CDN on Demand

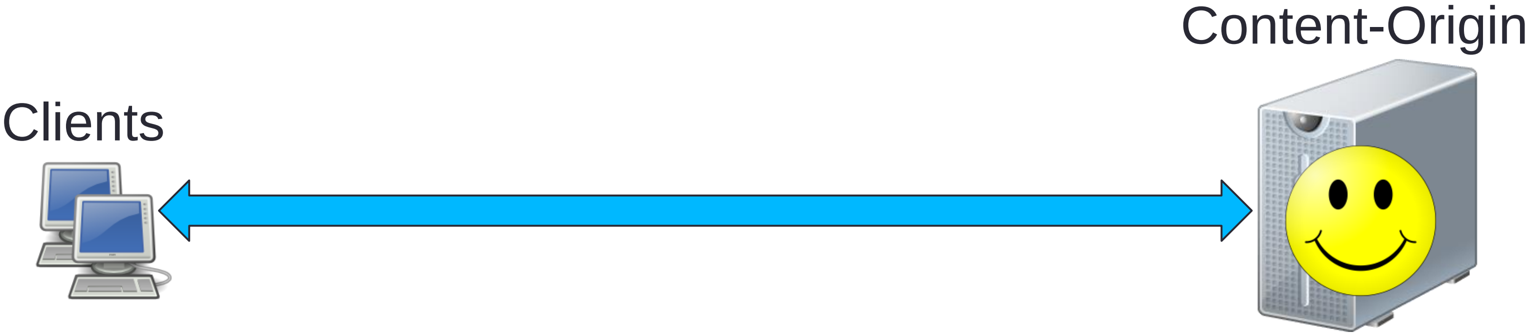
Affordable DDoS Defense using Untrusted IaaS-Clouds

Yossi Gilad, Michael Goberman,
Amir Herzberg and Michael Sudkovitch

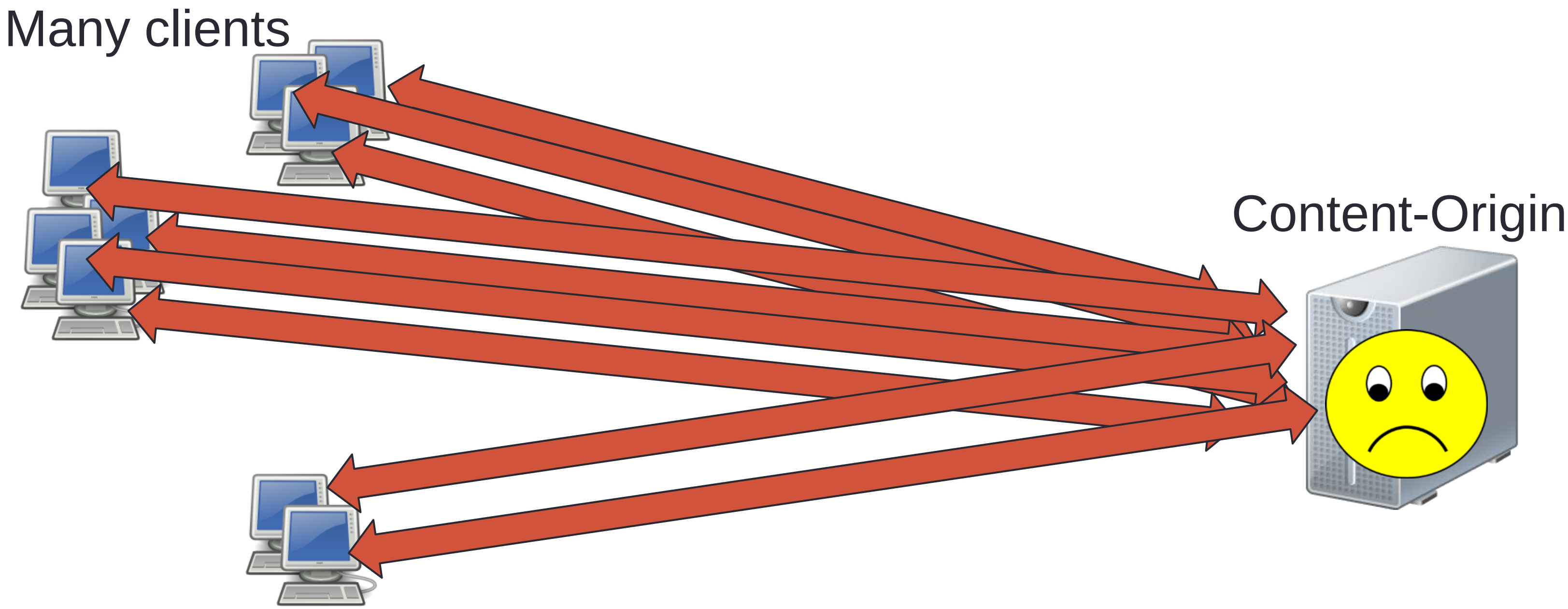
Talk Outline

- Content Delivery Networks as DoS defense
- The CDN-on-Demand system
  - Clientless secure objects
  - Loss resilient tunnel
- Performance evaluation

