Joint experimentation of modern Internet application protocols with SDN (Go-Quick)

Dr. Ioannis Giannoulakis
Eight Bells Ltd
giannoul@8bellsresearch.com
www.8bellsresearch.com

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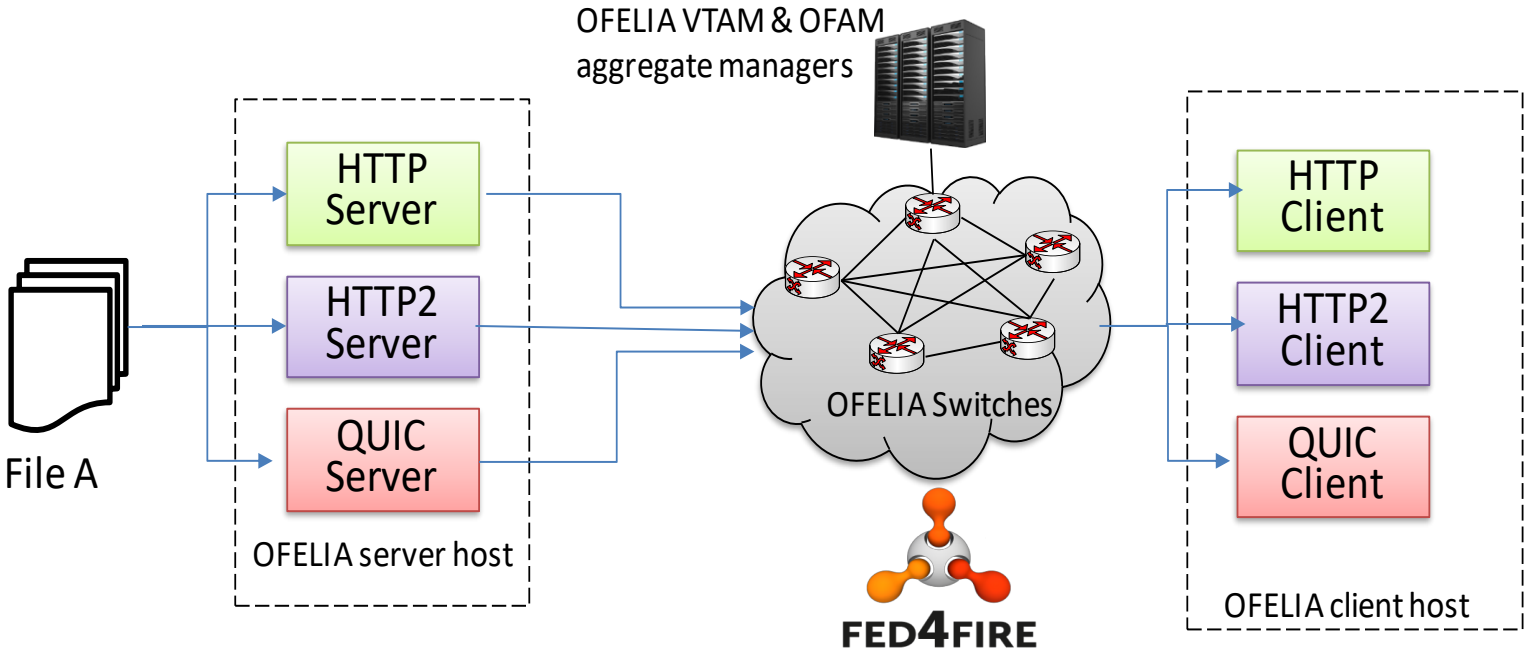
Project Summary

- Go-Quick experimentation aims to evaluate the performance of QUIC, as compared to HTTP and SPDY/HTTP2, through deploying virtual overlay networks on Fed4FIRE+ OpenFlow SDN-enabled infrastructure.
- Since sophisticated congestion avoidance and packet error correction mechanisms are used in all protocols, the actual network scenarios of the Go-Quick experiments determine which protocol performs best in each case.
- By deploying various network conditions and for different size of objects, performance metrics like throughput are assessed for the three protocols, QUIC, SPDY/HTTP2, and HTTP.
- Different virtual overlay networks are deployed on Fed4FIRE+ OpenFlow SDN-enabled infrastructure to adapt to changing network scenarios.

