Increase of Root and JP queries
-- Long-term trends of number of queries --

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Are DNS queries increasing ?

- Some people say that the load to DNS is still increasing and queries to root and TLD DNS servers are also increasing
- However, there is no evidence which indicates the increase of queries to root and TLD DNS servers

DNS-OARC Root Datasets

- "A Day in the Life of the Internet" (DITL) is a large-scale data collection project undertaken by CAIDA and DNS-OARC every year since 2006
  - https://www.dns-oarc.net/ditl/2011/
  - 50 hours packet capture at root DNS servers and other DNS servers (48 hours are used by this analysis)
 - Source IP addresses of i.root-servers.net data are anonymized

Year	Start(UTC)	End	Analyzed data from
2011	Apr 12 1200	Apr 14 1200	a,c,d,e,f,h,j,k,l,m (10/13)
2012	Apr 17 1200	Apr 19 1200	a,c,e,f,h,j,k,l,m (9/13)
2013	May 28 1200	May 30 1200	a,c,d,e,f,h,j,k,l,m (10/13)
2014	Apr 15 1200	Apr 17 1200	a,c,e,f,h,j,k,m (8/13)

JP datasets

- .JP has 1,391,422 registered domain names (on May 1, 2015)
- JP DNS servers serve approx. 1.6 billion queries per day
- Two datasets
  - Packet captures of all JP DNS servers, around the same time as DNS-OARC DITL event (and more)
  - Query logs of 2 (a and g) JP DNS servers, every day, for 9 years

| Name	Operator	Location	Address (IPv4:7, IPv6:6, total 13)	Capture
A.DNS.JP	JPRS	JP*2	203.119.1.1, 2001:dc4::1	Pcap/Log
B.DNS.JP	JPNIC	JP*1	202.12.30.131, 2001:dc2::1	Pcap
C.DNS.JP	JPRS	Worldwide	156.154.100.5, 2001:502:ad09::5	Pcap
D.DNS.JP	IIJ	JP*2, US*2	210.138.175.244, 2001:240::53	Pcap
E.DNS.JP	WIDE	JP*1,US*1, FR*1	192.50.43.53, 2001:200:c000::35	Pcap
F.DNS.JP	NII	JP*1	150.100.6.8, 2001:2f8:0:100::153	Pcap
G.DNS.JP	JPRS	JP*1	203.119.40.1	Pcap/Log

