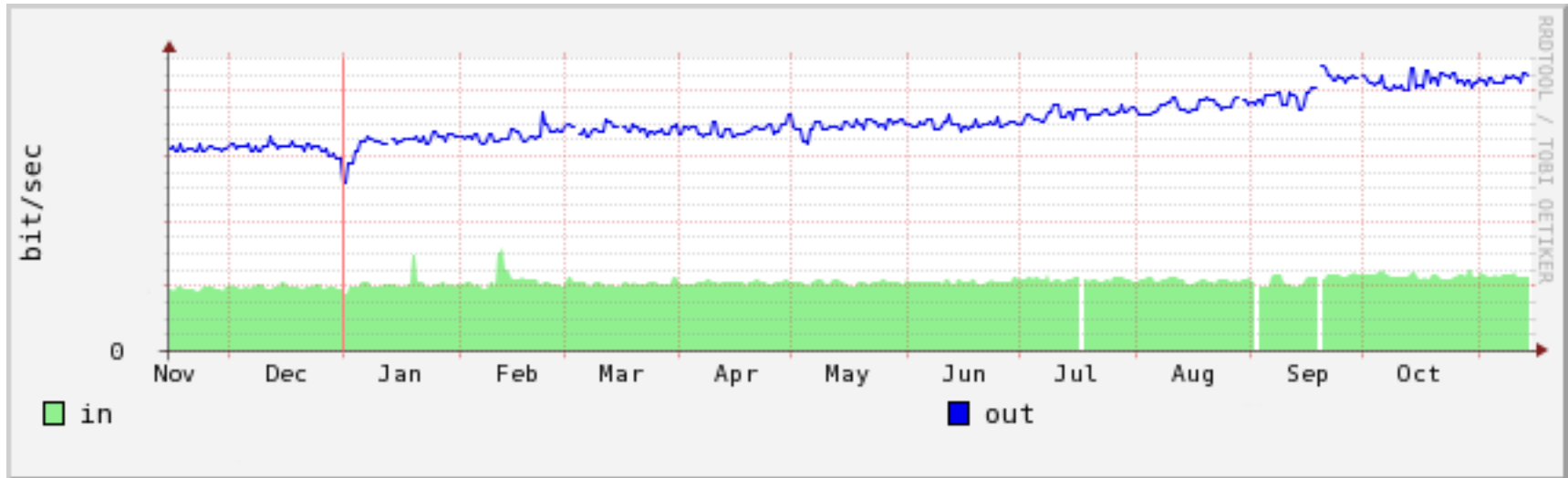


synced clients and traffic trend

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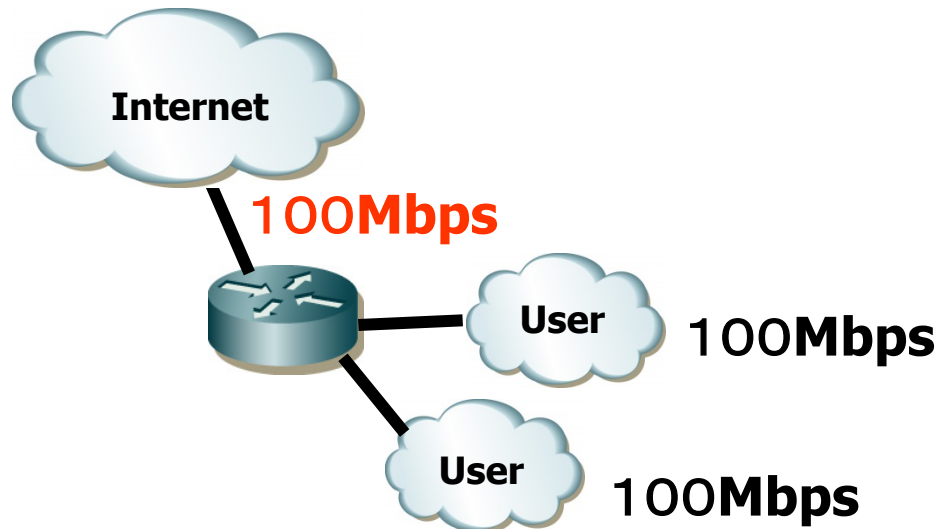
traffic and network design



