Far Cry: Will CDNs Hear NDN's Call?

♔ **Chavoosh Ghasemi** *(The University of Arizona)*
Hamed Yousefi *(Aryaka Networks)*
Beichuan Zhang *(The University of Arizona)*

Evolution

- Transport Network
  - End-point to end-point
  - Operates on IP addresses

- Content Network
  - End-point to content
  - Operates on content's names

Content Delivery Network (CDN)

- *Implements a content network over a transport network (i.e., the Internet)*

ICN/NDN

- A young networking technology to build a content network
  - Simple architecture & Secure design

- Goal:
  - Compare content networks built by CDNs and NDN

- Important Note:
  - This work is only focused on *caching and retrieval of static contents*

Real-World Measurements

- Deployed an adaptive video streaming service
- Evaluated content networks:
  - Akamai
  - Fastly
  - NDN testbed
- Users in four different continents
- Two-week experiment

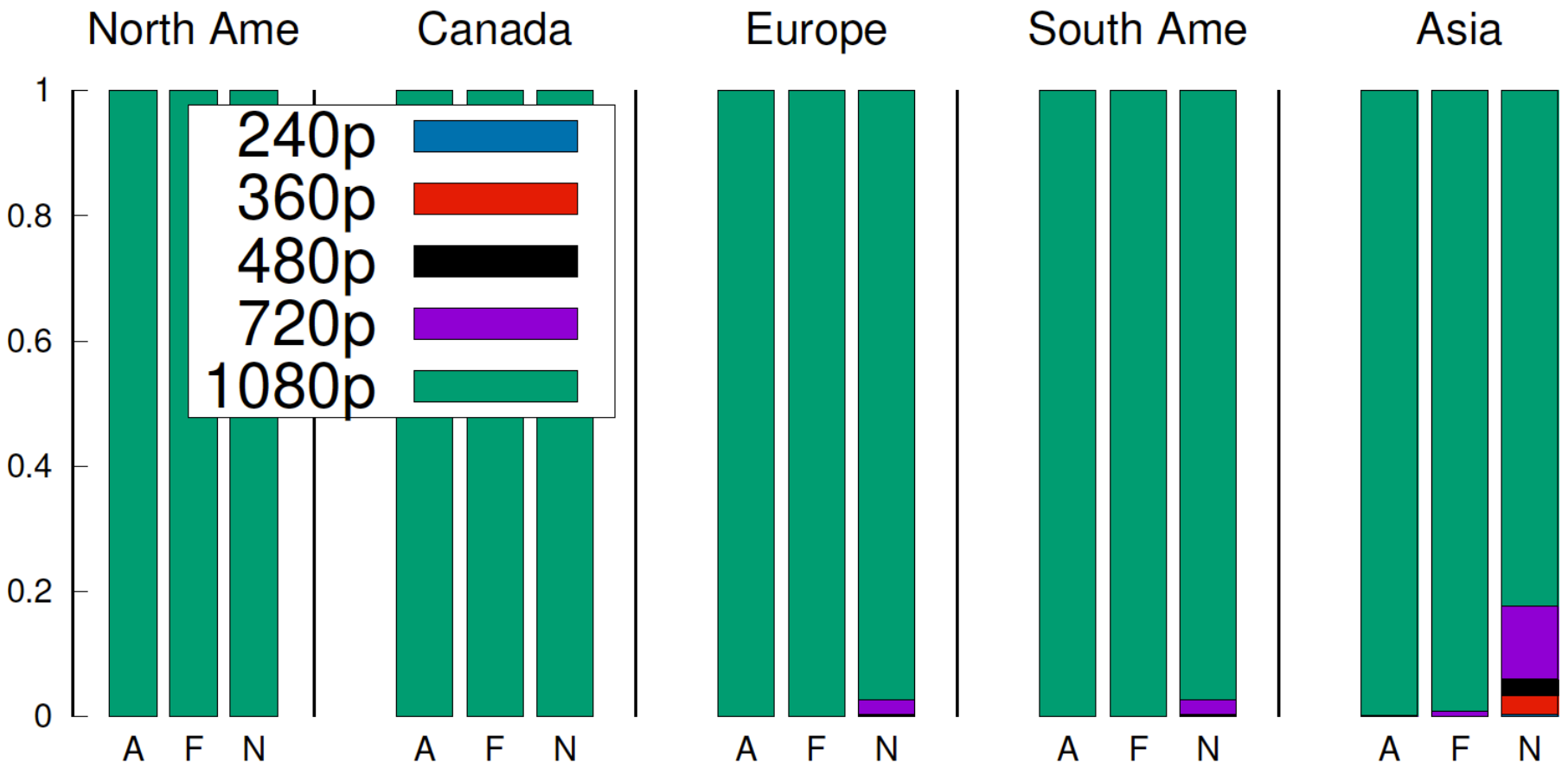
Metrics:

