# The Pynchon Gate

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# Motivations

- Pseudonymous mail retrieval
  - Users register their pseudonyms with “nym” server
  - The “nym” server can be part of or external to an anonymous communication system such as BABEL, Onion routing-based Mix-nets, Tarzan, ..
  - Nym server supports receiver anonymity
  - Either vulnerable to traffic analysis attacks or require a huge amount of cover traffic
  - PIR (private information retrieval) can be a solution

# Goals

- Forward message security
  - Active and passive attackers
- Deployable and usable
  - Recruite many users!

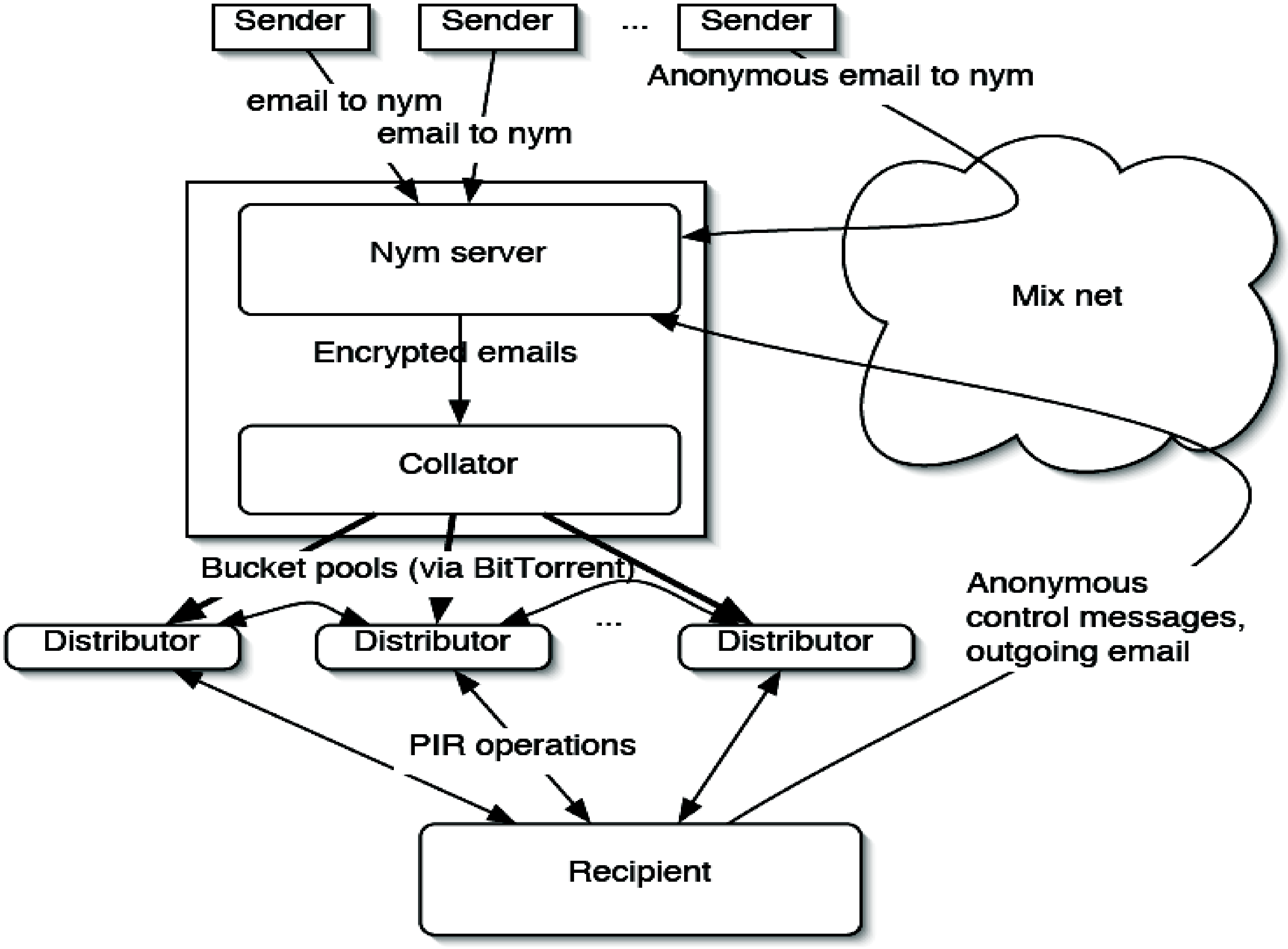
# Related work

- Chaum’81: reply blocks and return addresses
  - Time gap can lead to unreliability issues
  - Pseudonym management (multiple-use of reply blocks)
- Single-use reply blocks
  - Reliability issues still there
  - Intersection attacks possible
- Network level client anonymity
  - Widespread deployment in question: onion routing

# Related Work

- Network-level server anonymity
  - Onion routing: rendezvous points
  - Sender does’n need to know receiver’s IP address
- Broadcast message and dead-drops
  - Send everything to everywhere
  - Scalability problem?
- Re-encryption mixes?