- we plan upgrading based on traffic trend
 - to avoid congestions

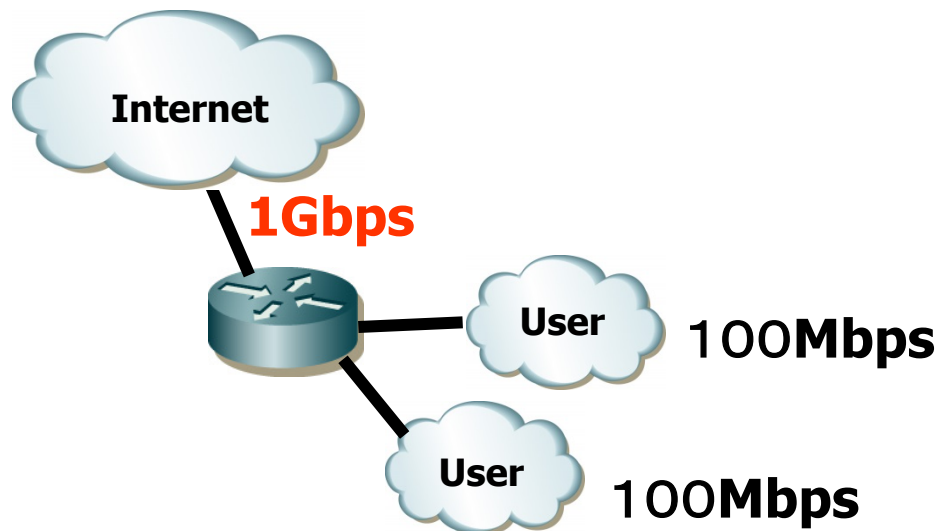
network design #1

- over-subscription
 - only some of users uses the network at once
 - expecting statistical multiplexing effect
 - need to estimate utilization to avoid congestion