1. Quality of Experience (QoE)
2. Origin workload
3. Failure resiliency
4. Content security

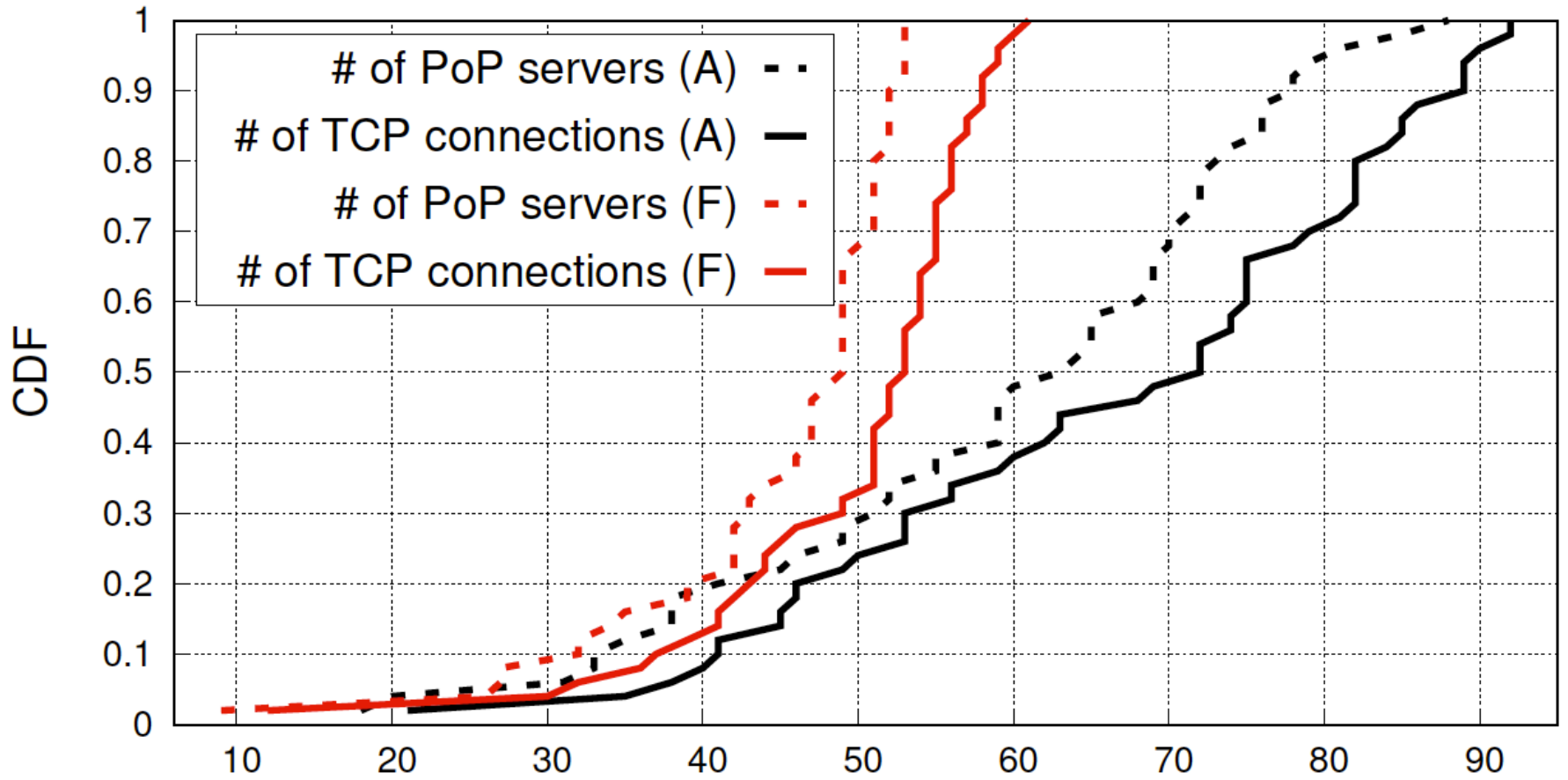
Quality of Experience (QoE)

