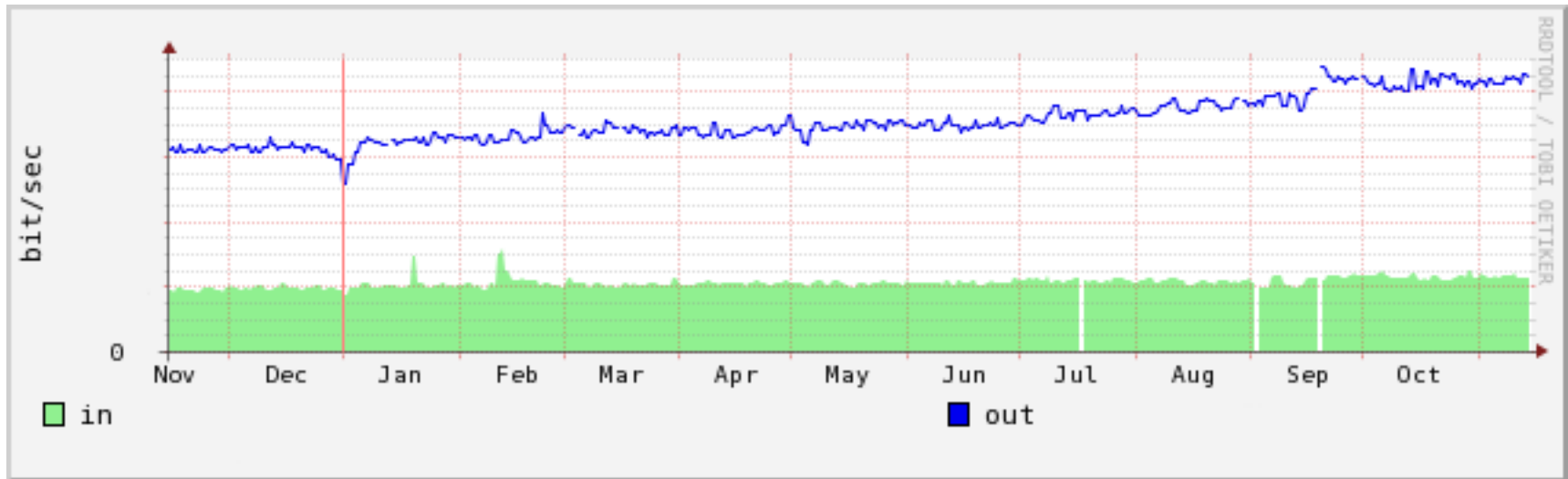


sync'ed clients and traffic trends

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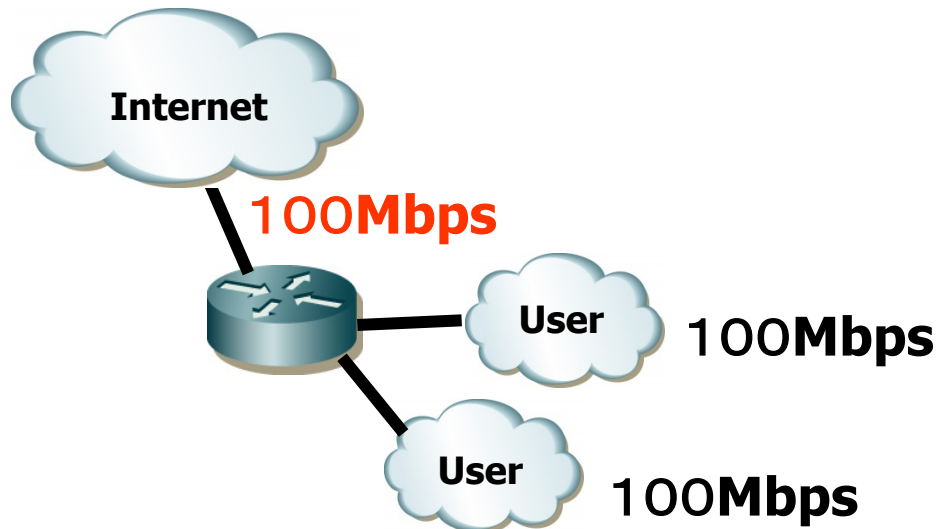
traffic and network design