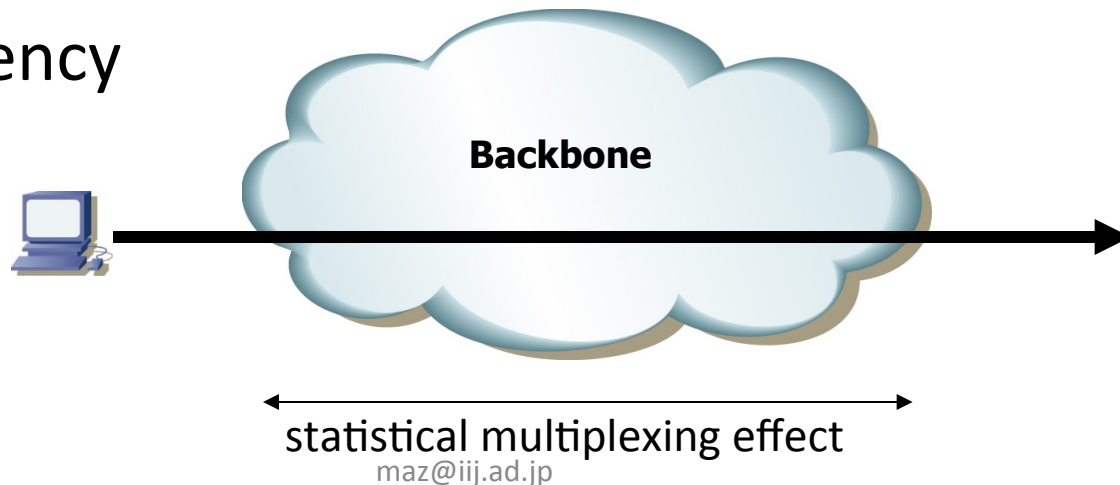
network design #2

- over-provisioning
 - provide more bandwidth than needed



backbone network design

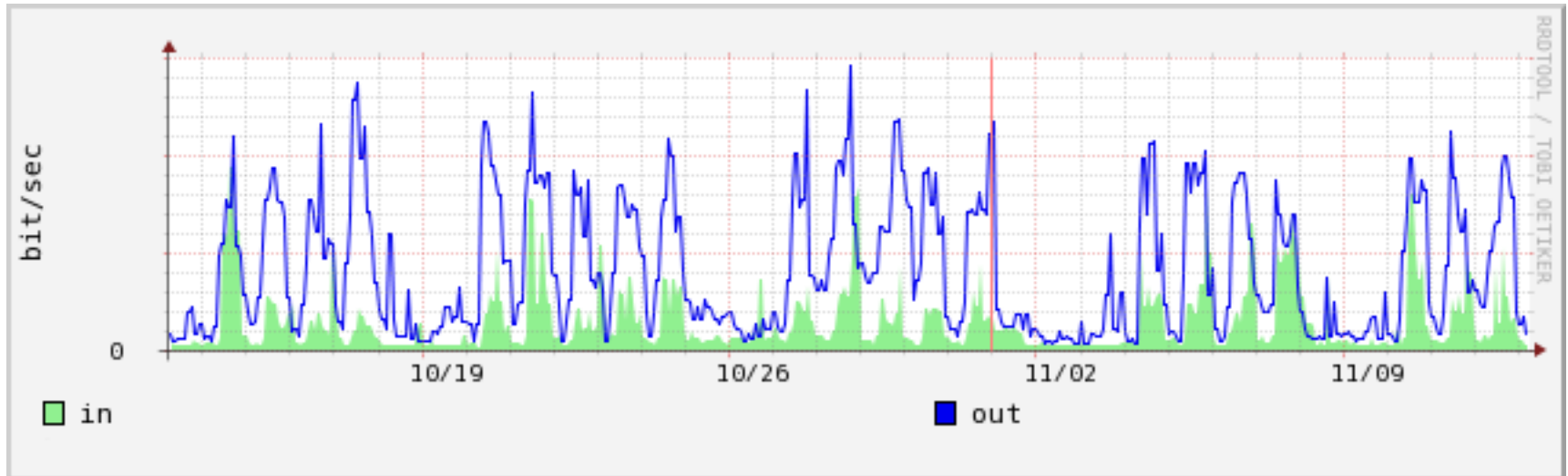
- based on over-subscription
 - we can expect more statistical multiplexing effect
 - cost effective
- over-provisioning to its utilization
 - for redundancy
 - low latency