CDN as a DoS Defense

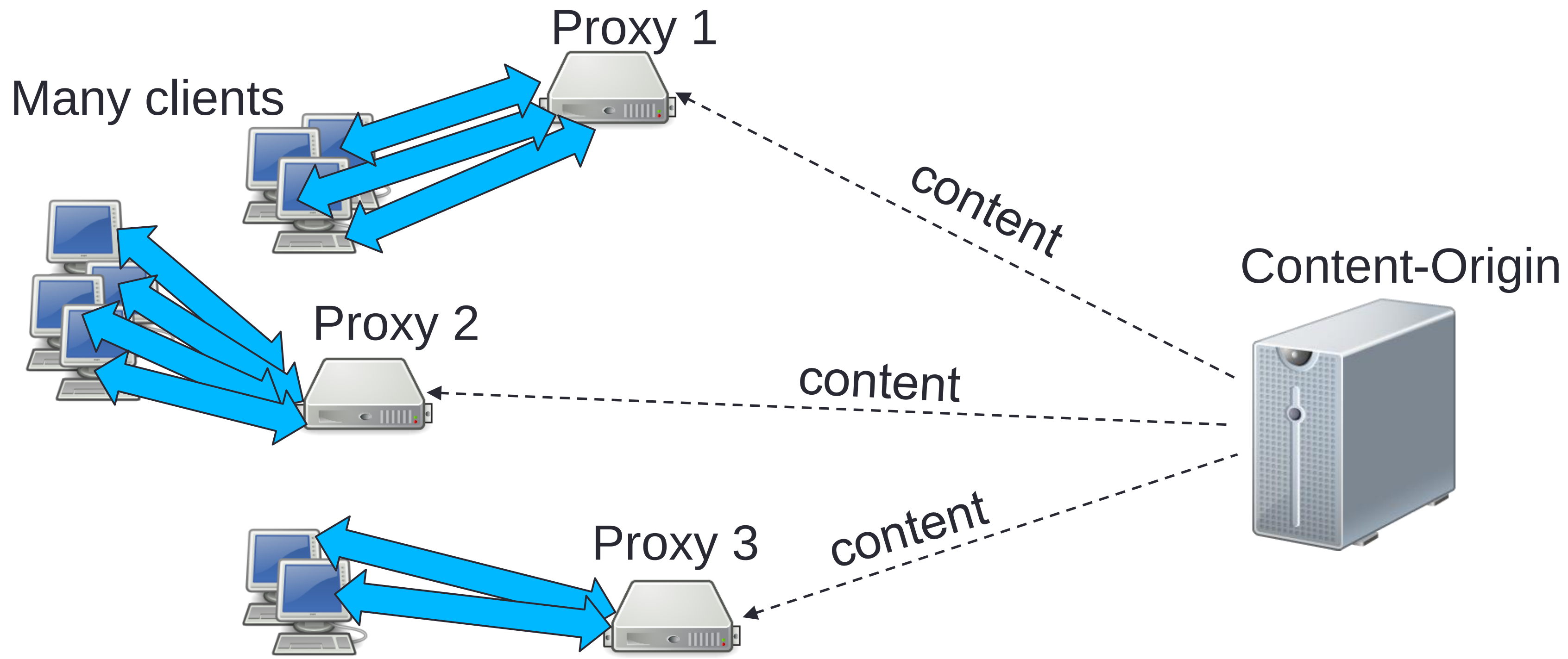


CDN as a DoS Defense



CDN as a DoS Defense

- Host site on Content Delivery Network (CDN)
  - Distribute content from multiple, geo-dispersed proxies
  - High-bandwidth, distributed and scalable infrastructure
- But there are problems…



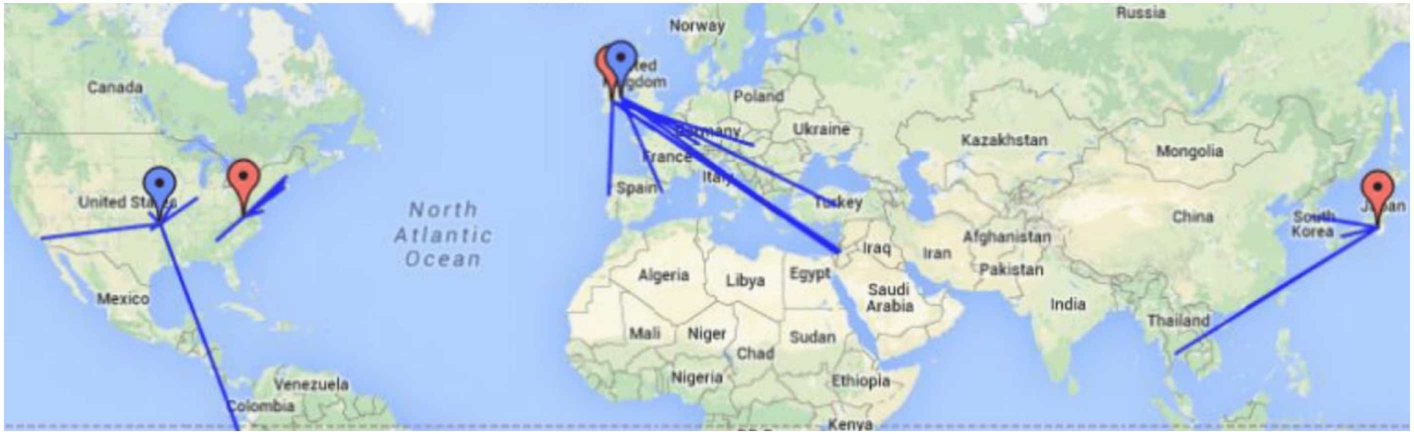
CDNs against DoS: Problems

- Cost
  - CDNs provide `continuous, full service’ → expensive
  - Service sometimes unavailable to small sites
- Disclose keys (HTTPS sites)
  - Threat model: CDN servers may be malicious/compromised
- Tradeoff: Cheaper CDNs may be less secure/trusted
  - Akamai/Amazon vs. CDN77 → 10X difference in cost

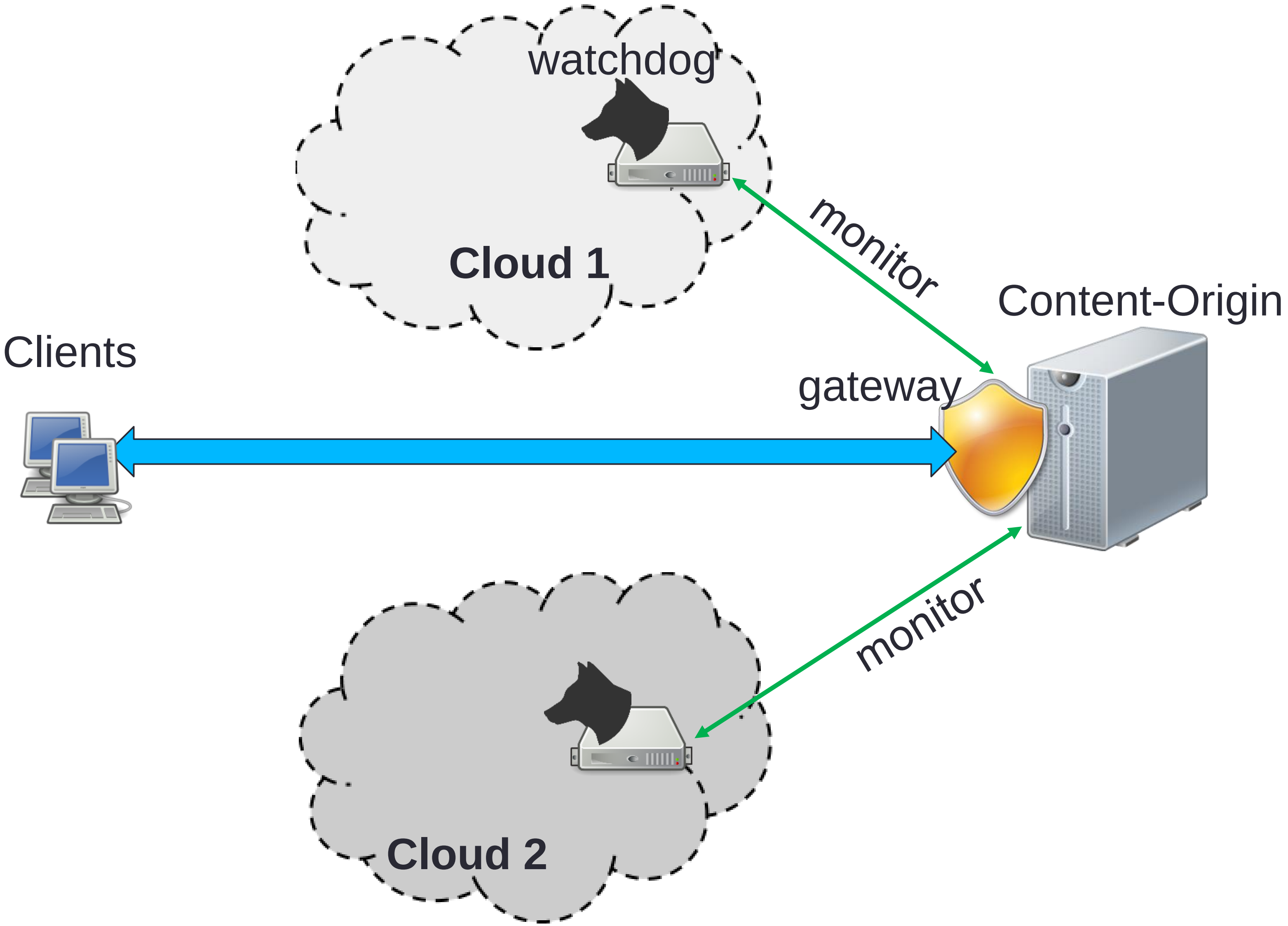
Can we build a secure & low-cost CDN-based defense?