Average QPS (queries/sec) seen at Root DITL data sets (48 hours)
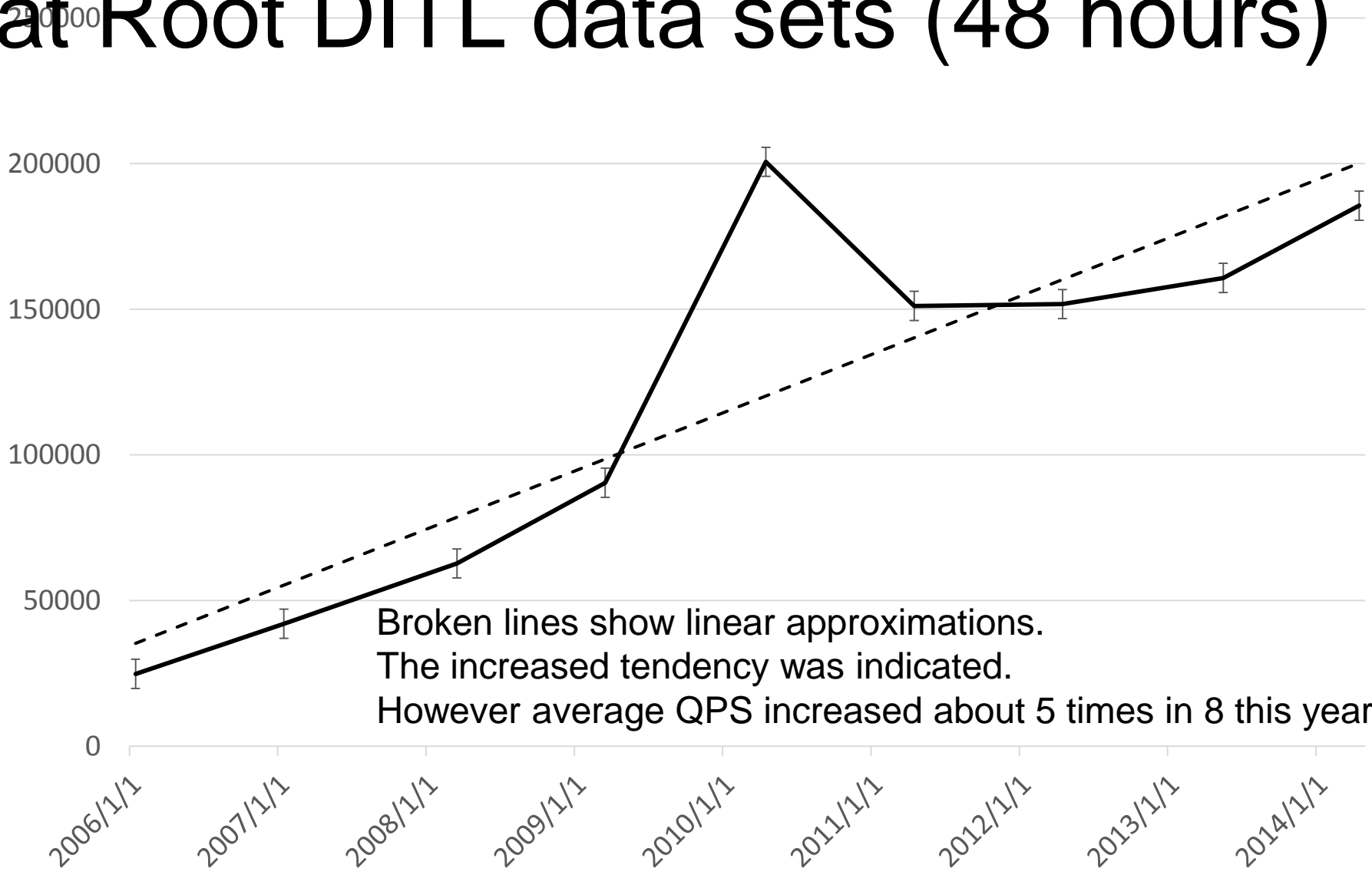
Broken lines show linear approximations.