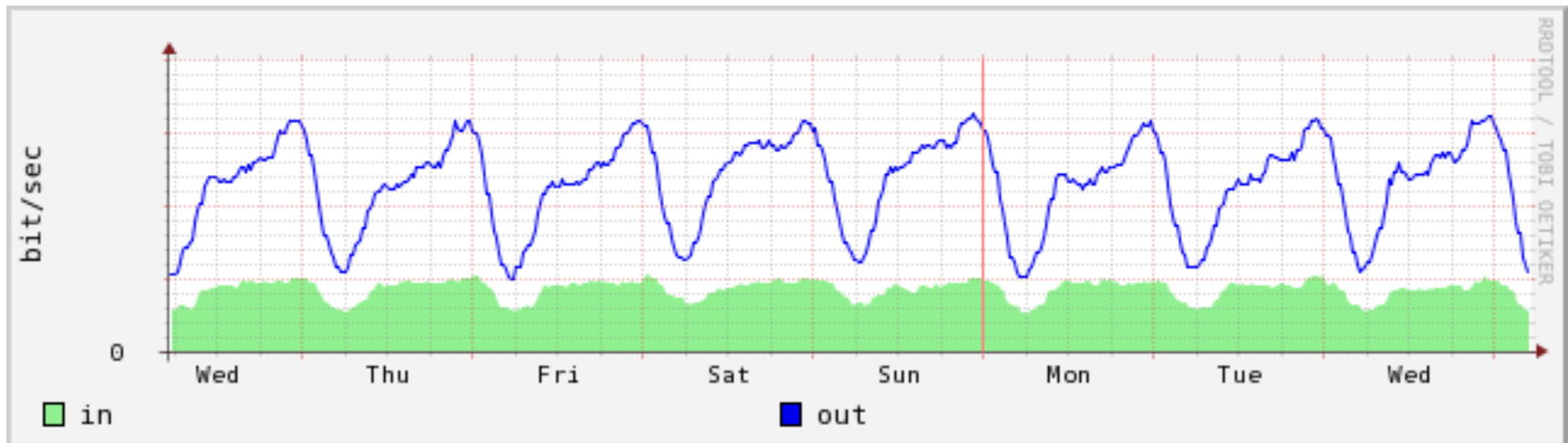
typical traffic

- enterprises
- consumers
- CDN
- IX
- mobile

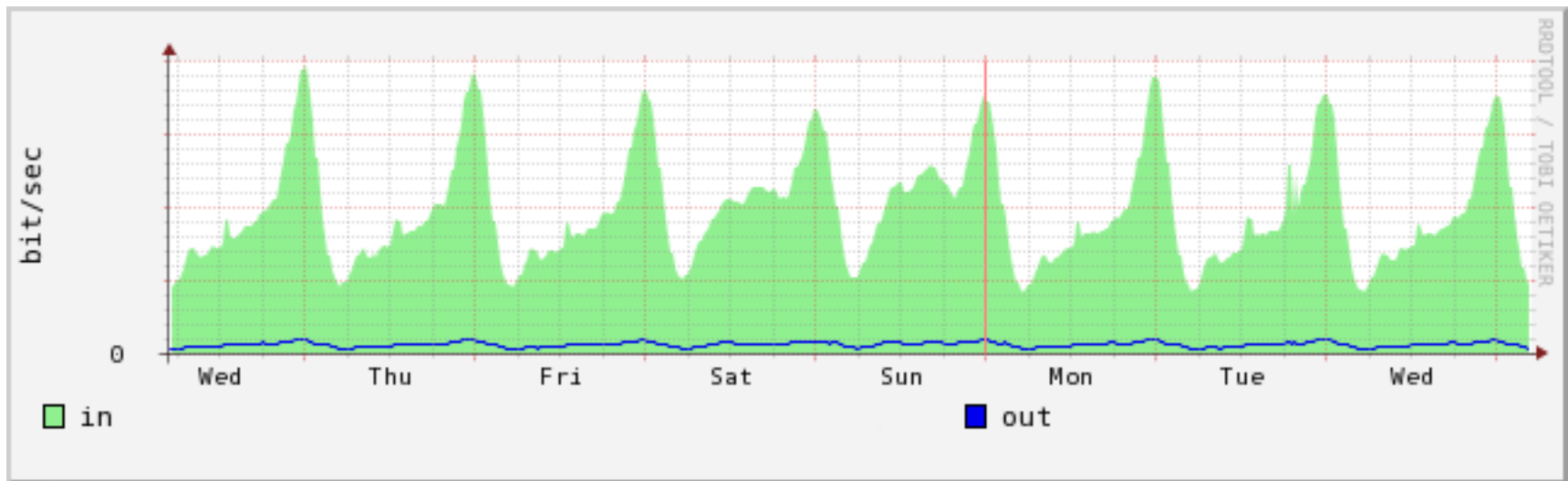