CDN-on-Demand: Overview

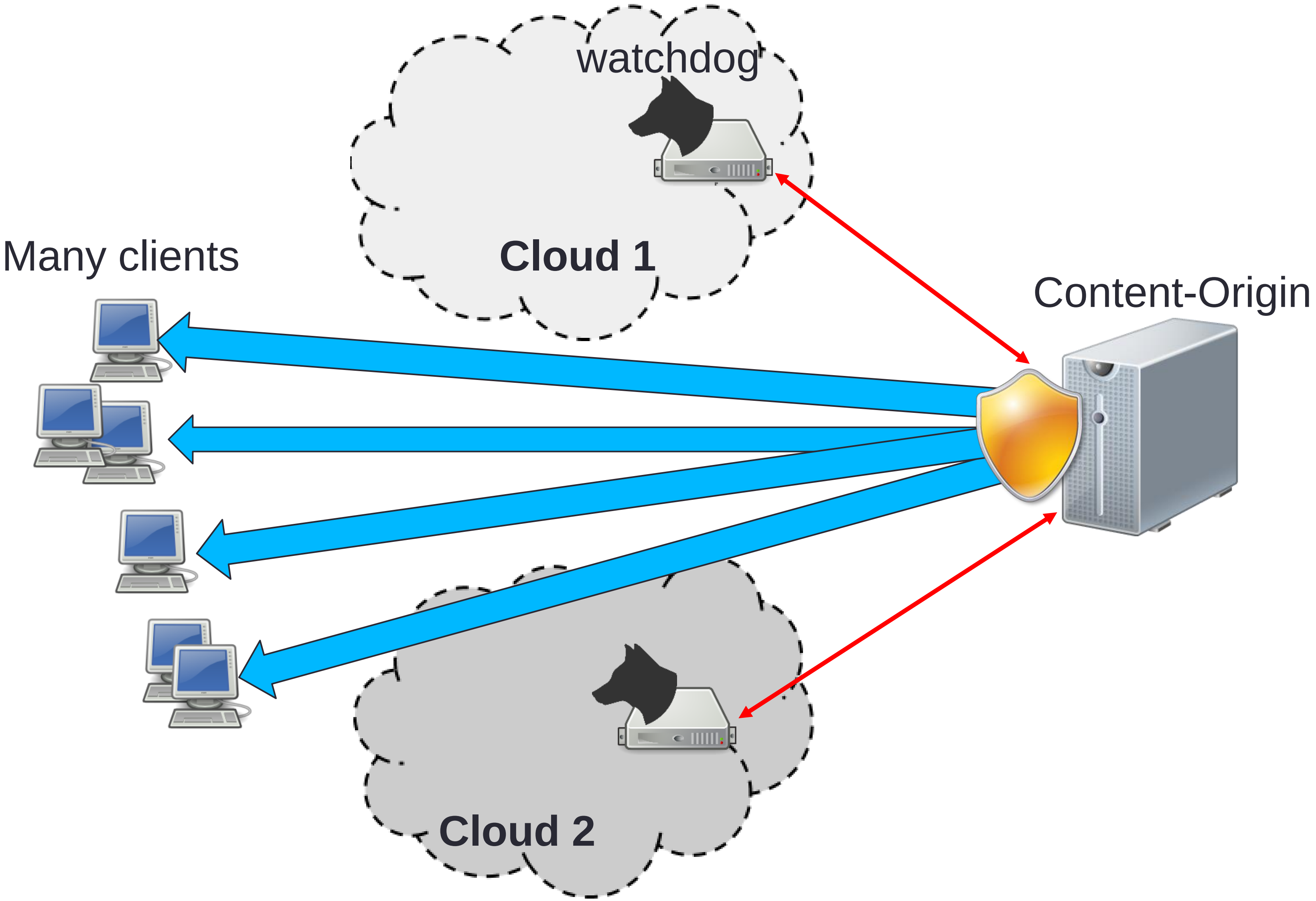
- A CDN system built on multiple low-cost IaaS clouds
  - Deploys proxies only when/where needed
- Object level security, avoid sharing keys with CDN
- Software package, rather than third-party service
  - Open source www.autocdn.org
  - Anyone can install