The increased tendency was indicated.
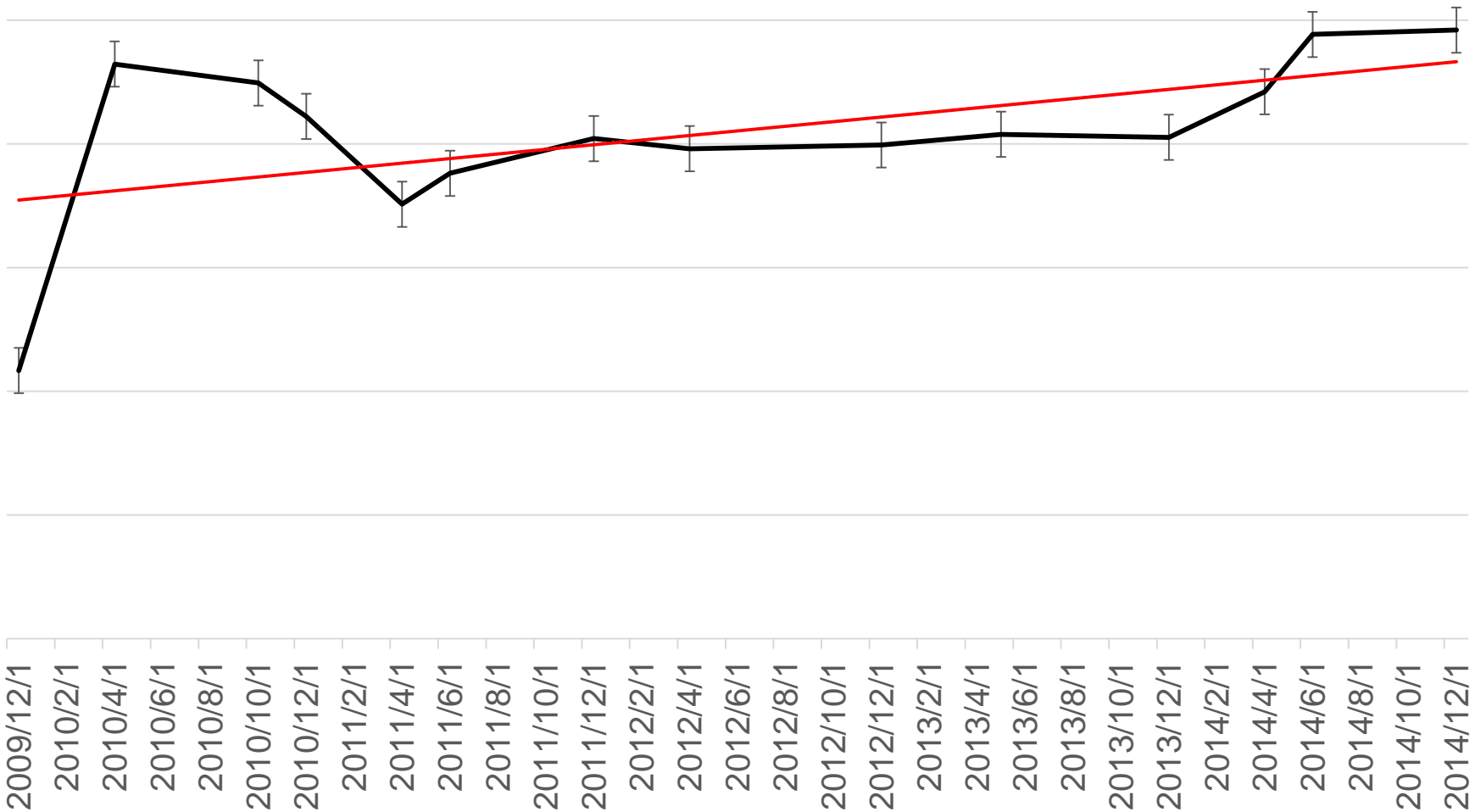However average QPS increased about 5 times in 8 this years.