enterprise



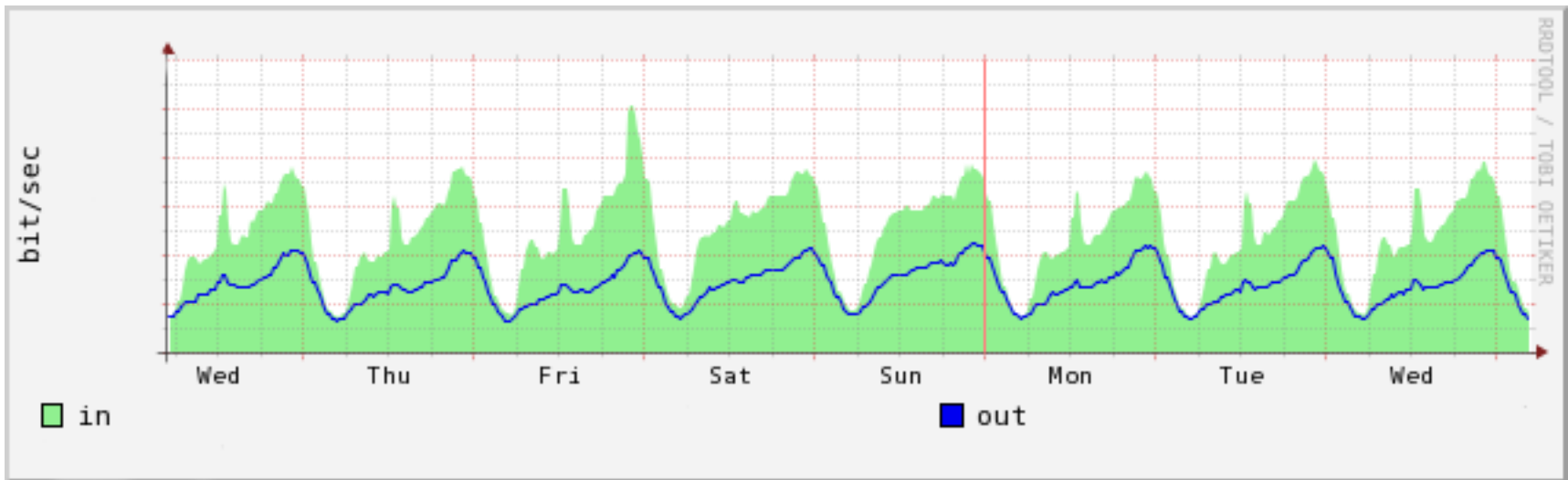
consumer (broadband)



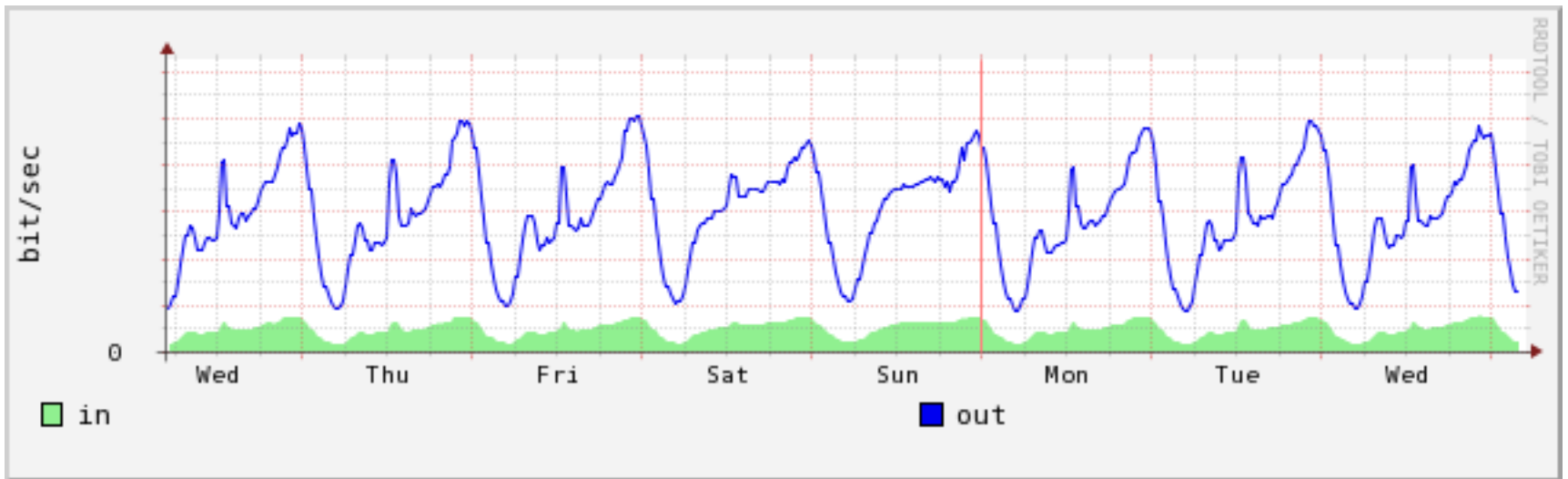
CDN (contents distribution network)



