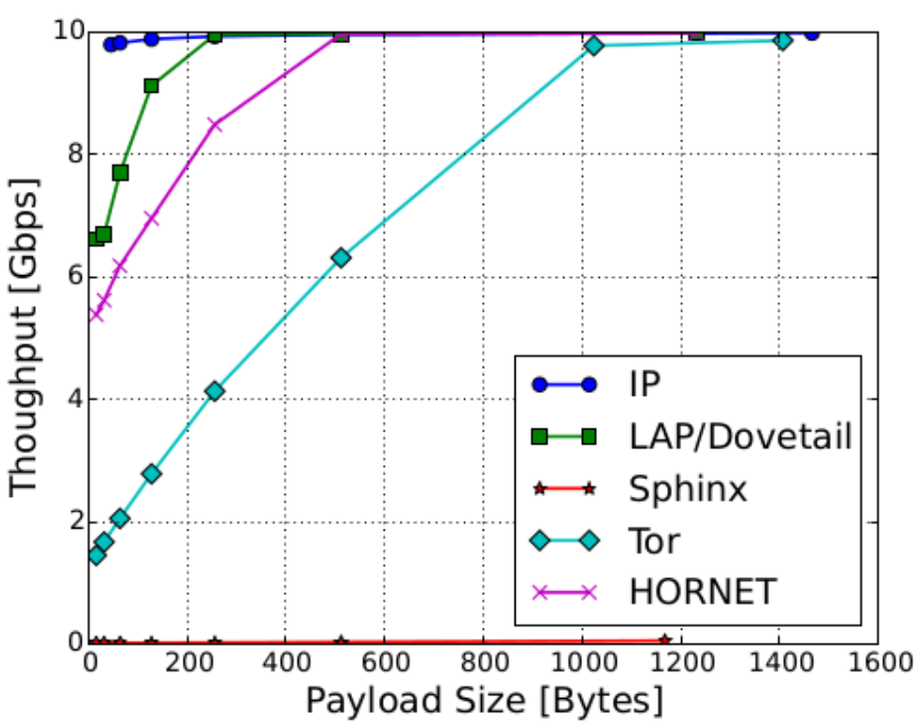

Figure 4: Data forwarding throughput on 10 Gb/s link

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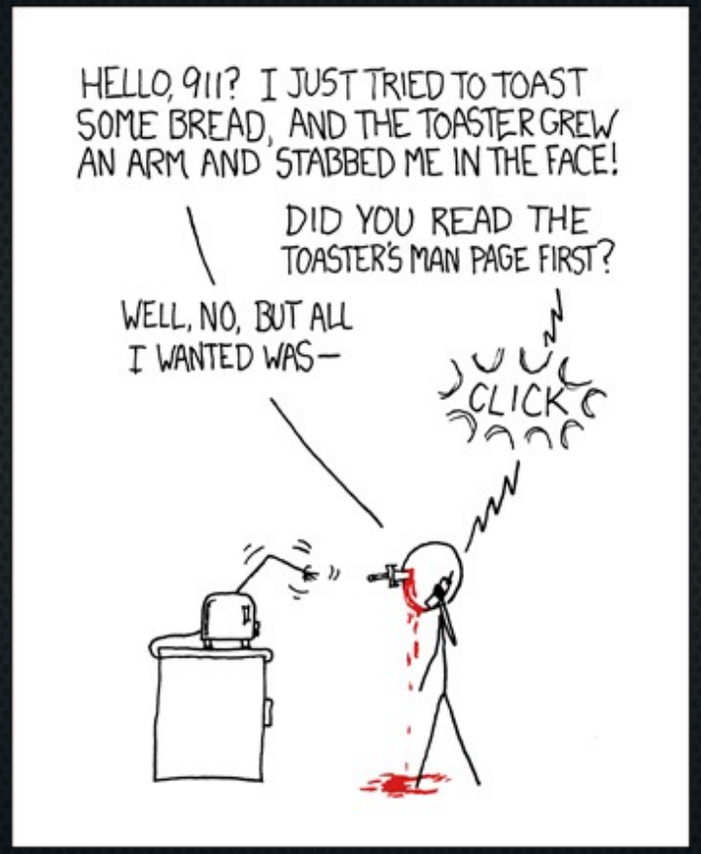
Security



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Why is it fast?