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

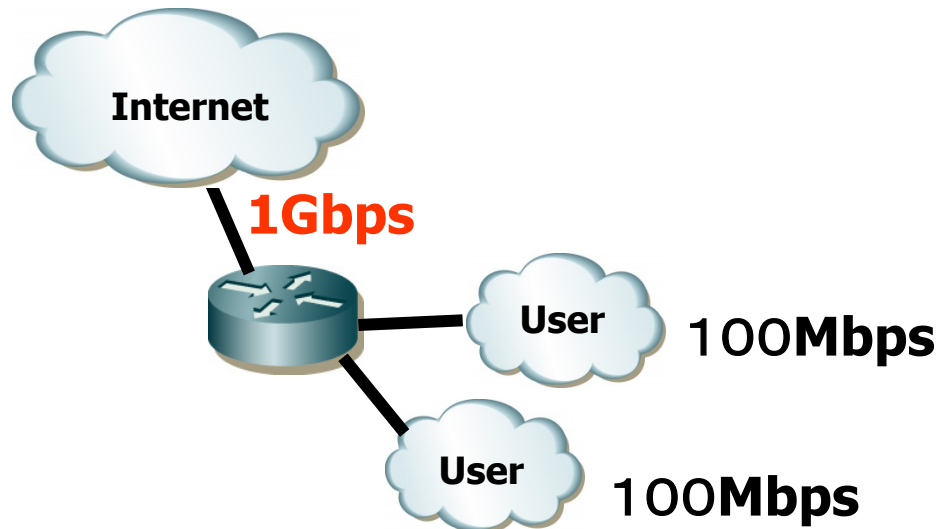
network design #1

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



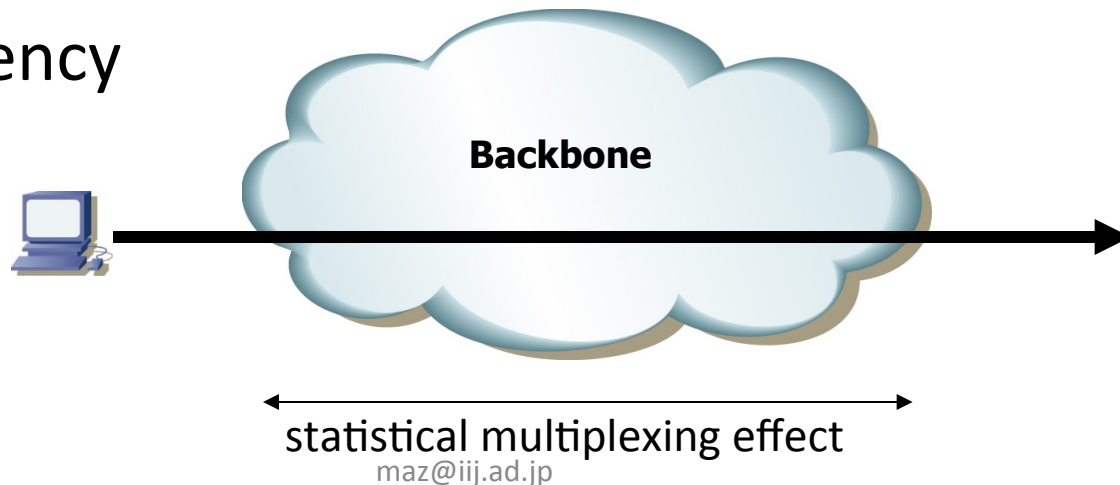
network design #2

- over-provisioning
 - provide more bandwidth than needed



backbone network design

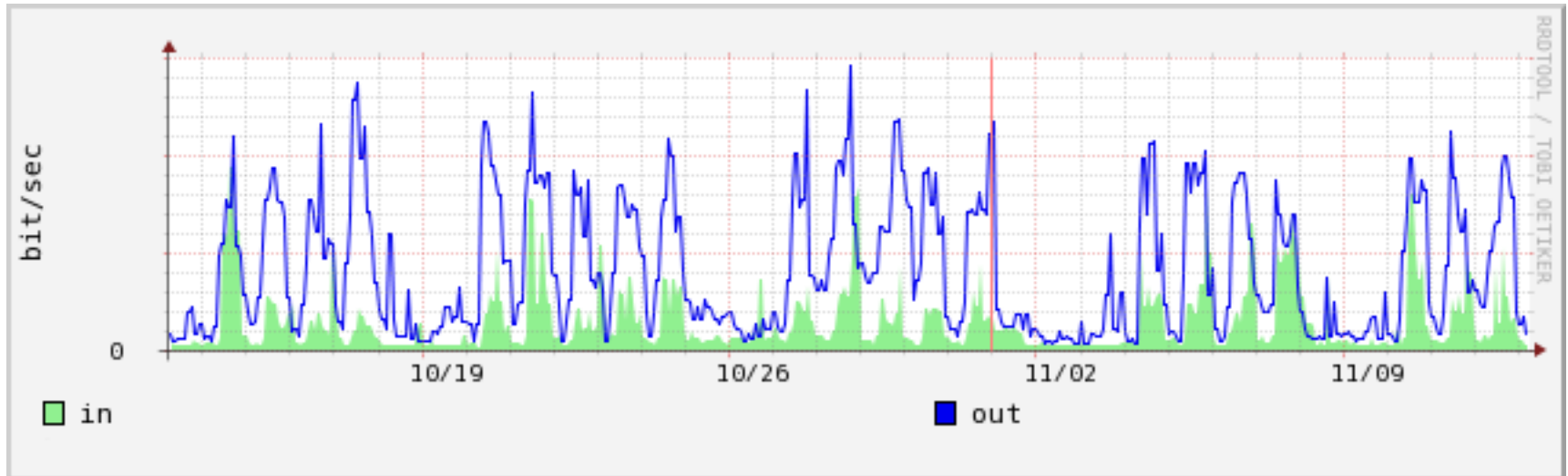
- based on over-subscription
 - we can expect more statistical multiplexing effect
 - cost effective
- over-provisioning to its utilization
 - for redundancy
 - low latency



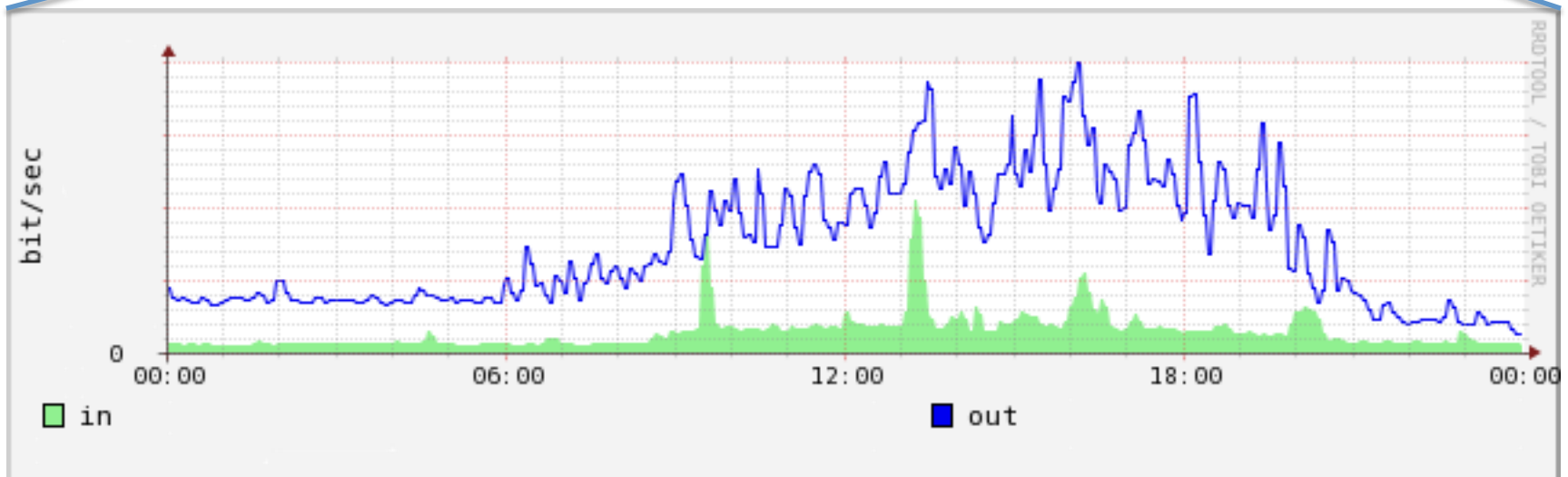
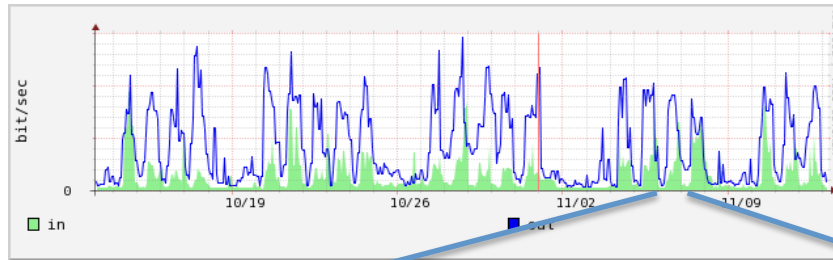
typical traffic