# Pynchon Gate



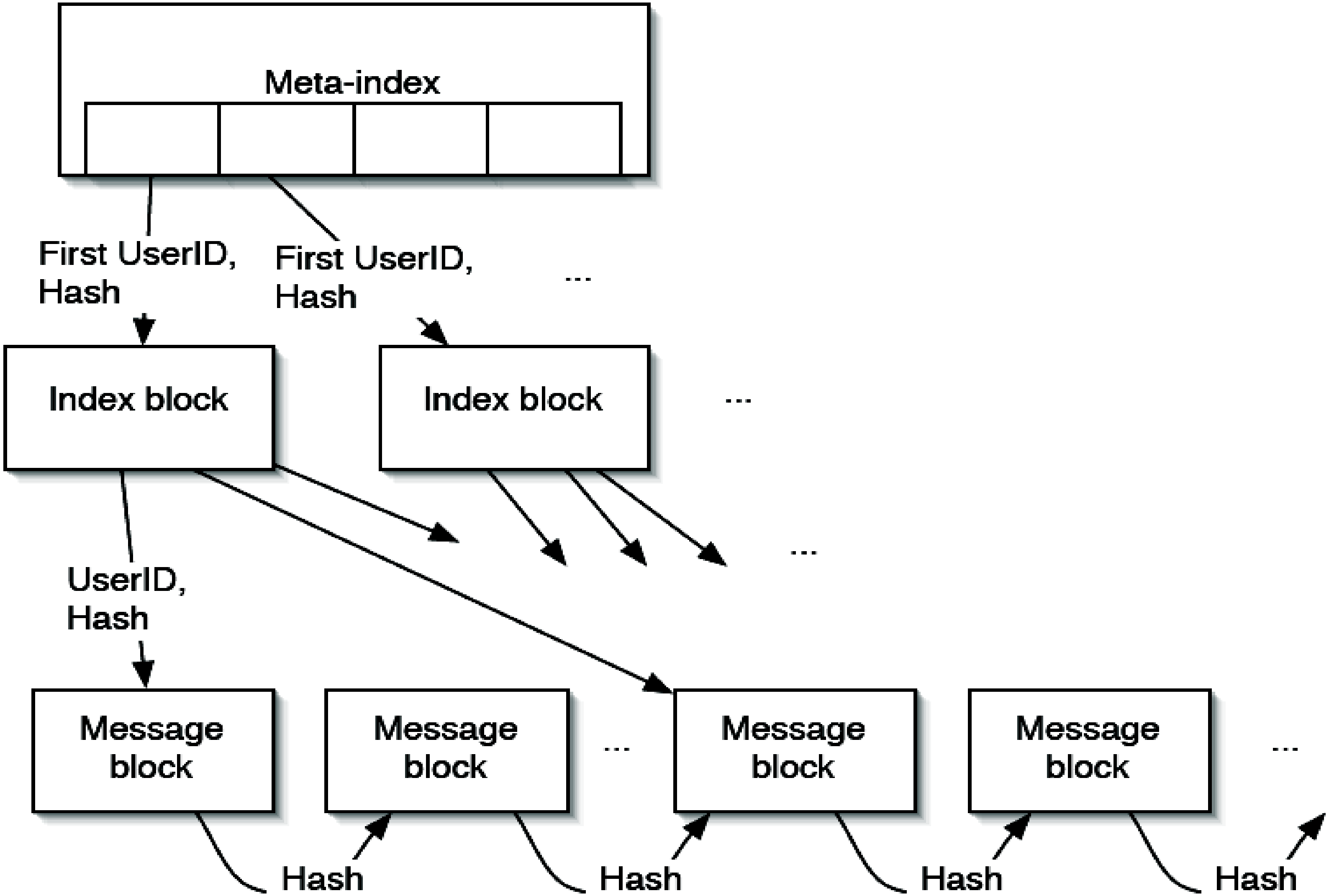
# Pynchon Gate Overview

- Pychon Gate: a group of servers
- Nym server receives emails for different pseudonyms
- Each cycle (24-hours) nym server passes the emails to collator.
- Collator batches them into indexed bucket pools and passes them to distributor nodes
- Distributors are independently operated (p2p)

# Pynchon Gate Overview

- Pseudonym holder makes a series of requests to “k” chosen distributors
- Distributors cannot determine the pseudonym being requested
- Resistant to “k-1” collusion attacks
  - User identity to pseudonym
- Distributed-trust PIR-based message retrieval system!
  - Send everything to everyewhere

# Meta-index and pool bucket



# Distributors and clients

- Independently operated (P2P)
- BitTorrent! (Bran Cohen)
- Client
  - Downloads the meta-index from a randomly chosen distributor
  - Finds which index bucket to look at
  - Downloads all the blocks form randomly chosen distributors (PIR)
  - Repeats these up to a maximum volume

# The PIR protocol

- Client retrieves a bucket from randomly chosen “K” distributors

# Attacks

- Legal and hacking attacks
  - Dynamic key rotation
- Man-in-the-middle attack
  - TLS
- Replay attack
  - TLS
- Tagging and known-cleartext attack
  - TLS

# Attacks

- Usage pattern and intersection attack
  - Hard to get usage pattern due to the cycle (24h)
  - Queries to distributors at a fixed interval
- Statistical disclosure against reply-block-based nym servers

# System performance, scalability, optimizations

- Comparison to
  - Cypherpunk
  - Underhill
  - NNTP