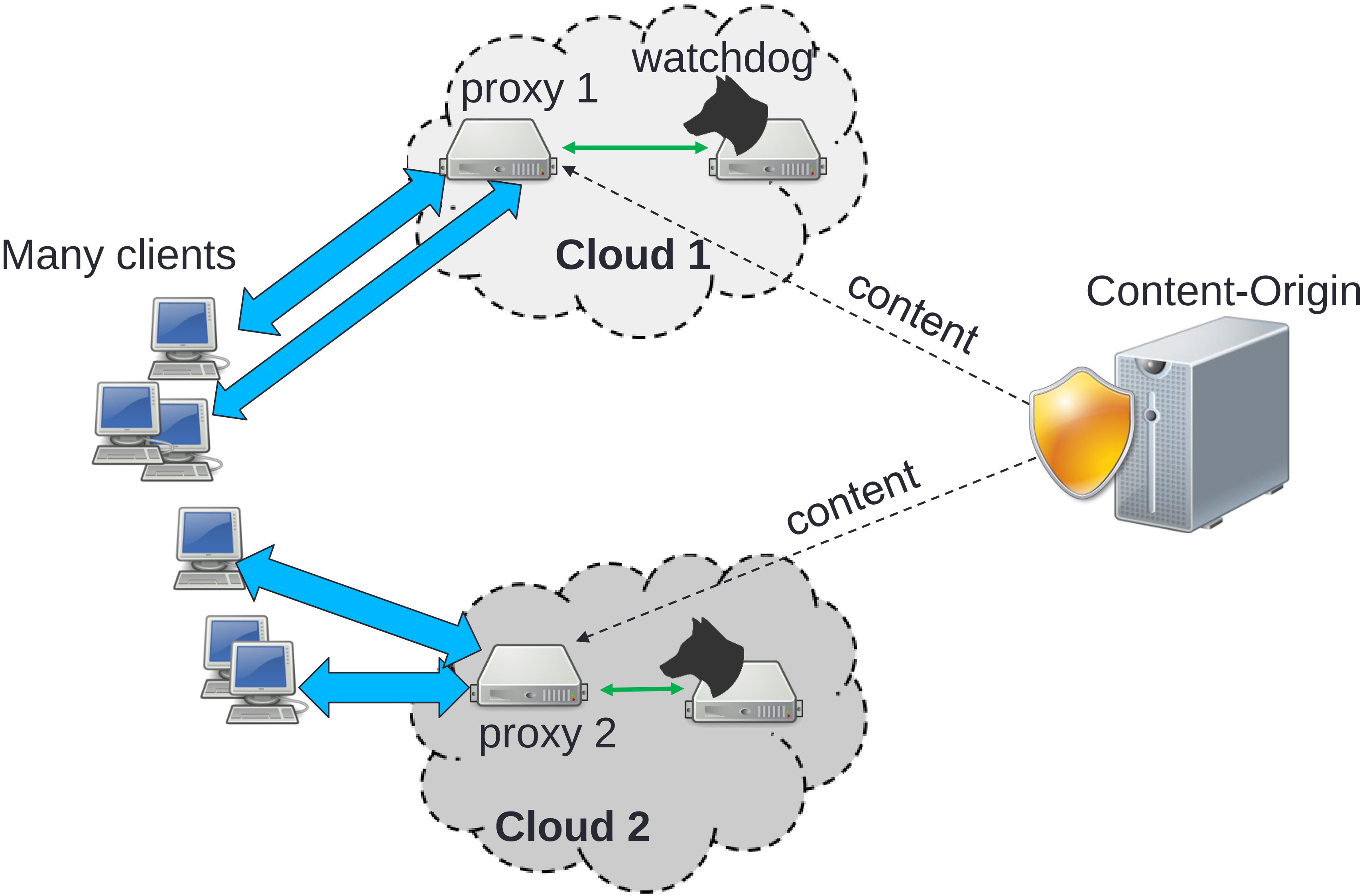
CDN-on-Demand: Overview



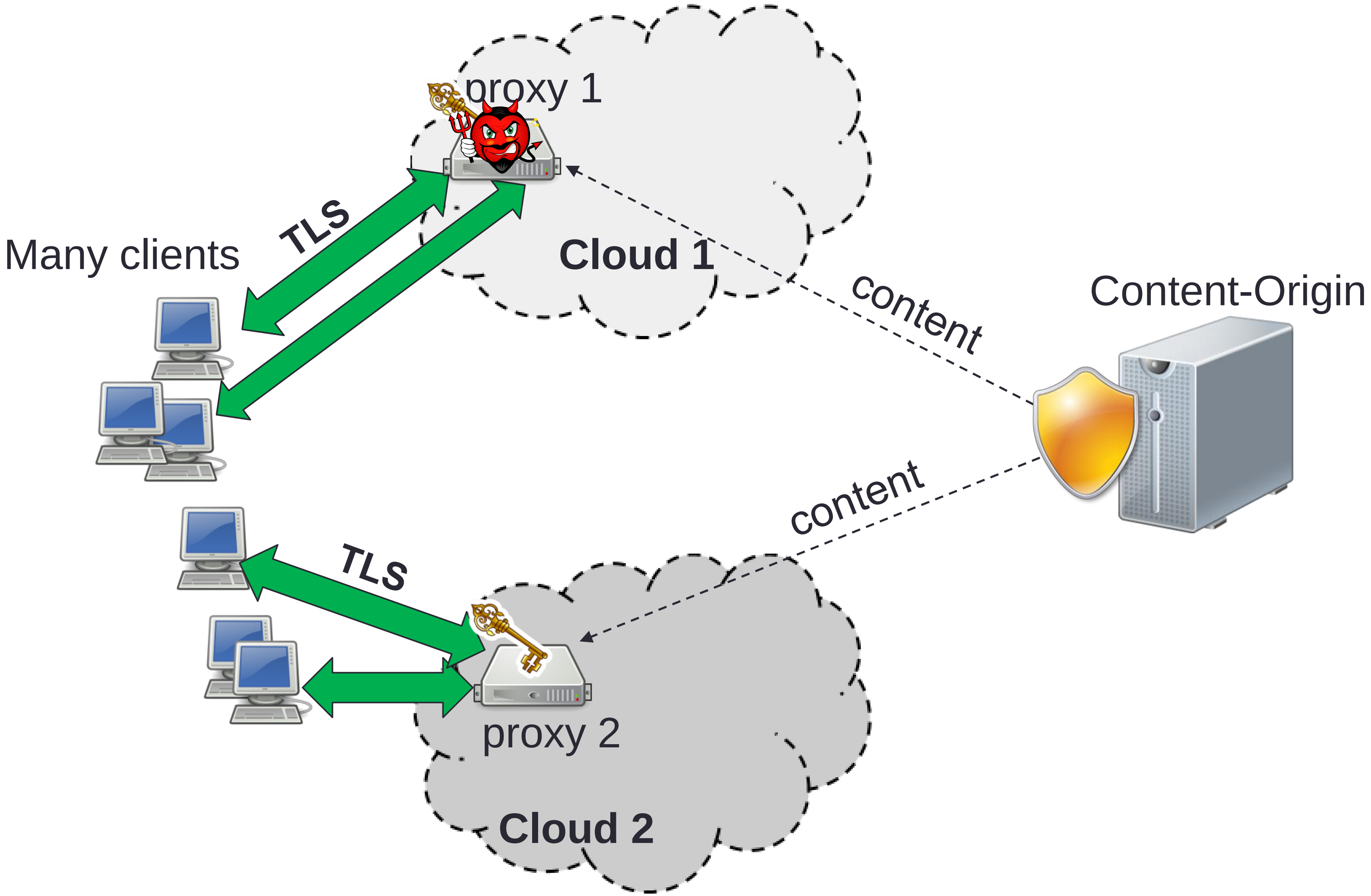
CDN-on-Demand: Overview



CDN-on-Demand: Overview

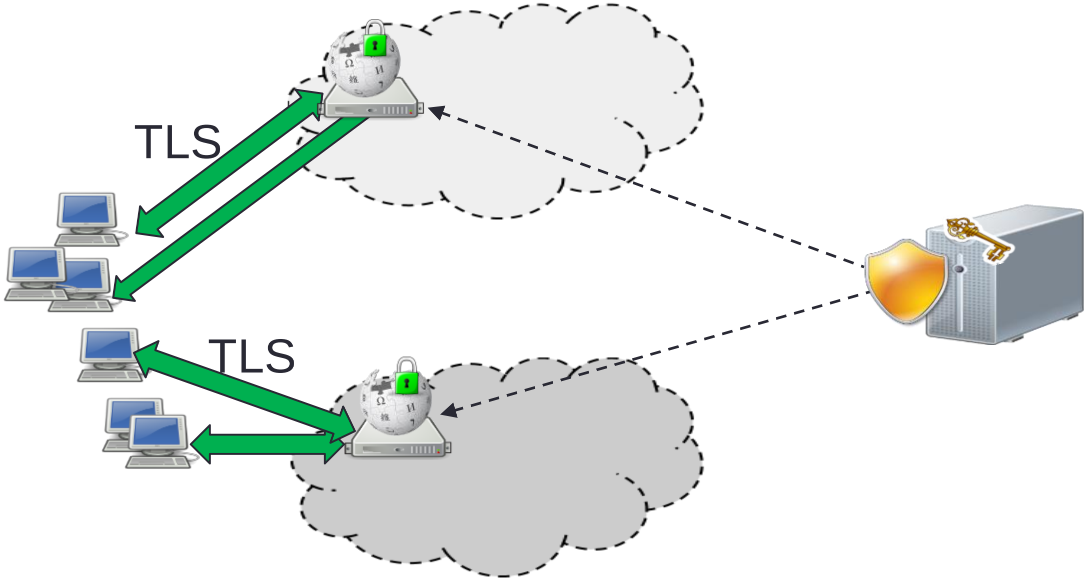


Security: Why not just use TLS?