- enterprises
- consumers
- CDN
- IX
- mobile

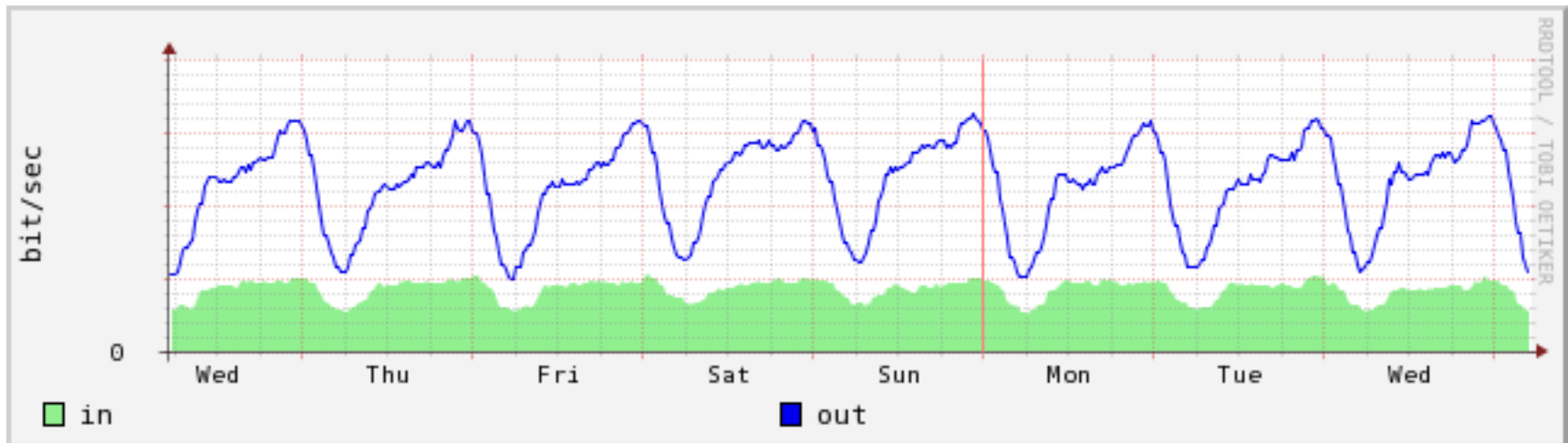
enterprise



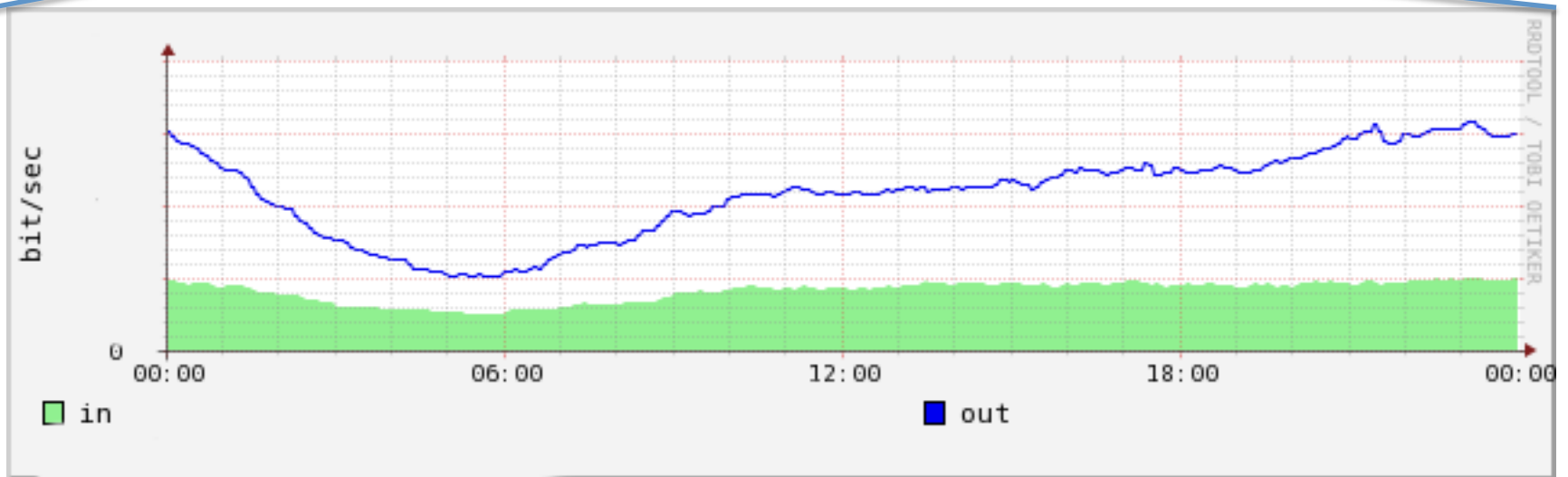
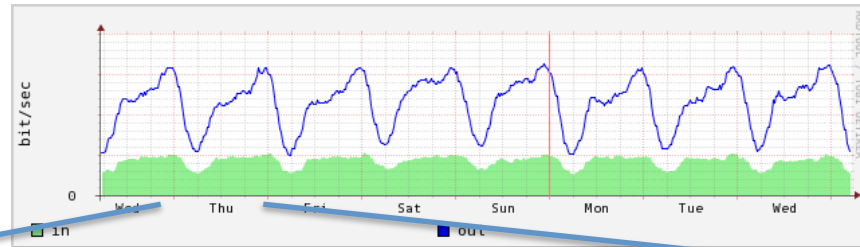
enterprise weekday