- Video resolution
- Video startup delay

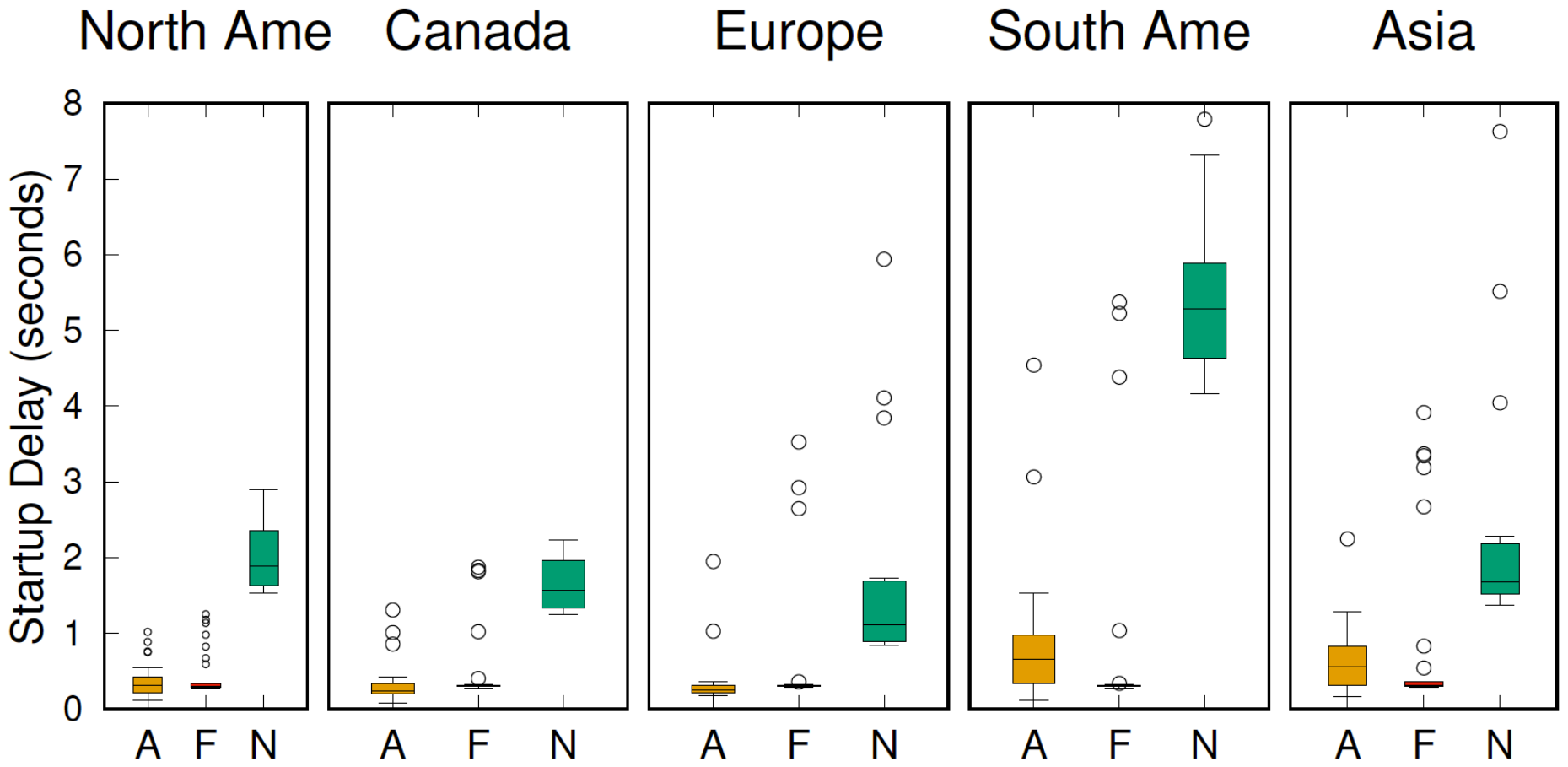
QoE – Video Resolution



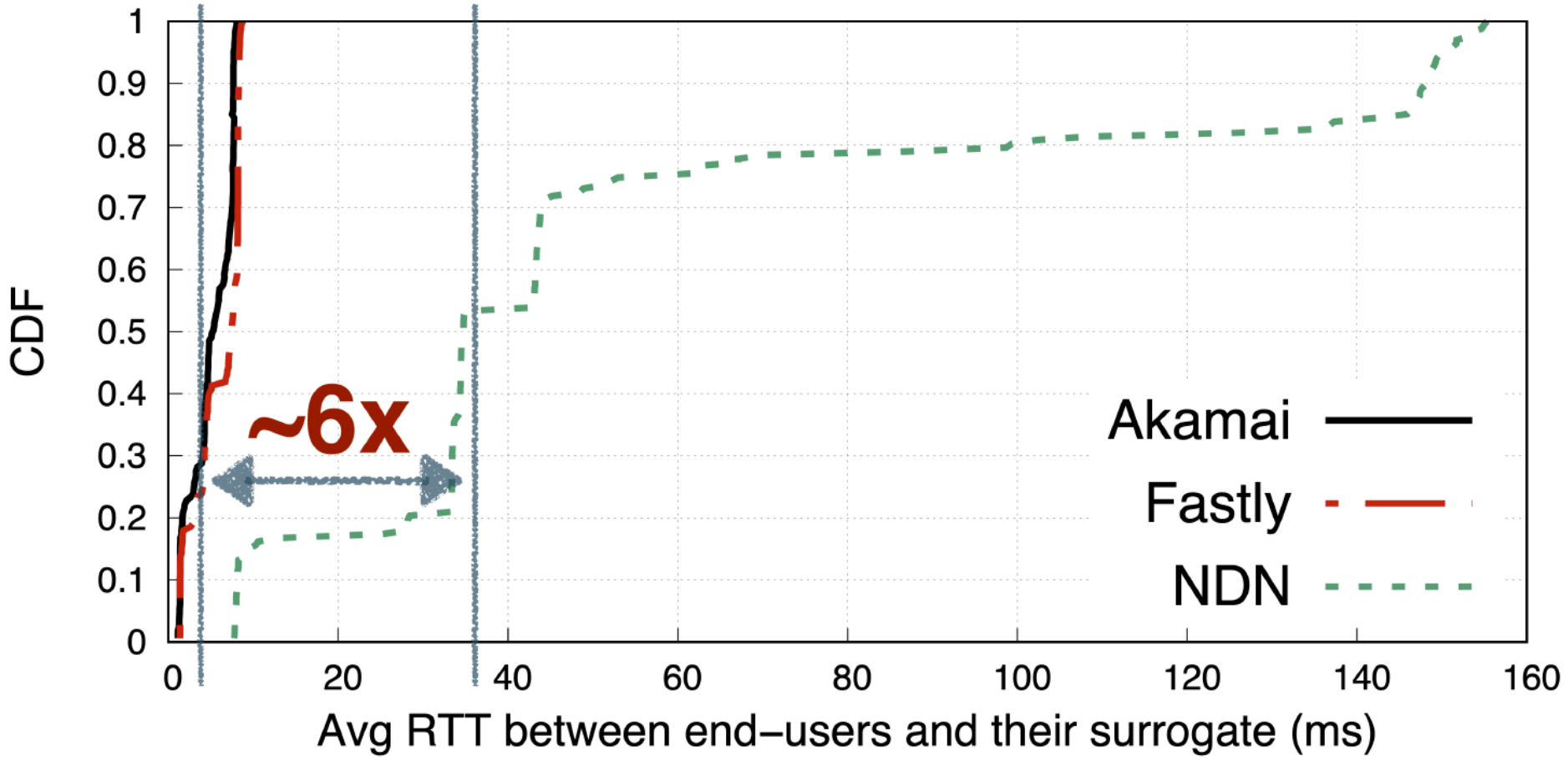
QoE – Video Resolution – Parallelism



QoE – Startup Delay



QoE – Startup Delay – Caching



QoE – Software Maturity

- A new set of experiments
  - **Exclude** contribution of parallelism and large deployment of CDNs