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Stateless data transmission

HORNET Session Setup Packet

type	hops	EXP
Sphinx Header		
Sphinx Payload		
FS Payload		

HORNET Data Packet

type	hops	nonce
AHDR		
Data Payload		

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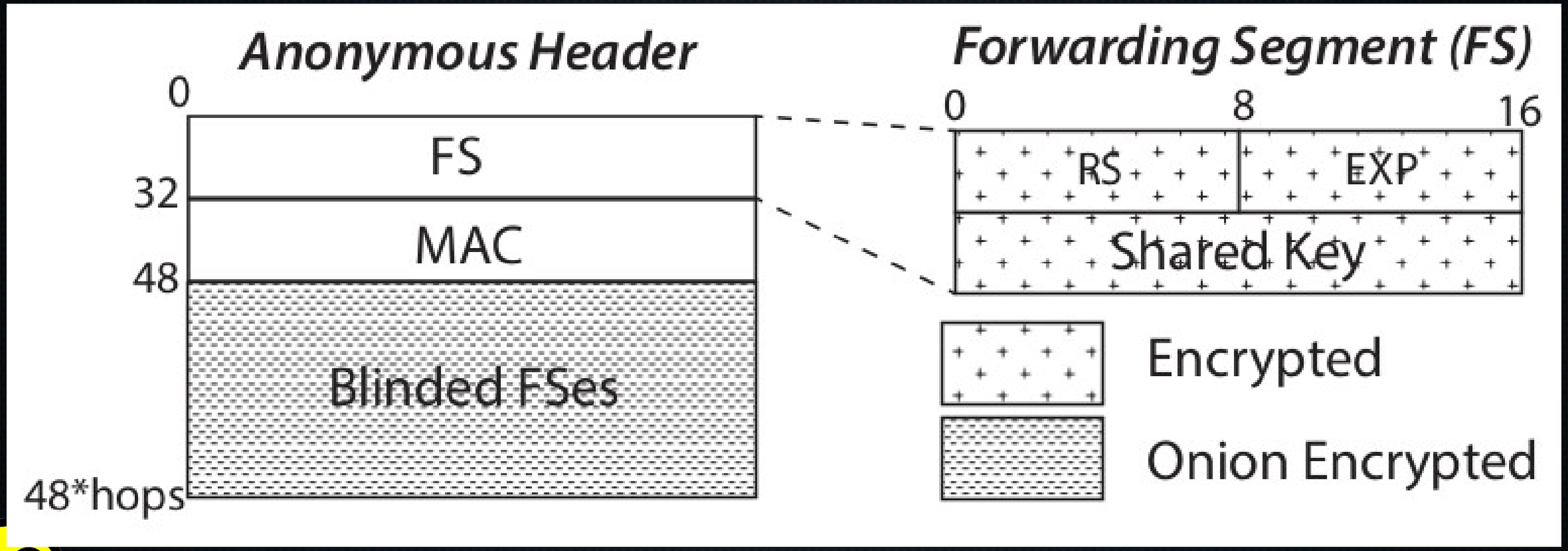
Stateless data transmission



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Data packet header lengths

Scheme	Header Length	Sample Length (Bytes)
LAP	$12 + 2s.r$	236
Dovetail	$12 + s.r$	124
Sphinx	$32 + (2r + 2)s$	296
Tor	$3 + 11.r$	80
I2P	20	20
HORNET	$8 + 3r.s$	344

s = length of symmetric element
r = maximum AS path length

For sample length, *s* = 16 Bytes and *r* = 7

Gains

- No route lookup time
- No route storage
  - Tor stores at least 376 bytes per circuit
    - Requires almost 20GB of memory for a load level of 5 million new sessions per minute

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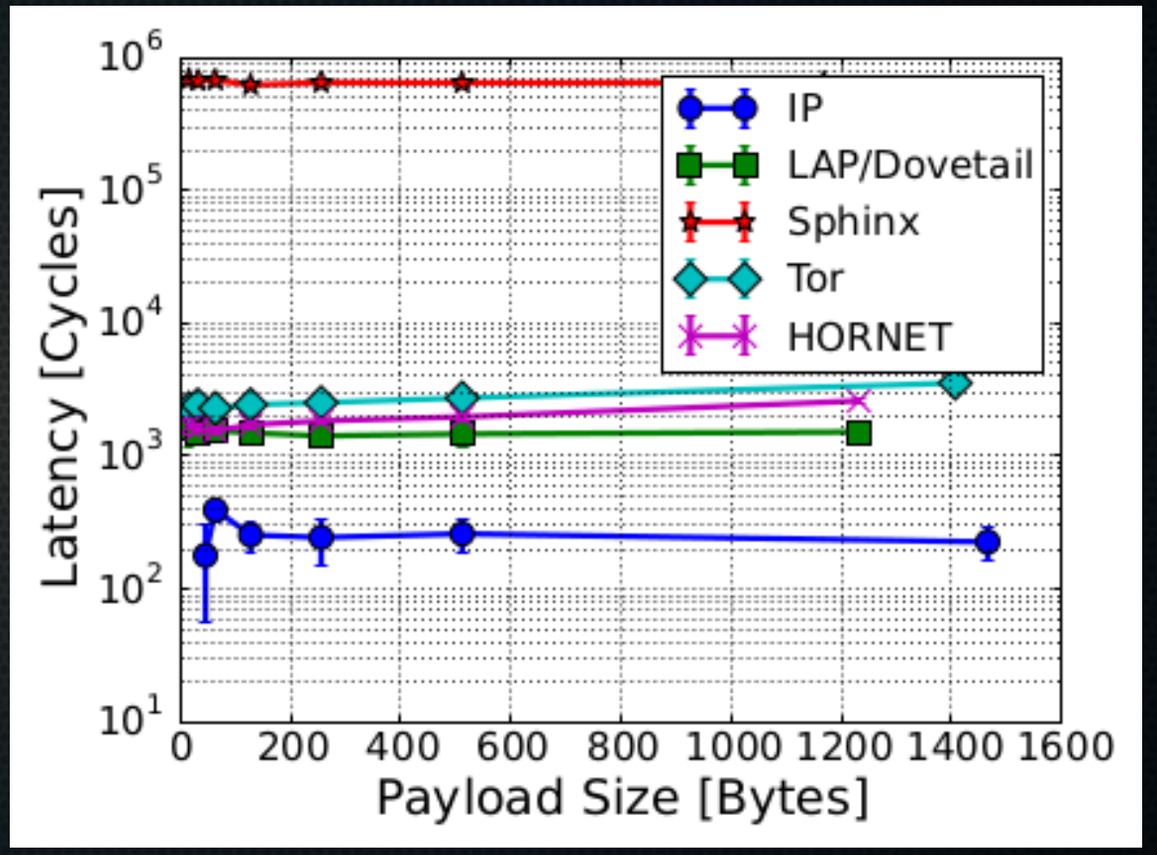
Mostly symmetric crypto