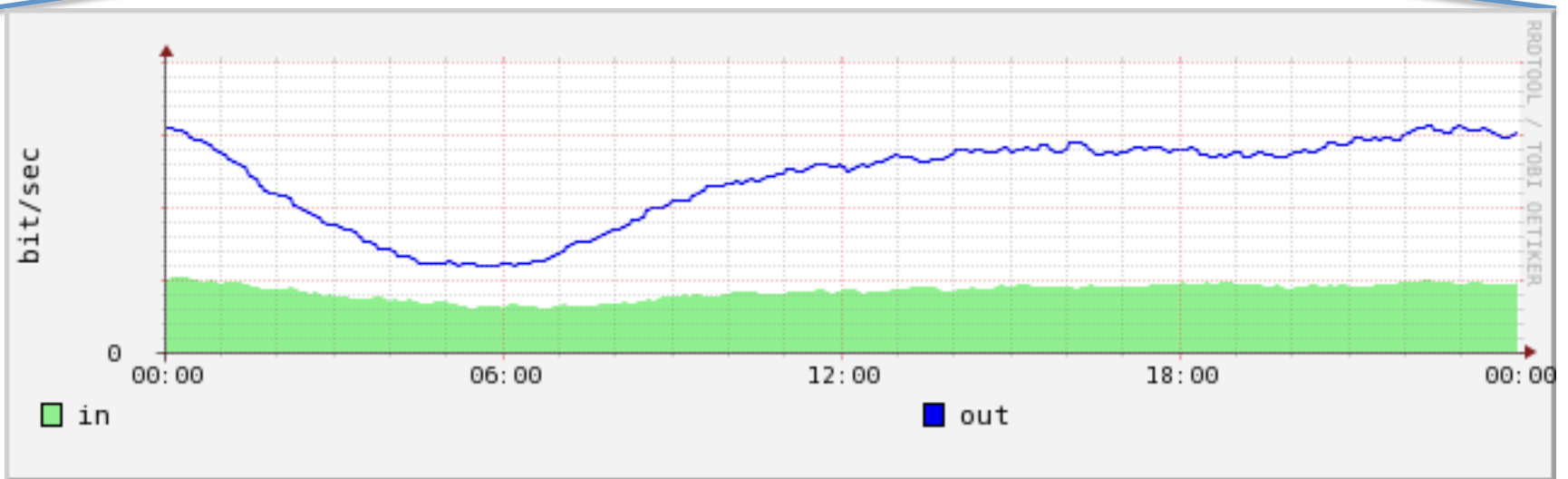
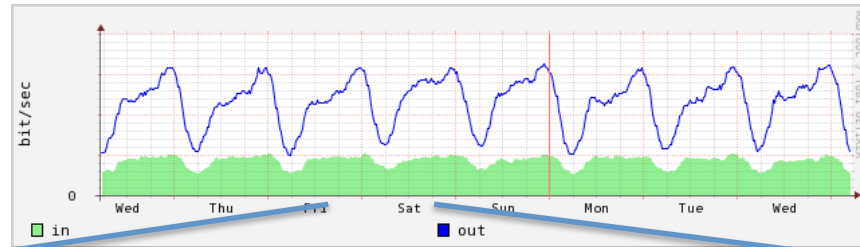
consumer (broadband)