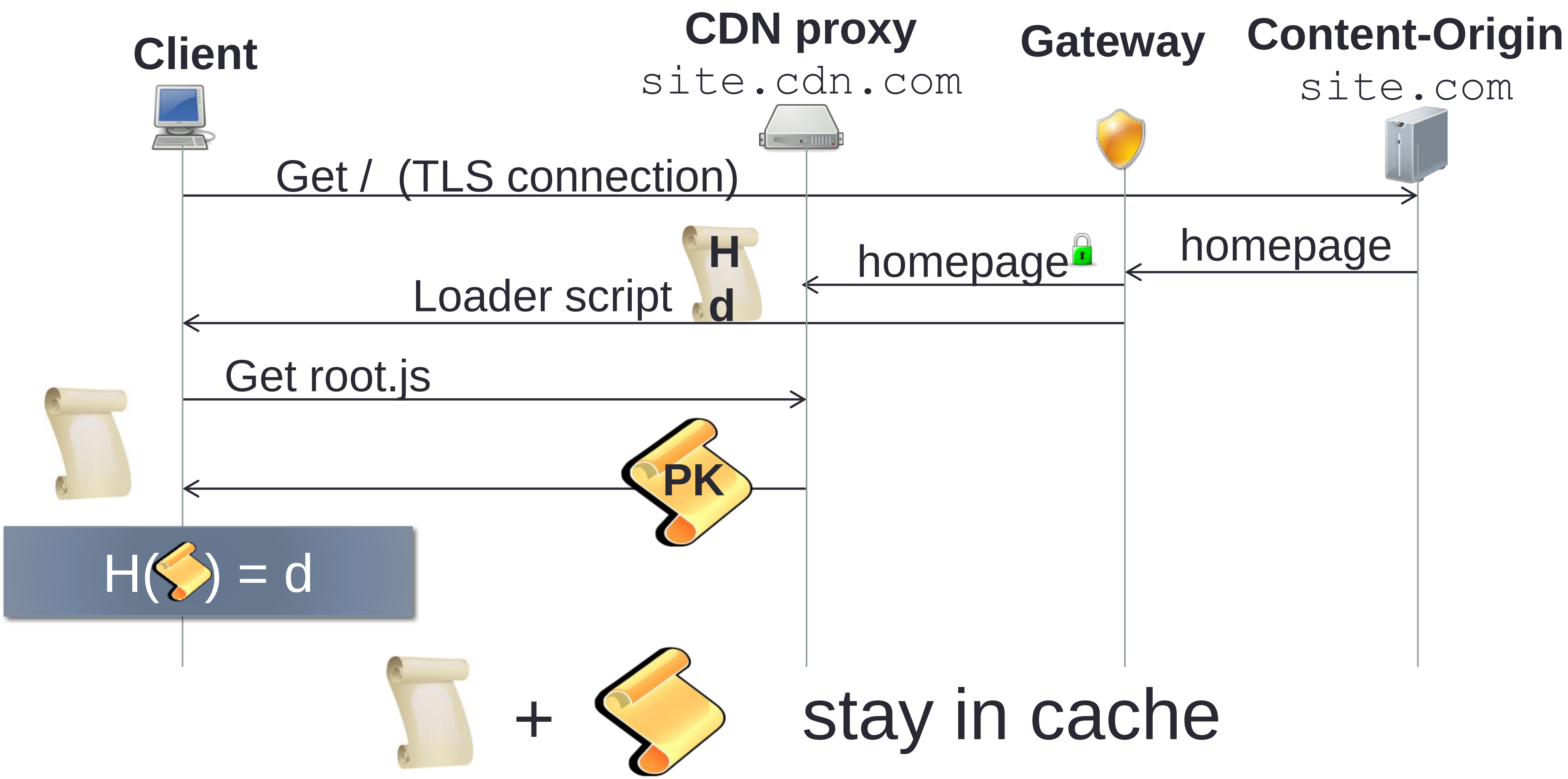


Clientless Secure Objects

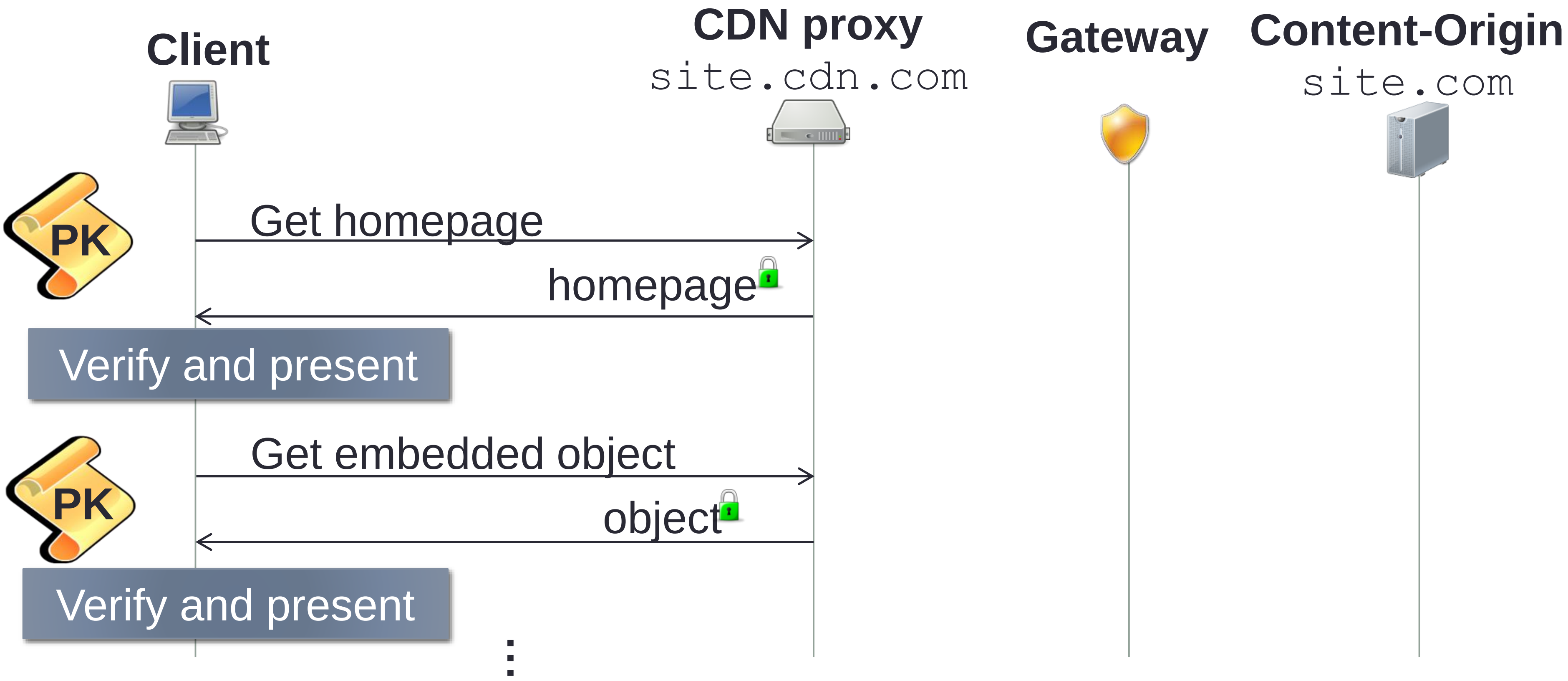
- Idea: store `secure objects' on untrusted proxies
  - Don't share private keys
  - Complement TLS network level protection
  - Restriction: avoid changes to clients
- Important flexibility for `on-demand' system
  - Allows to use cheaper, less trusted clouds
  - Allows to switch between clouds