- Each HORNET node performs one DH key exchange during setup phase
- Only symmetric operations used during data phase
  - 5% slower than LAP and Dovetail for small packets (64 bytes)
  - 71% slower for large packets (1200 bytes)



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How?

- Decrypts setup packet
  - Sym key from medium/long-term DH priv key and sender's DH pub key
- Generate transient DH key
- Calculate a symmetric key from transient DH priv key and sender's DH pub key
- Encrypt routing info with local medium-term symmetric key
- Forward encrypted routing info + transient DH pub key
- Delete transient DH key

No replay protection

- Packet replay is ignored within the lifetime of a session
  - Leads to easy DoS
- They suggest that adversaries would be deterred by the risk of being detected by volunteers / organizations / ASs
  - but the detection process is going to add additional processing time and therefore compromise throughput

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So is this the end of Tor and I2P?

Why not?

- Designed for new routing hardware that doesn't exist
- Only covers session setup and data transmission
  - Assumes routing state only shows next hop
  - Assumes the presence of path discovery
  - Assumes the presence of node discovery
- Can be used with upper-layer anonymity protocols for stronger security guarantees

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It's actually very similar to I2P tunnels!

- Both use "non-interactive" telescopic tunnel building
- Both only use symmetric crypto for data transmission
  - Don't confuse I2P tunnels with I2P sessions
    - (But I2P sessions also use mostly-symmetric crypto via "session tags"…)
      - ((Yes, yes, this gets confusing...))

Key difference between HORNET and I2P

- I2P tunnel packet headers are smaller than HORNET
  - But I2P pads all to 1024 bytes
- I2P stores routing data
- I2P uses a bloom filter to detect packet replay
- I2P has a higher-level end-to-end crypto layer

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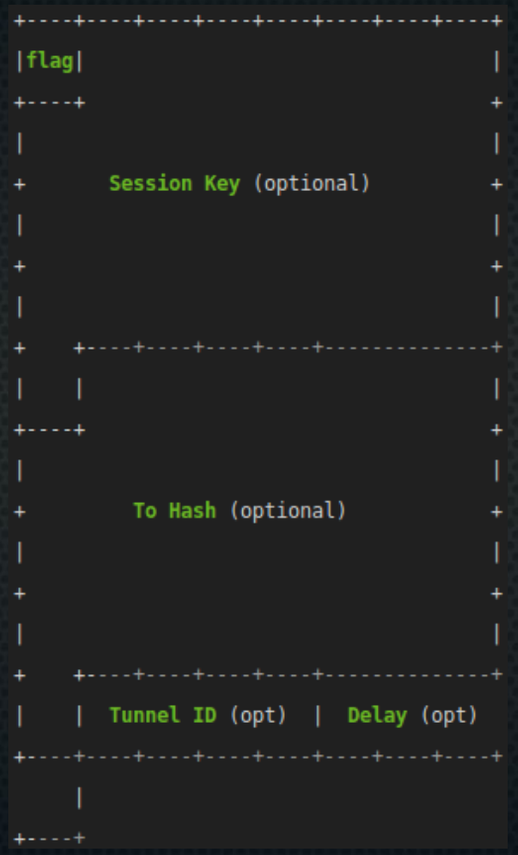
Key points

- It doesn't actually exist
  - You can't throw away Tor and I2P just yet ;)
- It's only one piece of the puzzle
- Speed has trade-offs
- It's still a good idea!

Fun aside (if we get time): Implementing HORNET in I2P



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Discussion time :)

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