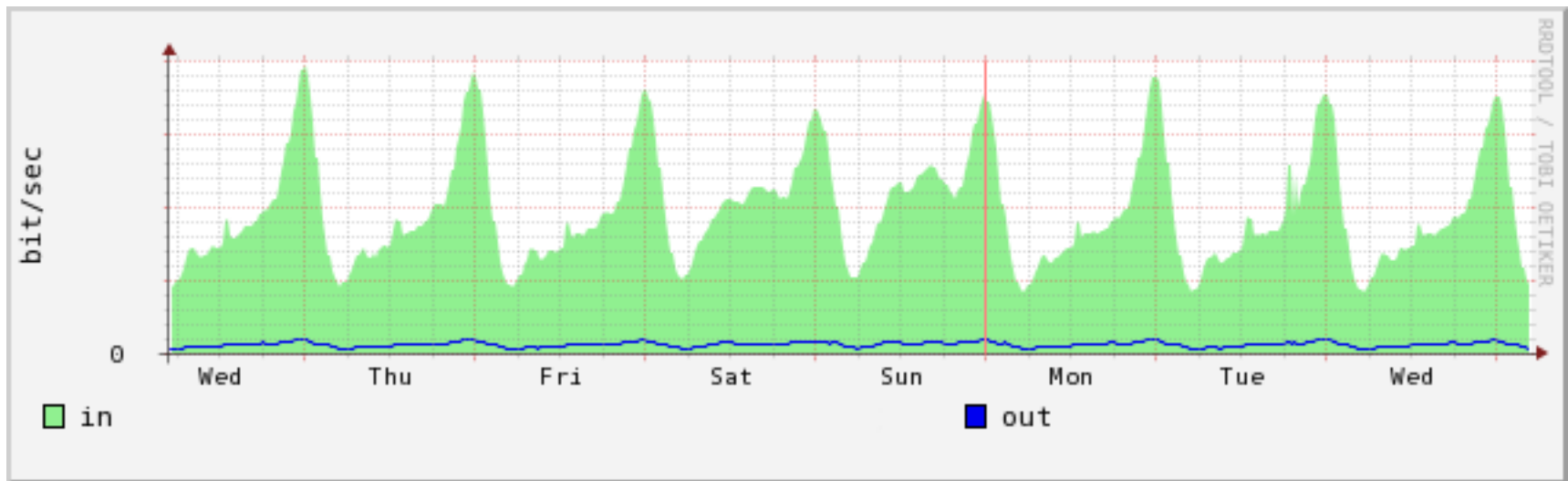
consumer weekday



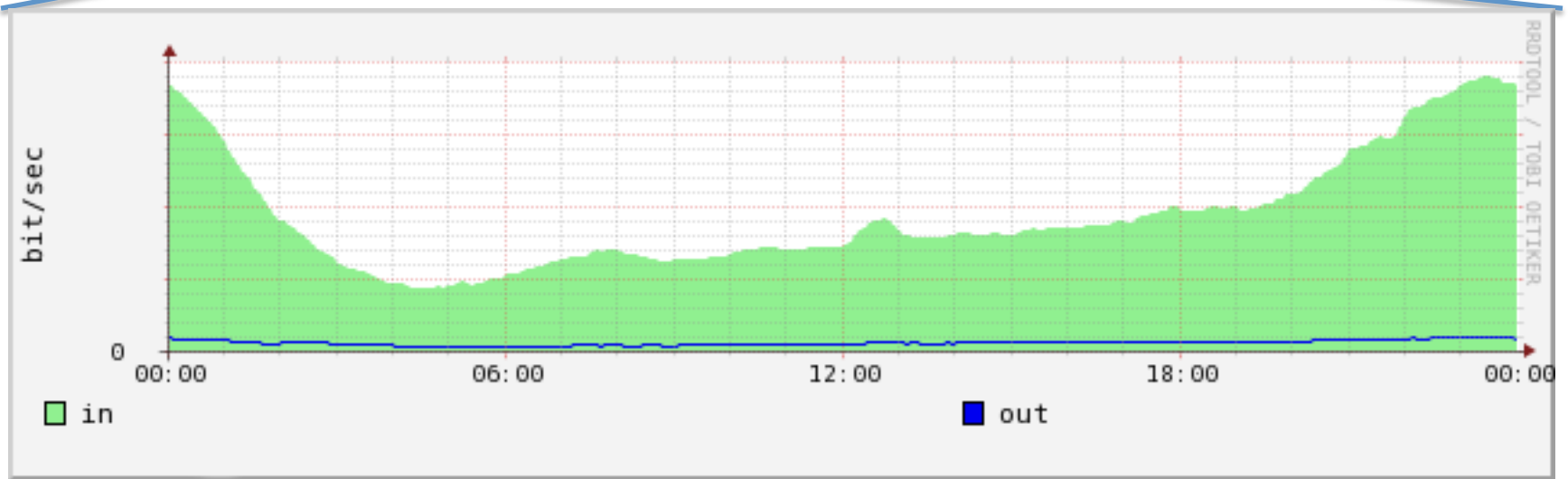
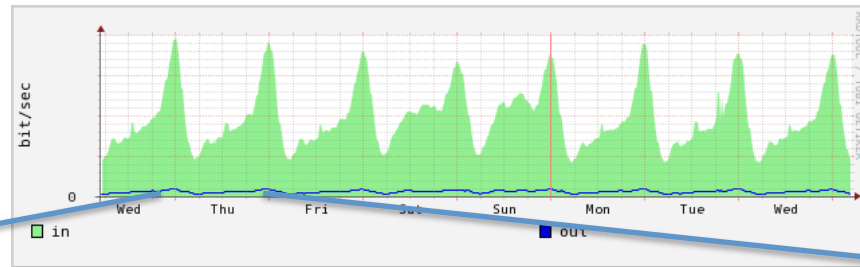
consumer weekend



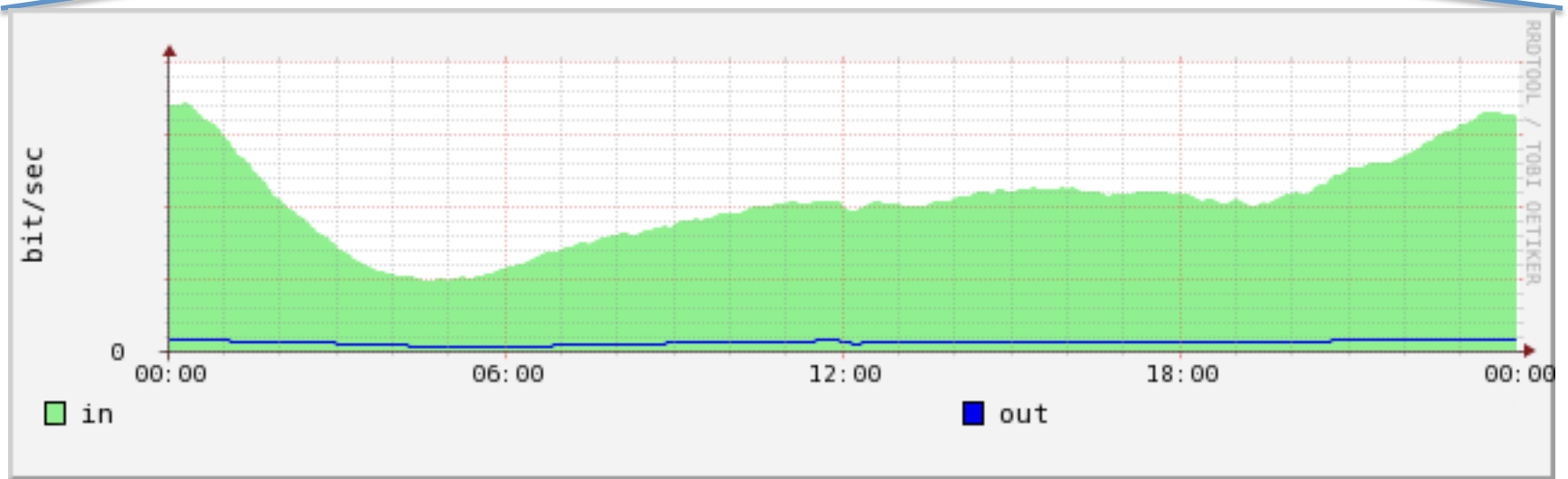
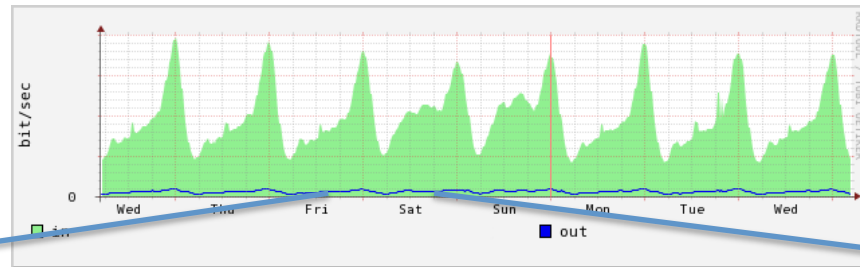
CDN (contents distribution network)