Setup (once per month)



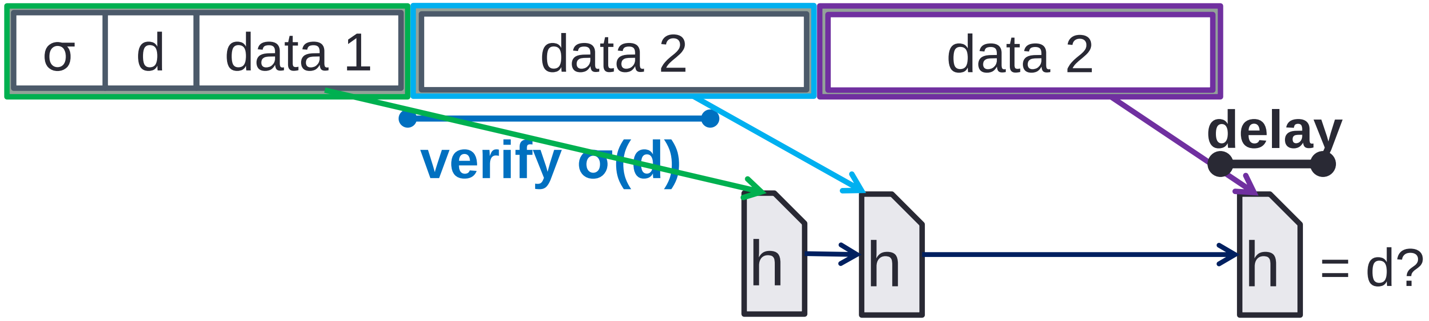
Content Distribution



Content-origin not involved

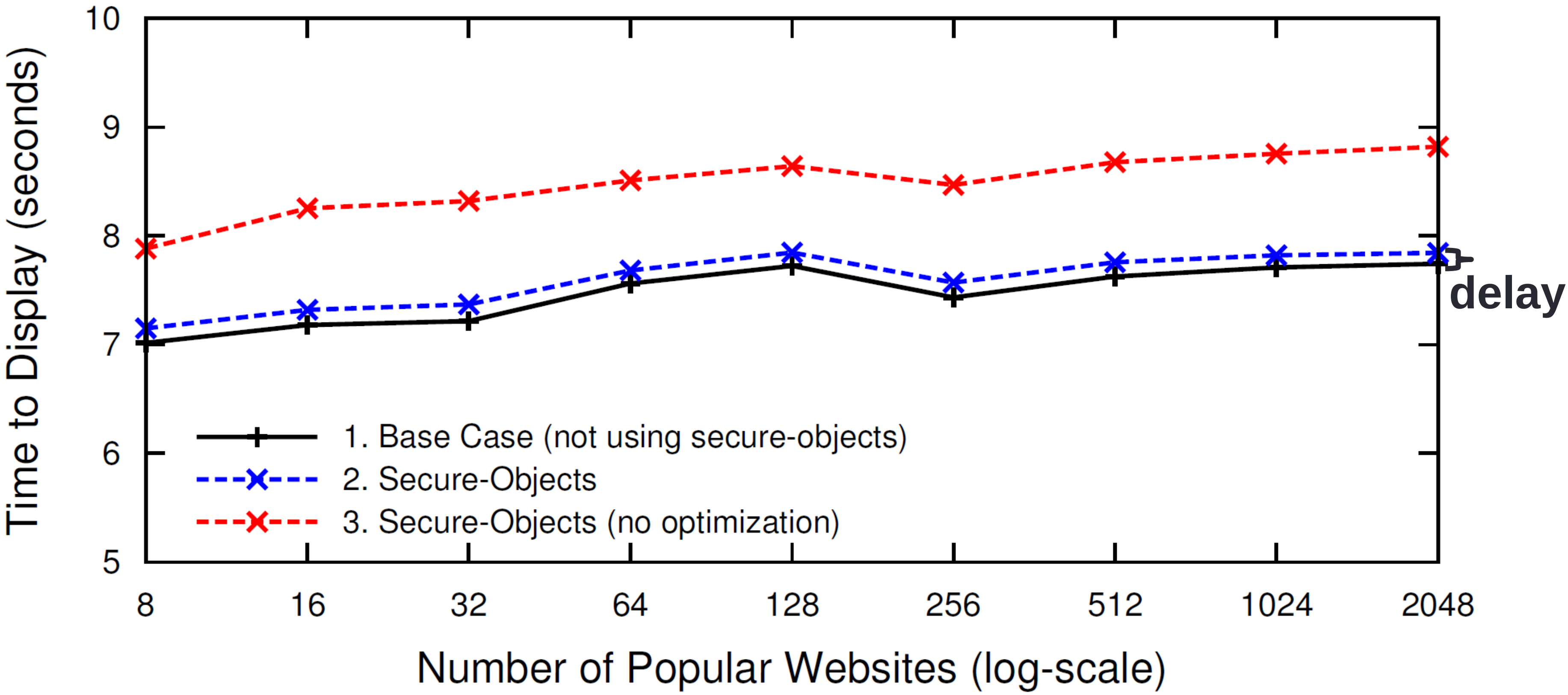
Clientless Secure Objects: Computations

- JavaScript crypto is inefficient
  - Over 20X time for signature verification cf. native code (RSA2048)
  - Single threaded computations
  - Significantly delays content display time
- Observation: most of the time loading an object is spent waiting for its data to arrive
- Compute incrementally utilizing Merkle-Damgard