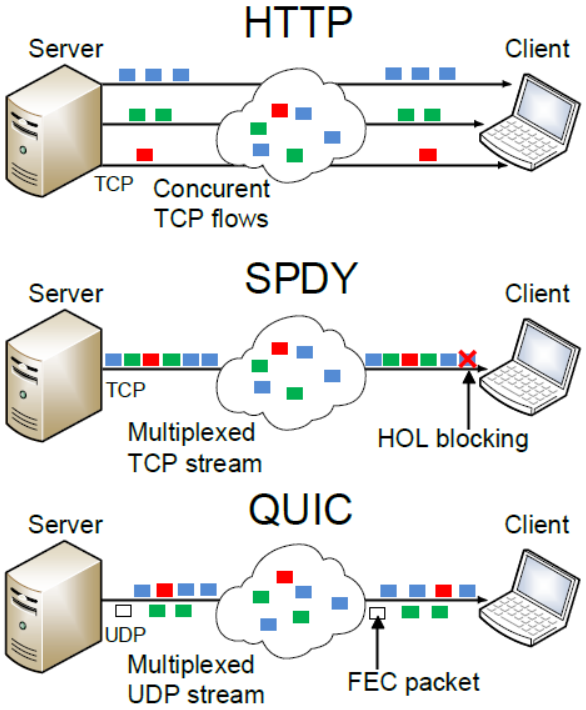
Objectives

- Deployment of a virtual overlay network on Fed4FIRE+ OpenFlow SDN-enabled infrastructure
- Installation and configuration of QUIC, APACHE servers and emulation of different network conditions
- Google's QUIC Client and Server are meant mainly for integration testing: neither is performant at scale
- Go Quick has developed Bash scripts for full automation of the experiments
- Performance evaluation of QUIC as compared to other L7 protocols (e.g., HTTP/HTTP2)

Go Quick Topology



Internet Protocols in a nutshell

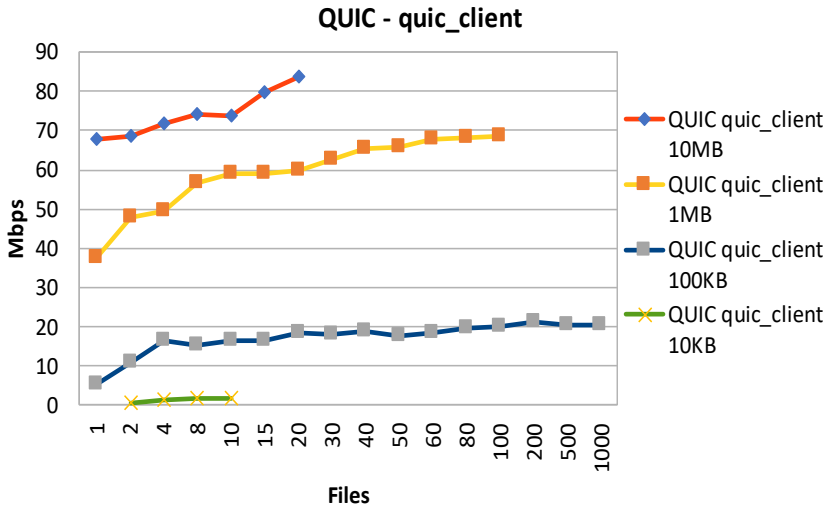


*P. Megyesi, Z. Kramer, S. Molnar, "How quick is QUIC?", in Proc. of IEEE ICC 2016, 22-27 May 2016.

- One of the bottlenecks of HTTP performance is the opening of too many TCP connections to achieve concurrency. A large portion of HTTP data flows consist of small (less than 15KB), bursty data transfers over dozens of distinct TCP connections.
- Another limitation is that HTTP based web transfers are strictly initiated by the client. This presents a serious problem because it hurts performance significantly in the case of loading embedded objects.
- HTTP2 introduces request prioritization. The client is allowed to specify a priority level for each object and the server then schedules the transfer of the objects accordingly.
- QUIC is working over UDP. The protocol does not force in-order delivery of packets thus QUIC avoids HOL blocking.