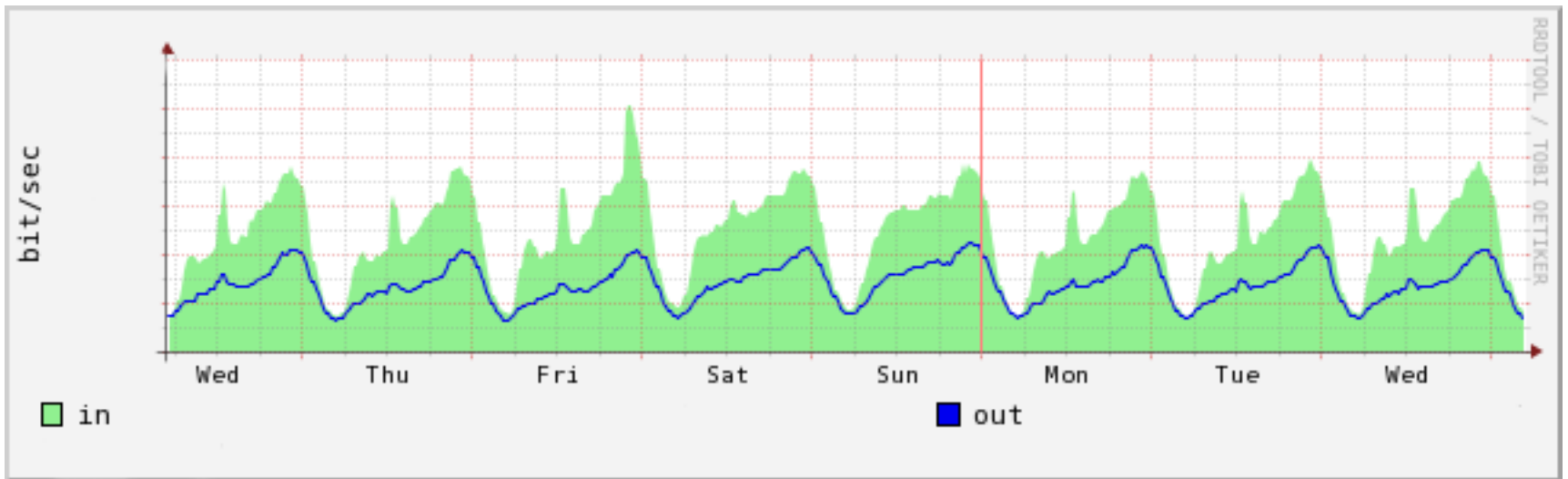
CDN weekday



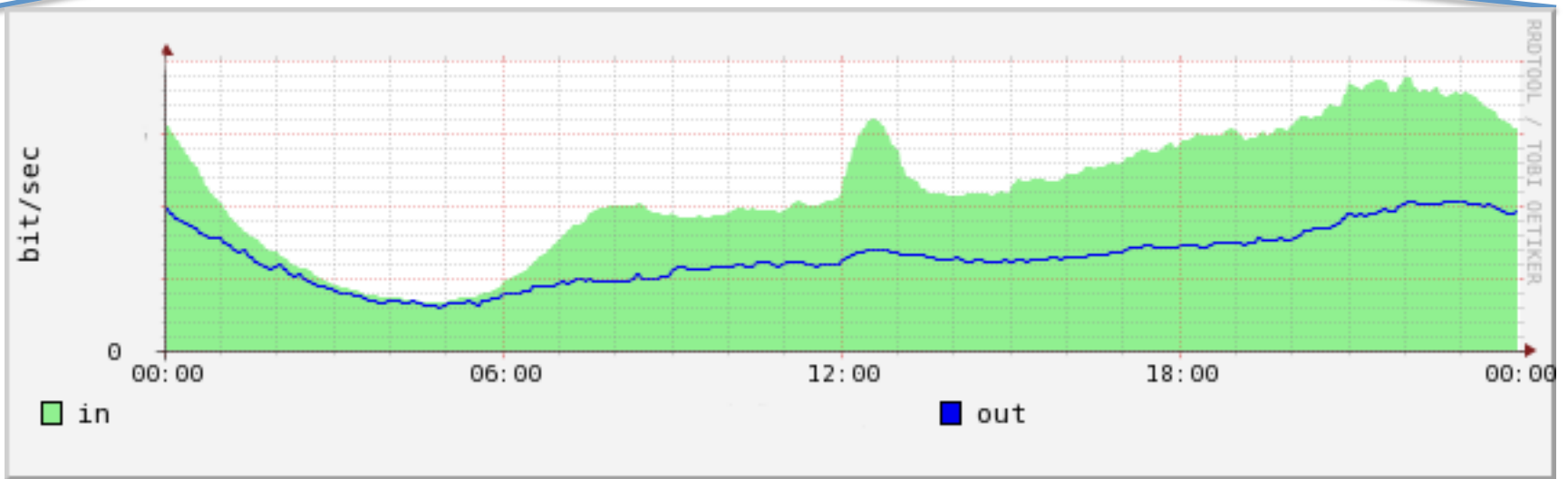
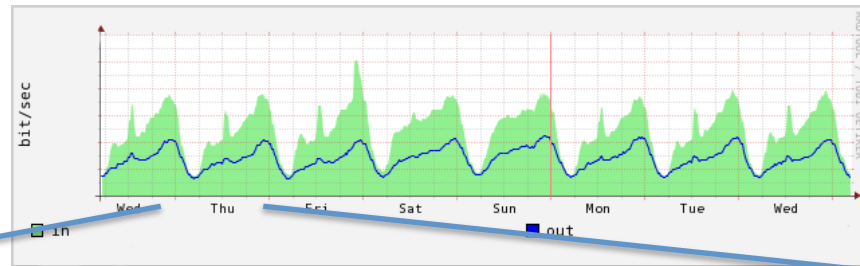
CDN weekend