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Average QPS seen
at each root DNS server

Broken lines show linear approximations.
The increased tendency was indicated.
However average QPS increased about 5 times in 8 this years.
(almost of the same as all DITL data)
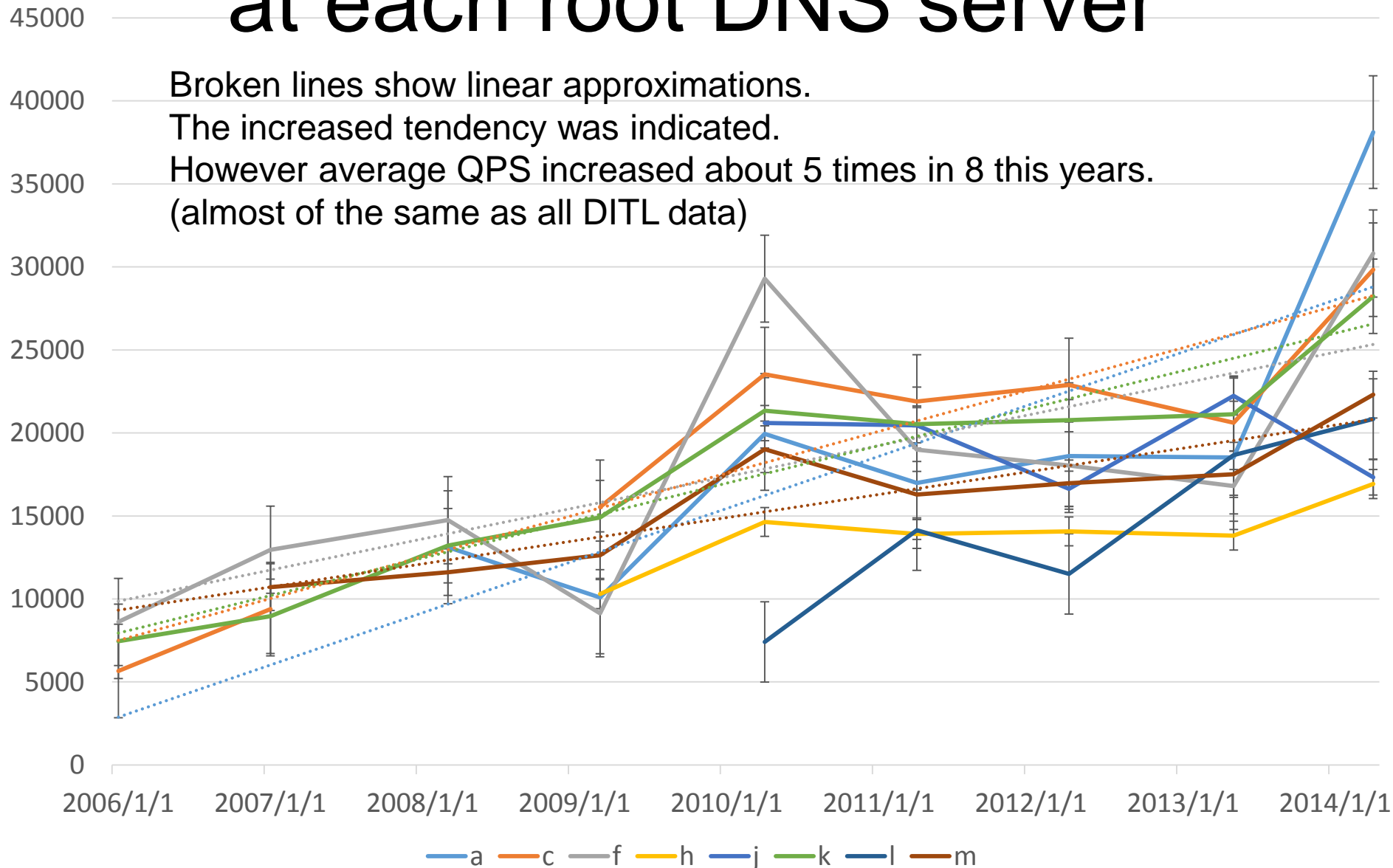
# Num. of queries seen at JP (all JP DNS, 48 hours, 5 years)

The increased tendency was indicated.
However, it is slightly lower than Root

2009/12/1 2010/2/1 2010/4/1 2010/6/1 2010/8/1 2010/10/1 2010/12/1 2011/2/1 2011/4/1 2011/6/1 2011/8/1 2011/10/1 2011/12/1 2012/2/1 2012/4/1 2012/6/1 2012/8/1 2012/10/1 2012/12/1 2013/2/1 2013/4/1 2013/6/1 2013/8/1 2013/10/1 2013/12/1 2014/2/1 2014/4/1 2014/6/1 2014/8/1 2014/10/1 2014/12/1

Number of daily queries seen at A.DNS.JP and G.DNS.JP (jp)

The increased tendency was indicated.
However, average number of daily queries continuously increased about 5 times in 10 this years.