IX (Internet Exchange)



mobile

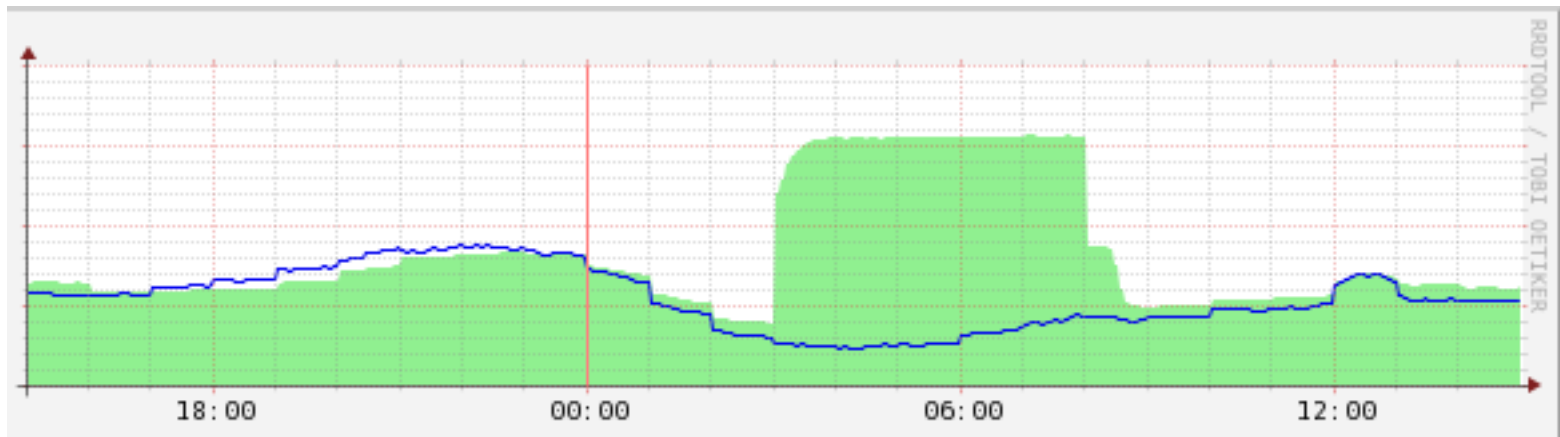


traffic trend

- we can upgrade based on that
 - important!
- know your customer
 - how they are using network

traffic concentration

- it sometimes happens
- 'statistical multiplexing effect' is reduced



how to deal with concentrations

- upgrade
 - more bandwidth
 - cost +
- wait and see
 - congestion
 - customer experience -
- something else
 - ??

new year greetings

- January 1st 00:00-02:00
 - phone call
 - SMS
 - e-mail
 - SNS
- about 7 times more messages than usual
- mobile operators have asked users to avoid such messages during the peak time