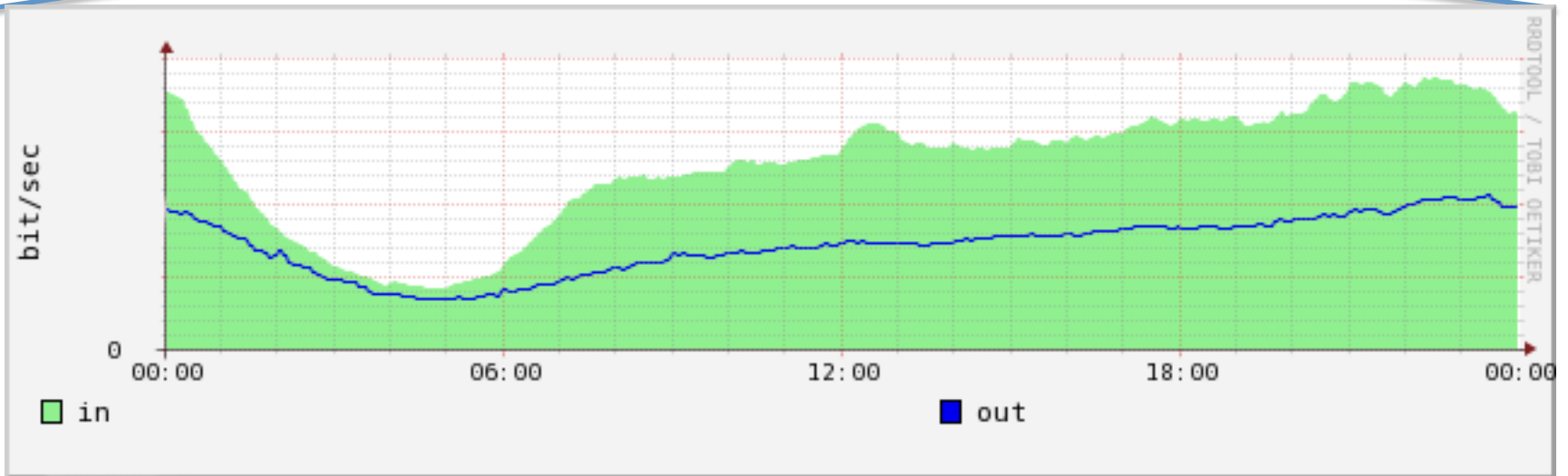
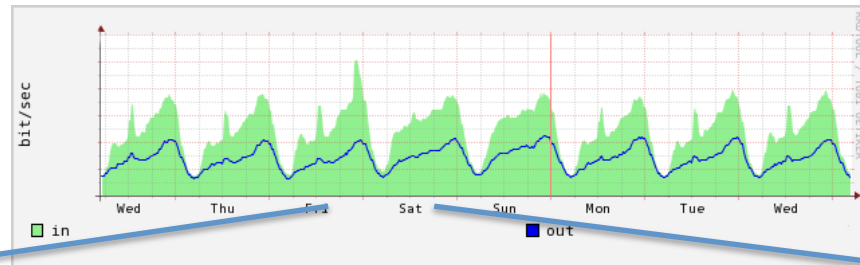
IX (Internet Exchange)



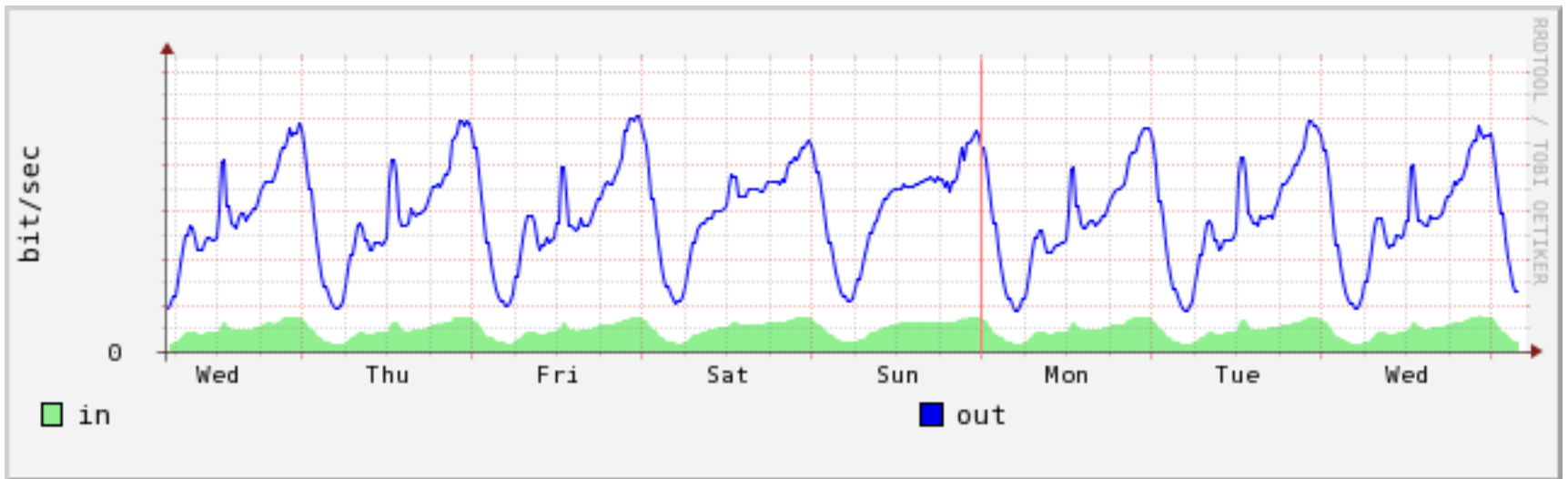
IX weekday



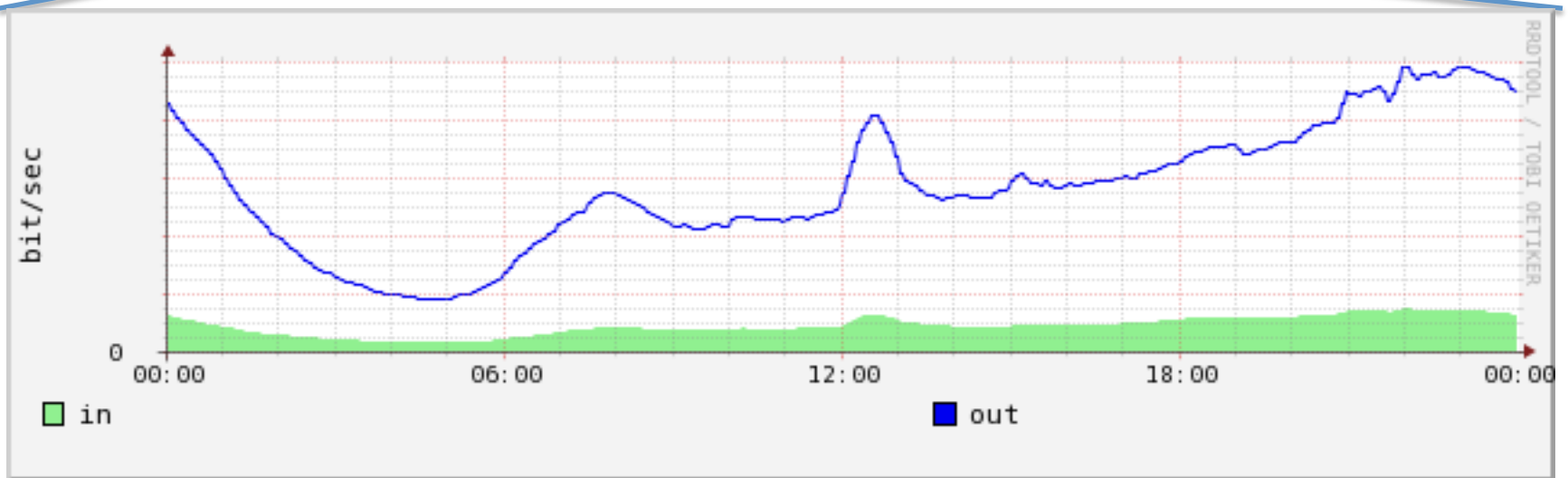
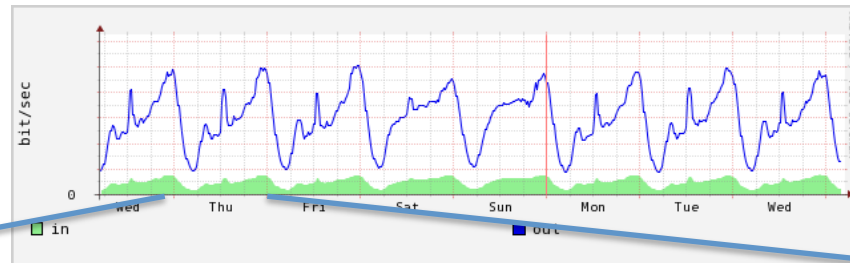
IX weekend