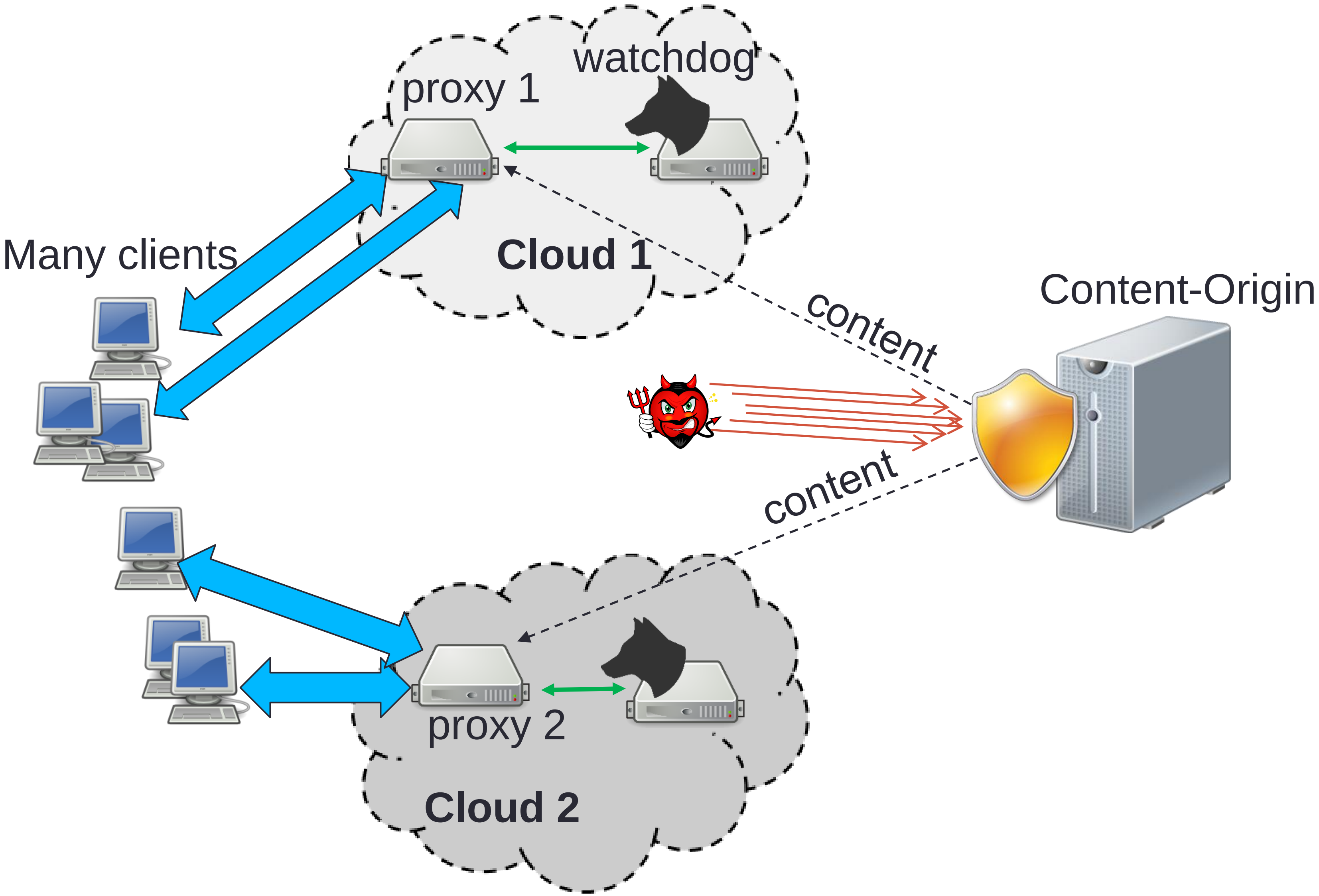


Clientless Secure Objects: Performance

- Tested using content from popular homepages
- 2% overhead for page load-time
  - Incremental processing reduces overhead approx. 70%