A.DNS.JP ▬▬ G.DNS.JP
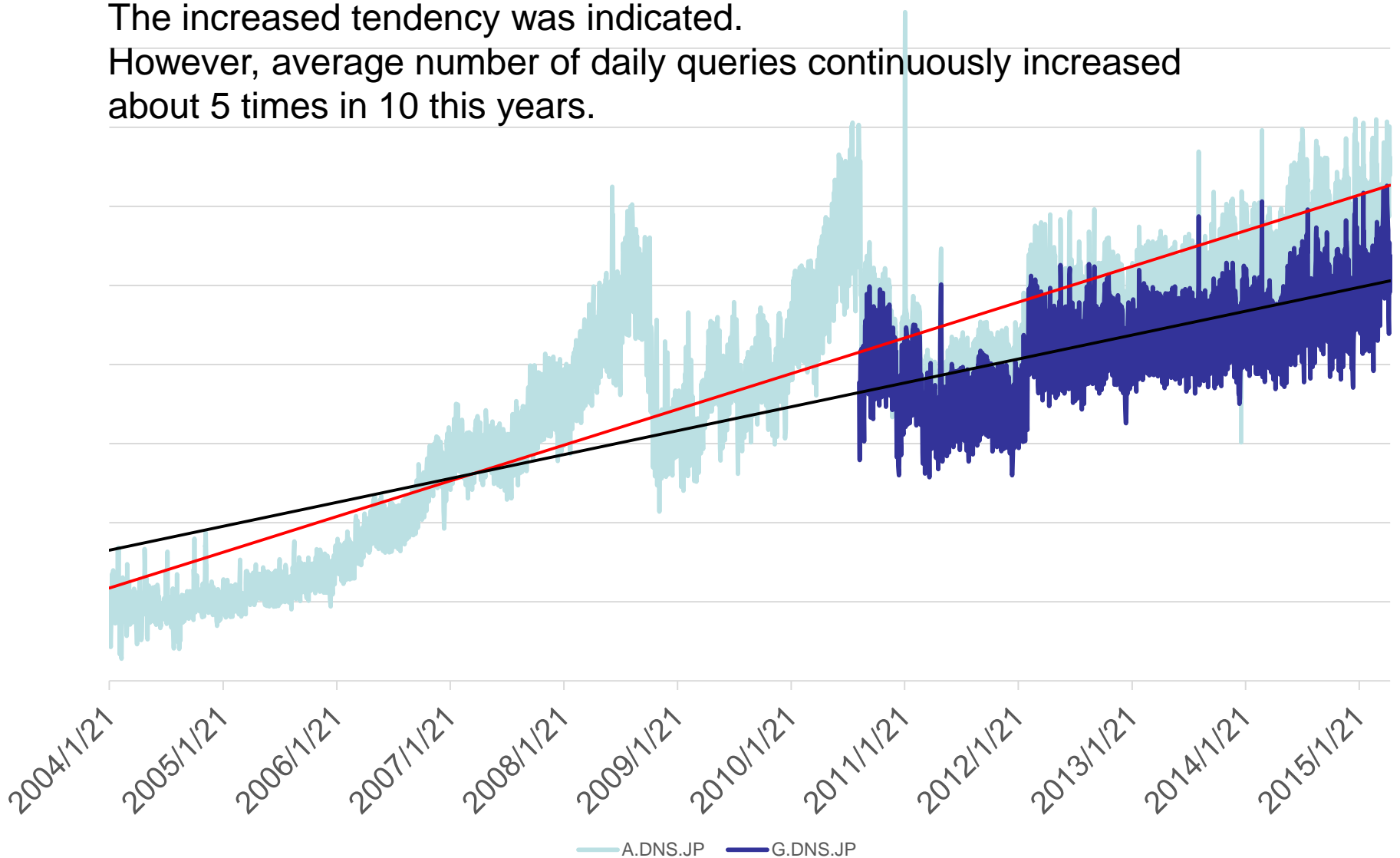
Fluctuations of Data

- Fluctuations of data come from differences
  - DoS attacks
  - Daily / Weekly changes
    - Days of a week are different on each DITL data capture
      - Comment from Daune Wessels
        - Each DITL data capture planed between Tuesday-Thursday
        - 2009 and 2015: different days of a week
  - Captured number of roots changes
  - The difference in the load tendencies by configuration changes (Anycast, adding NS, …)

Conclusion

- Queries to root DNS servers and JP DNS servers are continuously increasing
  - Average QPS seen at Root increased about 5 times in this 8 years
  - Average QPS seen at JP increased about 5 times in this 10 years
- However, the increase ratio of DNS queries is smaller than the increase of the Internet traffic trends (shown by IX operators and broadband operators)
- The increase of DNS queries seen at Root and JP is limited
  - Except to DoS attacks

Next steps

- I would like to know the DNS query trends seen at other edges
  - TLDs
  - Full-resolvers at ISPs
  - Auth. Servers of popular web sites

- Please show DNS traffic trends observed by your organizations and discuss the future DNS traffic trends

Acknowledgements

- DNS-OARC as the data source of Root dataset