Results

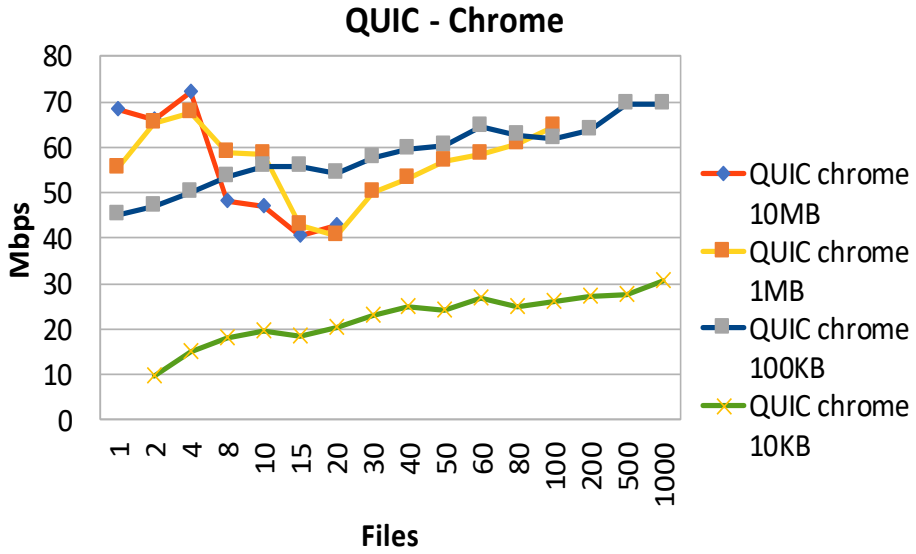
QUIC – SERVER & CLIENT



- QUIC aims to improve performance compared to HTTP, HTTP2 by multiplexing web objects in one stream over UDP
- “Go Quick” performed a comparative analysis

Results

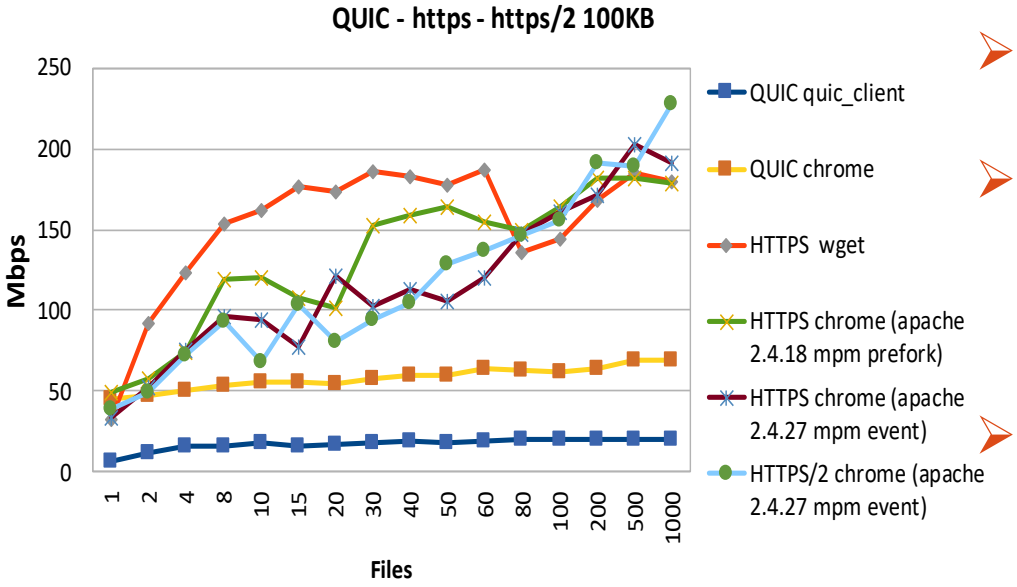
QUIC SERVER – CHROME CLIENT



- Performance is greatly affected by the file size and the number of concurrent file requests.
- OFELIA SDN physical switches were configured to route data and to create congestion and losses according to the network scenarios of the experiment.