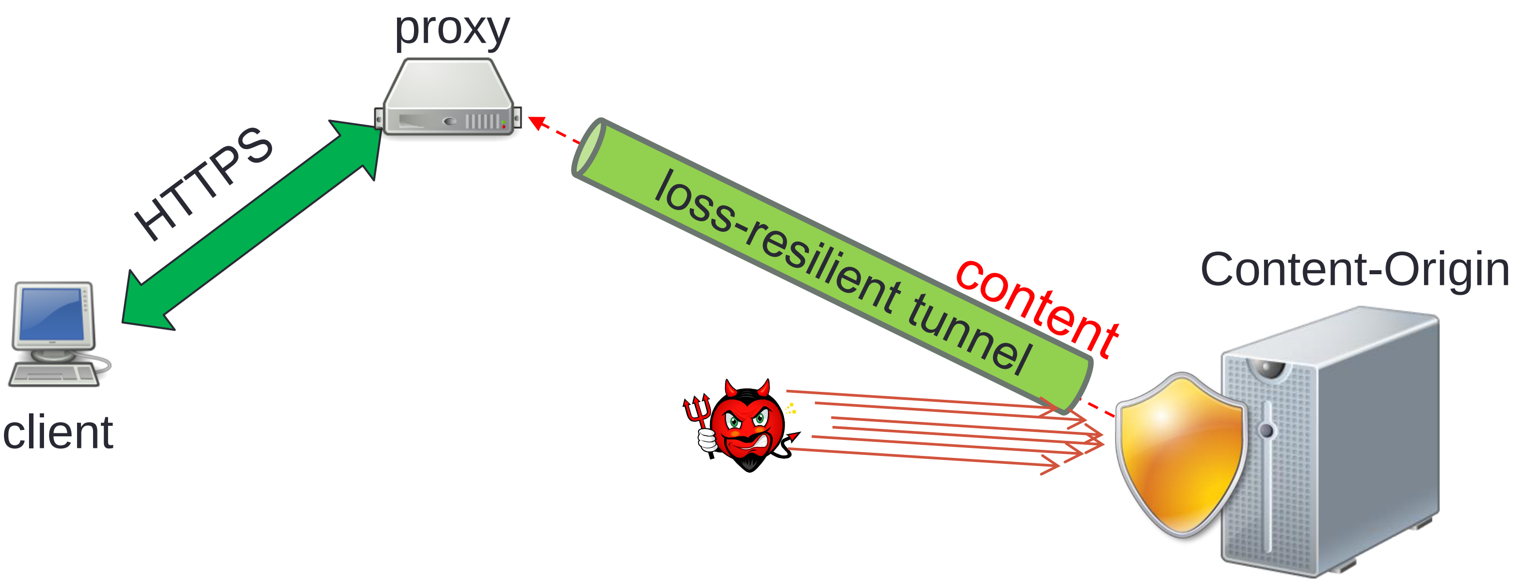


Delivering Content Updates under DoS

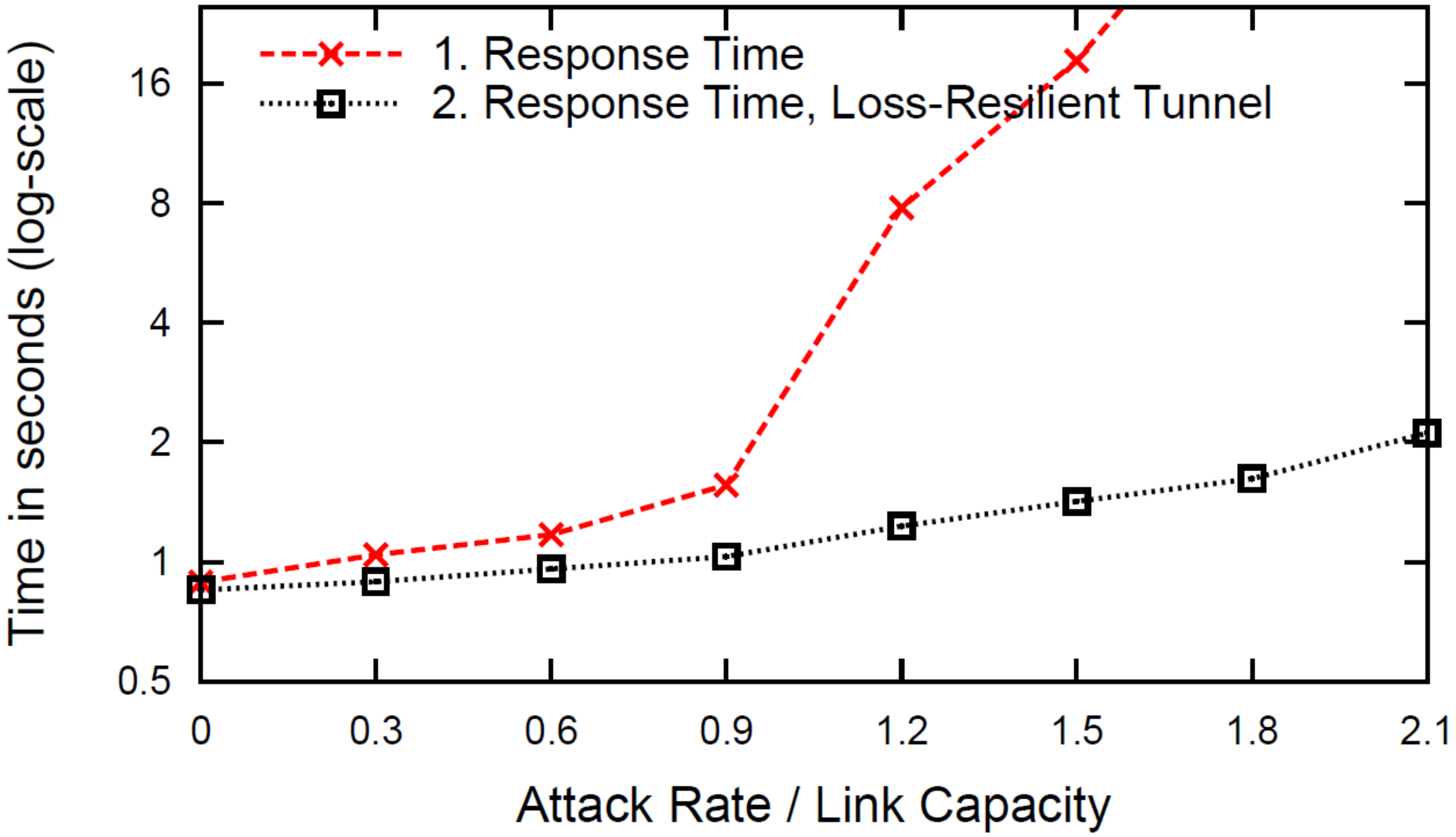


Loss-Resilient Tunnel

- Tunnel packets between content-origin (via gateway) and proxies over UDP
  - Client connects via HTTP(S) -- no changes to clients
- Use network coding to ensure delivery even with high loss, e.g., [Rabin 89']
  - Recover from loss if n-out-of-m packets arrive



Loss-Resilient Tunnel

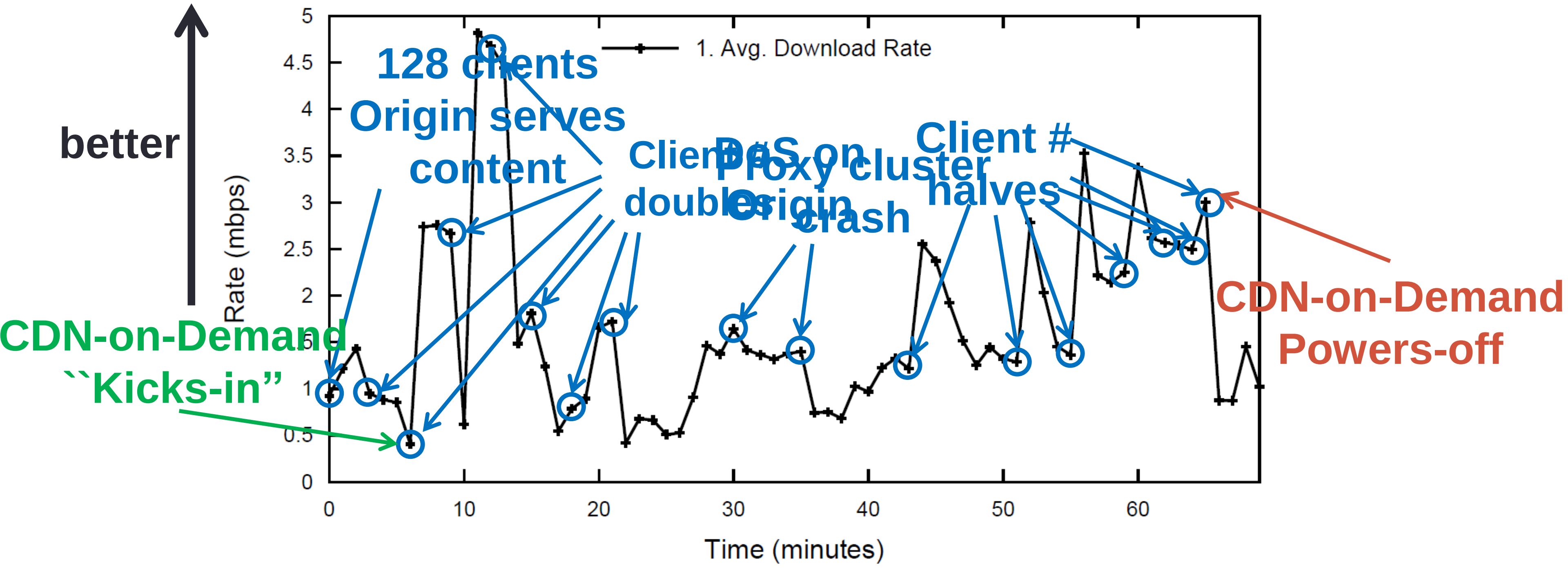


Evaluation

- Deployment over EC2 and GCE
- PlanetLab clients download 50KB object repeatedly
- Monitor performance while introducing changes to the setting every few minutes
  - more clients, server crash, attack on origin…

Results

- Handle thousands of clients simultaneously
- Attacks on content-origin have limited effect
  - due to loss-resilient tunnel
- Fraction of the cost of commercial CDN defenses



128 clients

Origin serves content

Client # doubles

DoS on Proxy cluster

Origin crash

Client # halves

CDN-on-Demand ``Kicks-in”

CDN-on-Demand Powers-off

Questions?

Thank you ☺