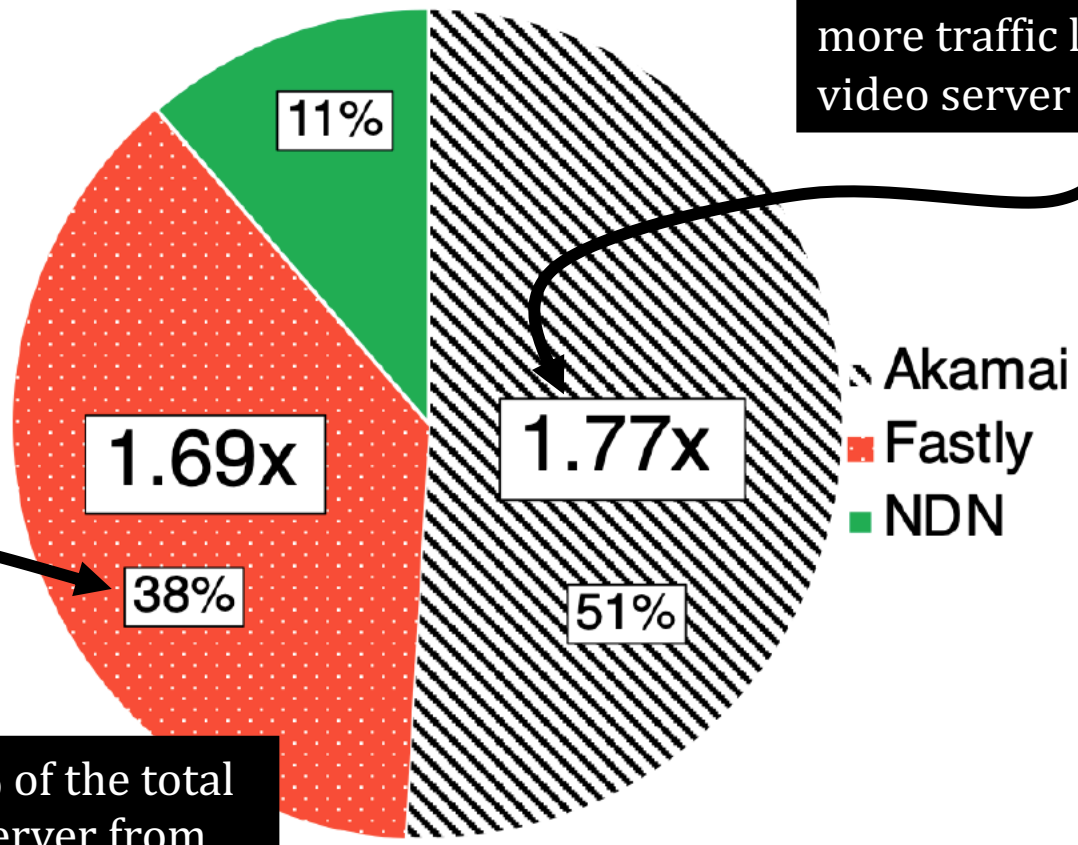
- **Average** throughput:
  - NDN testbed ➔ 7.54 Mbps (*23.48 Mbps at best*)
  - Akamai ➔ 96.7 Mbps
  - Fastly ➔ 83.2 Mbps

QoE – Summarize

- Akamai and Fastly try to:
  1. Cache contents as close as possible to end-users
  2. Download contents through a massive parallelism, using optimized software/protocols

- NDN can barely meet these two goals
  - Lack of software maturity and large deployment

Origin Workload



Akamai incurs **1.77** times more traffic load to the video server than NDN does

Fastly is accountable for **38%** of the total traffic received by the video server from all three networks.

Origin Workload – Why NDN is better?

Two main contributors to NDN testbed's performance:

- **Network architecture**
  - Akamai and Fastly partition their network to *islands*
- **Request aggregation**
  - Akamai does not aggregate requests seeking for the same content

Failure Resiliency

The success ratio of each network in serving the end-users' requests from their caches when the origin stops serving content

Network	Akamai	Fastly	NDN
Success ratio	9.42%	13.98%	100%

Origin Workload & Failure Resiliency – Summarize

- High traffic load and failure resiliency issues in CDNs are related to their network design
  - Resource over-provisioning in CDNs cannot address these issues

- NDN benefits from:
  - Stateful forwarding plane
  - Non-partitioned network design
  - Unique in-network caching features

Content Security

- CDNs secure channels by Transport Layer Security (TLS)
  - TLS guarantees *data privacy*

- NDN secures contents by data signature
  - NDN guarantees *data integrity*

Security – Real-World Scenarios

- Keep your private key private

- Schematize trust for dynamic contents

Security - Summarize

- NDN security model is promising for large content distribution purposes

- Main issue of NDN security model
  - *Lack of privacy*

Lessons & Challenges

- ***Hardware & Software Maturity***

- ***The Need for NDN Applications***

- ***Management and Debugging***

Conclusion

- Compare the content networks built by NDN and CDNs
- QoE is mainly determined by hardware and software maturity
  - CDNs outperform the current NDN deployment in terms of QoE
- Origin workload and failure resiliency are mainly the products of the network design
  - NDN testbed outperforms CDNs
- NDN ***can*** realize a resilient, secure, and scalable content network if accompanied by
  - Mature software and protocols
  - Sufficient hardware resources


Thank You