Results

QUIC HTTPS HTTPS2 (100KB)



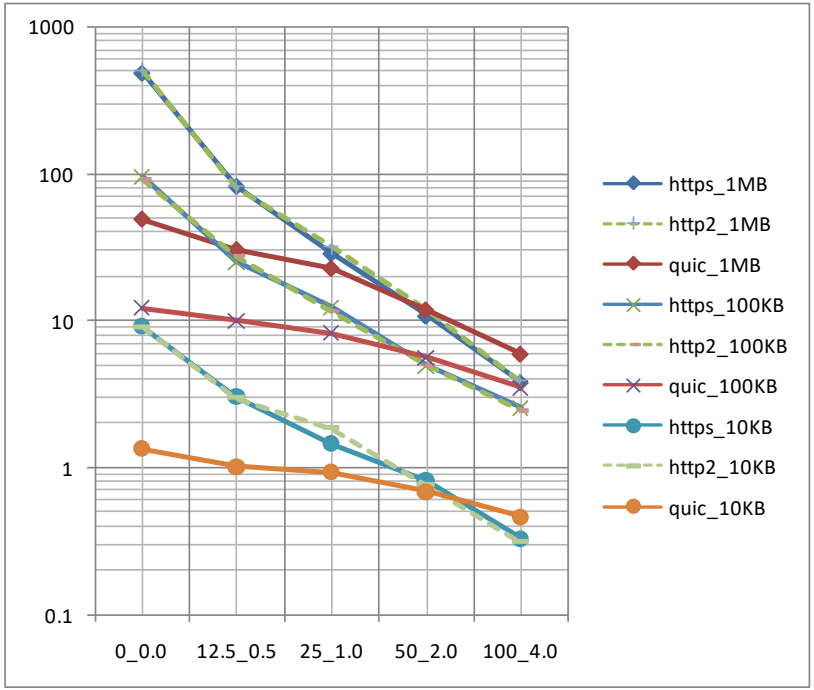
- In all scenarios QUIC protocol is outperformed by HTTPS/HTTPS2
- For typical web object sizes and for a big number of objects (i.e., many parallel flows), HTTPS2 is up to 80% better.
- In future work, measurements with Google Sites Server will be collected to exploit multi-threading capabilities

Network conditions under congestion

4 SCENARIOS USING SDN AND LINUX TC TOOL

- Negligible delays and losses.
  - only delay by the interfaces and routing software
- Comparatively low values for delays and losses.
  - delay of 12.5 ms is added and losses of about 0.5%, both upstream and downstream
- Moderate values for delays and losses.
  - delay of 25 ms is added and losses of about 1%, both upstream and downstream
- Moderate values for delays and losses.
  - delay of 50 ms is added and losses of about 2%, both upstream and downstream
- Comparatively high values for delays and losses.
  - delay of 100 ms is added and losses of about 4%, on both upstream and downstream

Throughput rate under the 4 scenarios



- QUIC is affected less by losses and network delays

Benefits gained for Eight Bells

- Go-Quick project leveraged the OpenFlow OFELIA testbed provided by Fed4FIRE+ (i2CAT) for the small-scale experiment on real equipment.
- Eight Bells plans to invest in studying network services and their interactions, therefore it had access to cutting edge technology environments for transport layer applications.
- Our analysts found into the Fed4FIRE+ experimentation testbed an SDN-capable platform with diverse set of capabilities and experimentation tools.

Business Impact

- 8BELLS is a start-up company specializing in modelling and analysis for businesses as well as in selected parts of Information ICT, based in Nicosia, Cyprus.
- The company has been established recently by ICT researchers and financial analysts pursuing the application of their research expertise and innovations in the ICT related arena.
- 8BELLS delivers customizable solutions that enhance modern communications relevant to the area of 5G Mobile Technology, NFV and also management solutions for Cloud infrastructures.
- 8BELLS translates business data into financial models, providing forecasts and supporting decision makers.

Business Impact

- Eight Bells plans to provide evaluation reports and research studies based on the outcomes of Go-Quick.
- The company cooperates with network operators and other ICT stakeholders that will be interested on the experimental results.
- The innovative approach of Go-Quick experiment will consist a basis for a technical modelling framework in the existing company's portfolio.

Feedback to Fed4FIRE

- OFELIA testbed proved powerful enough to support the required VMs.
- Also flexible enough to adapt to the diverse topology demands, during the experiment.
- The support of the Patron (i2CAT) was valuable for the smooth execution of the experiment.
- Fruitful discussions and exchange of ideas took place during past meetings of Fed4FIRE.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