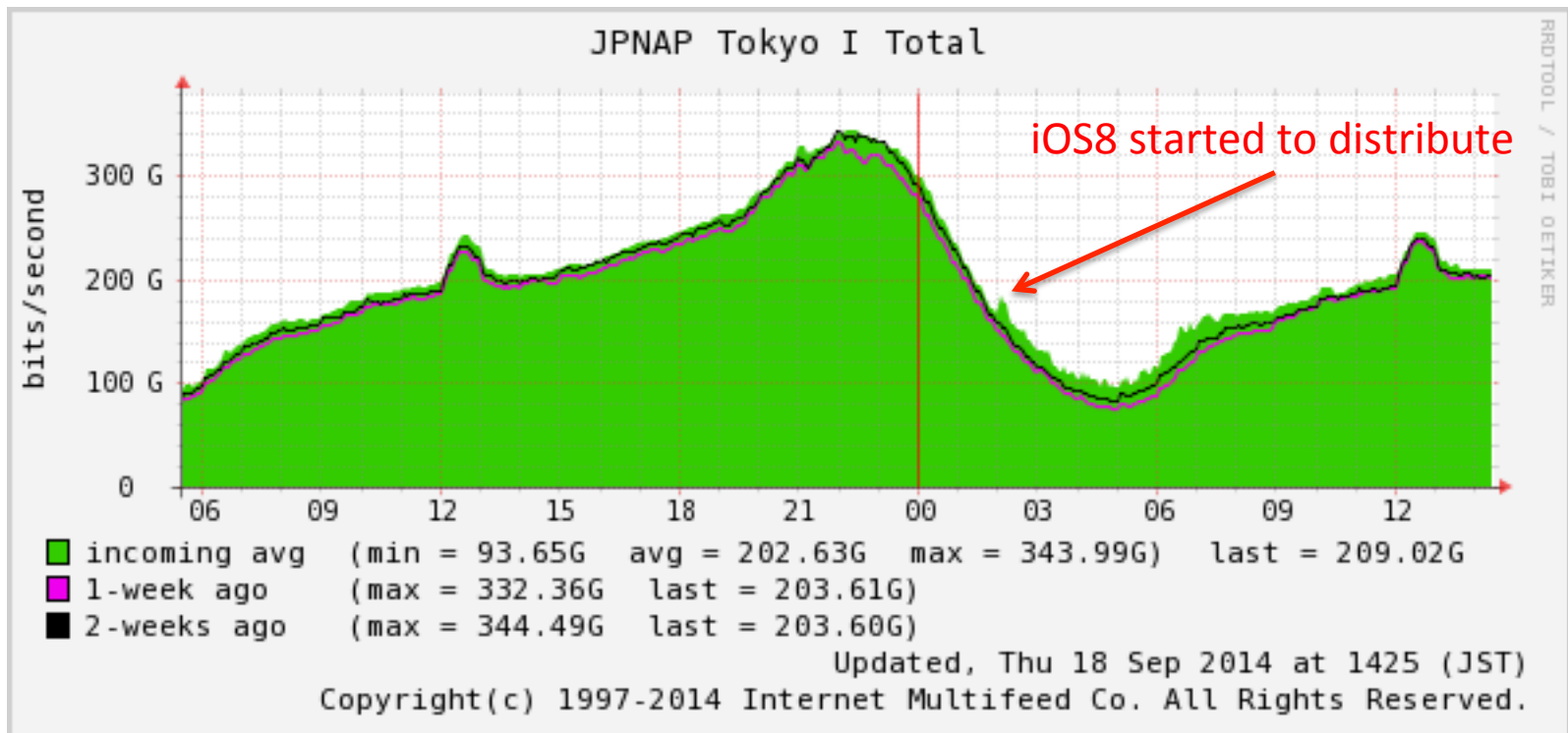
software/data distribution

- Windows Update
- iOS/MacOS Update
- game update
- karaoke update

- several giga byte data
- at the same time
- many clients

iOS8

- it seems Apple introduced some kinds of queuing mechanism



mobile device

- people bring it always
 - they can use it anytime
- it changed traffic pattern
 - commuting and lunch time
- commuting is a challenge for mobile in tokyo
 - about 3000 persons per train
 - 47 trains per hour
 - somehow you need to do handover ☹️

mobile devices and alarm clock

- clock on mobile devices is well synced
 - you can use mobile as a clock
- mobile devices ‘sleep’ to reduce battery usage
 - and once wakeup, it starts to communicate
- mobile operators see high traffic peek at
 - 6:30, 7:00, 7:30....
 - very short period traffic

summary

- ‘Statistical multiplexing effect’ is a key of backbone network design
- There could be concentrations because of social and technical reasons
- Network operators should give feedback
 - to users, CDNs and application developers
 - to avoid concentrations where possible