DNS Does Not Suffice for MEC-CDN

Ke-Jou (Carol) Hsu      James Choncholas
Ketan Bhardwaj         Ada Gavrilovska
Mobile-Edge Computing (MEC) serves requests from short network distance

E.g. AR/VR gaming

MEC deployment supports latency-sensitive workloads: AR/VR, Automation, ML services, and CDN
CDN process relies on DNS resolution

mycdn.io/hotnet.img?

High performance CDN = fast DNS resolution + cache hit
Can MEC support current CDNs?

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High performance CDN = fast DNS resolution + cache hit at really near place

Require evaluation on DNS processing in mobile network
CDNs’ DNS lookup time Evaluation

![Graphs showing DNS lookup times for wired-campus, wifi-home, and cellular-mobile connectivity.]

- **Airbnb**
  - Content domain: a0.muscache.com
  - High DNS lookup latency and variability

- **Booking.com**
  - Content domain: q-cf.bstatic.com
  - The 20-ms MEC expectation
Behind-the-scene complexity

➡️ Same geo-location, different connectivities, may be served by different CDN cache servers or CDN providers

MEC-CDN needs new system design for low DNS lookup latency and high cache hit rate
Our MEC-CDN Design
Our MEC-CDN Design

L-DNS at edge can respond clients’ DNS requests quickly
Our MEC-CDN Design

C-DNS at edge can quickly respond the specific cache-in-MEC
Our MEC-CDN Design

- **L-DNS** and **C-DNS** are collocated with cache instances at edge, within first hop
  - L-DNS can respond to clients quickly
  - Content can be accessed quickly
  - C-DNS can redirect the address of accurate content cache instance
Latency comparison of DNS lookup via LTE

MEC-CDN

L-DNS

C-DNS

LAN

WAN

L-DNS

e.g. Google DNS

C-DNS

C-DNS

C-DNS
Latency comparison of DNS lookup via LTE

DNS query w/o CDN:
The request needs to go accessing original content server

Cloudflare DNS: 285.7 ms
Google DNS: 112.5 ms
LAN L-DNS: 114.6 ms

0 100 200 300 400 500 Millisecond (ms)

Wireless networking
DNS query over LTE
Latency comparison of DNS lookup via LTE

**L-DNS at MEC w/ CDN:** (ETSI/3GPP proposed deployment) more than 2x speedup

![Graph showing latency comparison of DNS lookup via LTE]

- **MEC L-DNS w/ WAN C-DNS:** 60.9 ms
- **LAN L-DNS:** 114.6 ms
- **Google DNS:** 112.5 ms
- **Cloudflare DNS:** 285.7 ms

← The ETSI/3GPP proposed setup
Latency comparison of DNS lookup via LTE

C-DNS (CDN router) at LAN or MEC location dramatically improve query time!

- MEC L-DNS w/ MEC C-DNS: 29.2 ms
- MEC L-DNS w/ LAN C-DNS: 34.8 ms
- MEC L-DNS w/ WAN C-DNS: 60.9 ms
- LAN L-DNS: 114.6 ms
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Millisecond (ms)
Latency comparison of DNS lookup via LTE

C-DNS (CDN router) deployed with MEC platform minimizes the latency of DNS resolution for cache instance.

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The C-DNS (CDN router) deployed with MEC platform minimizes the latency of DNS resolution for cache instance by 55%.
Latency comparison of DNS lookup via LTE

C-DNS (CDN router) deployed with MEC platform minimizes the latency of DNS resolution for cache instance.

No required public IP

Wireless networking DNS query over LTE

<table>
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<tr>
<th>Scenario</th>
<th>Latency (ms)</th>
<th>Reduction</th>
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RAN Functions | CoreDNS (L-DNS) | CDN Router (C-DNS) | Cache Instance

Kubernetes

Cloudflare DNS with MEC platform.
Conclusion and Next Step

- **Evaluate DNS query overhead in mobile network**
  - Latency far from sub 20 ms expectations of latency-critical services
  - Complex CDN eco-system makes performance improvement more difficult

- **Propose MEC-CDN design**
  - 96% DNS query time reduction compared to Public DNS/LAN DNS
  - and 90% compared to current ETSI proposed structure
  - and 55% compared to LAN C-DNS
Conclusion and Next Step

• Evaluate DNS query overhead in mobile network
  - Latency far from sub 20 ms expectations of latency-critical services
  - Complex CDN eco-system makes performance improvement more difficult

• Propose MEC-CDN design
  - 96% DNS query time reduction compared to Public DNS/LAN DNS
  - and 90% compared to current ETSI proposed structure
  - and 55% compared to LAN C-DNS

• Further MEC-CDN performance evaluation at edge
  - DNS TTL, content cache update, synchronization across core networks
  - realistic testbed and workloads

• Coordination of MEC-CDN and MEC platform services
  - Finer resource isolation and management
Thanks for your attention!