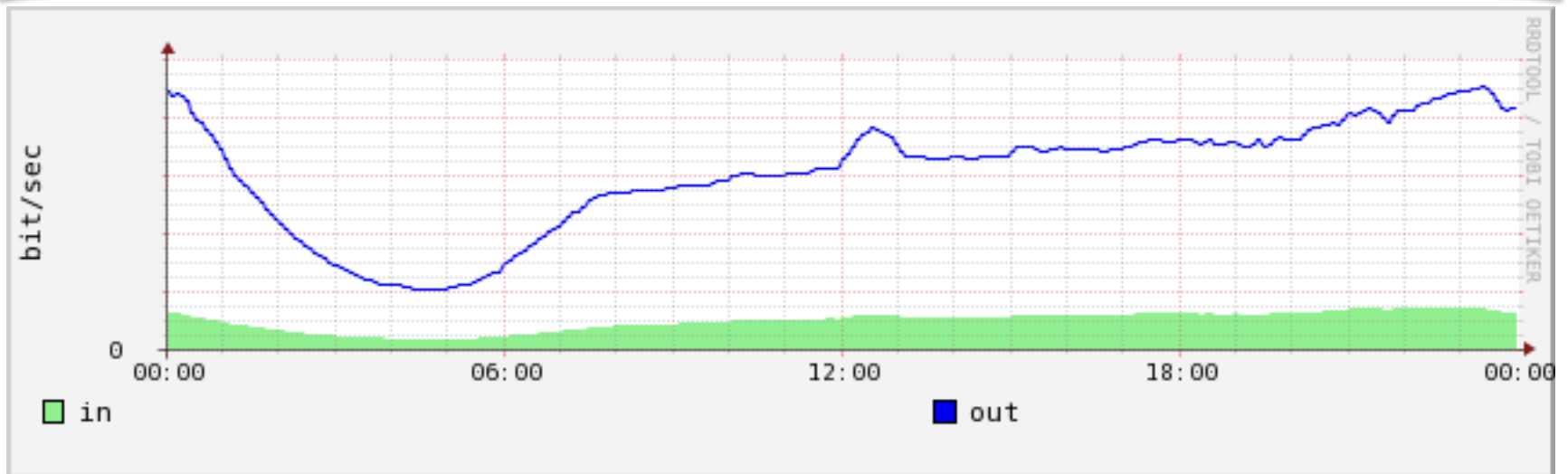
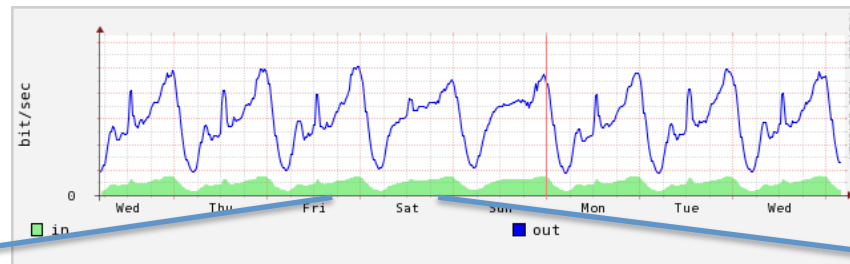
mobile



mobile weekday



mobile weekend

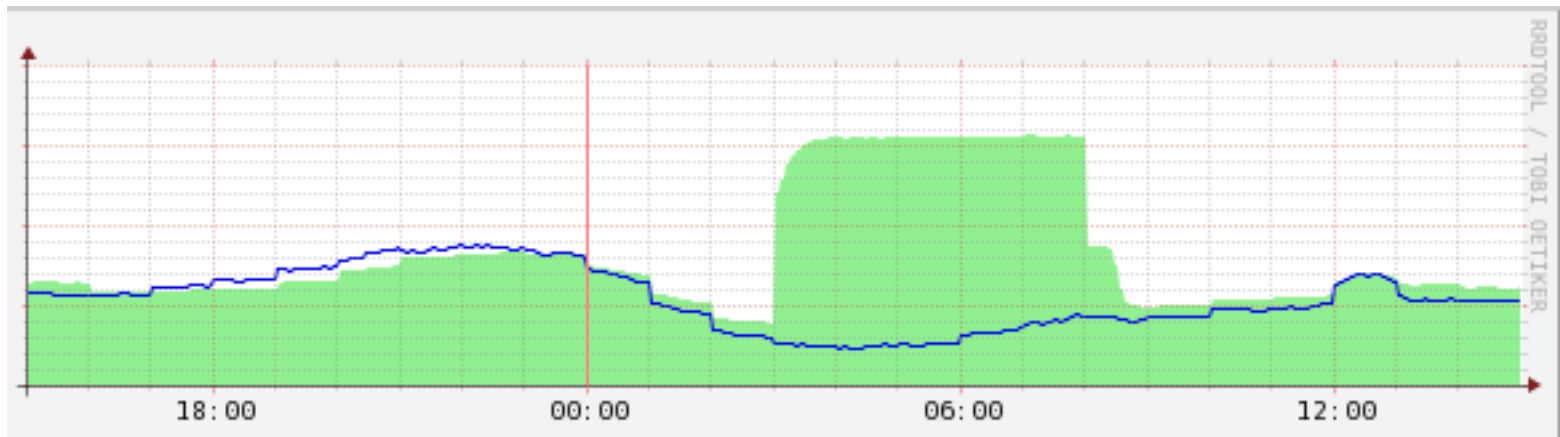


traffic trend

- 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

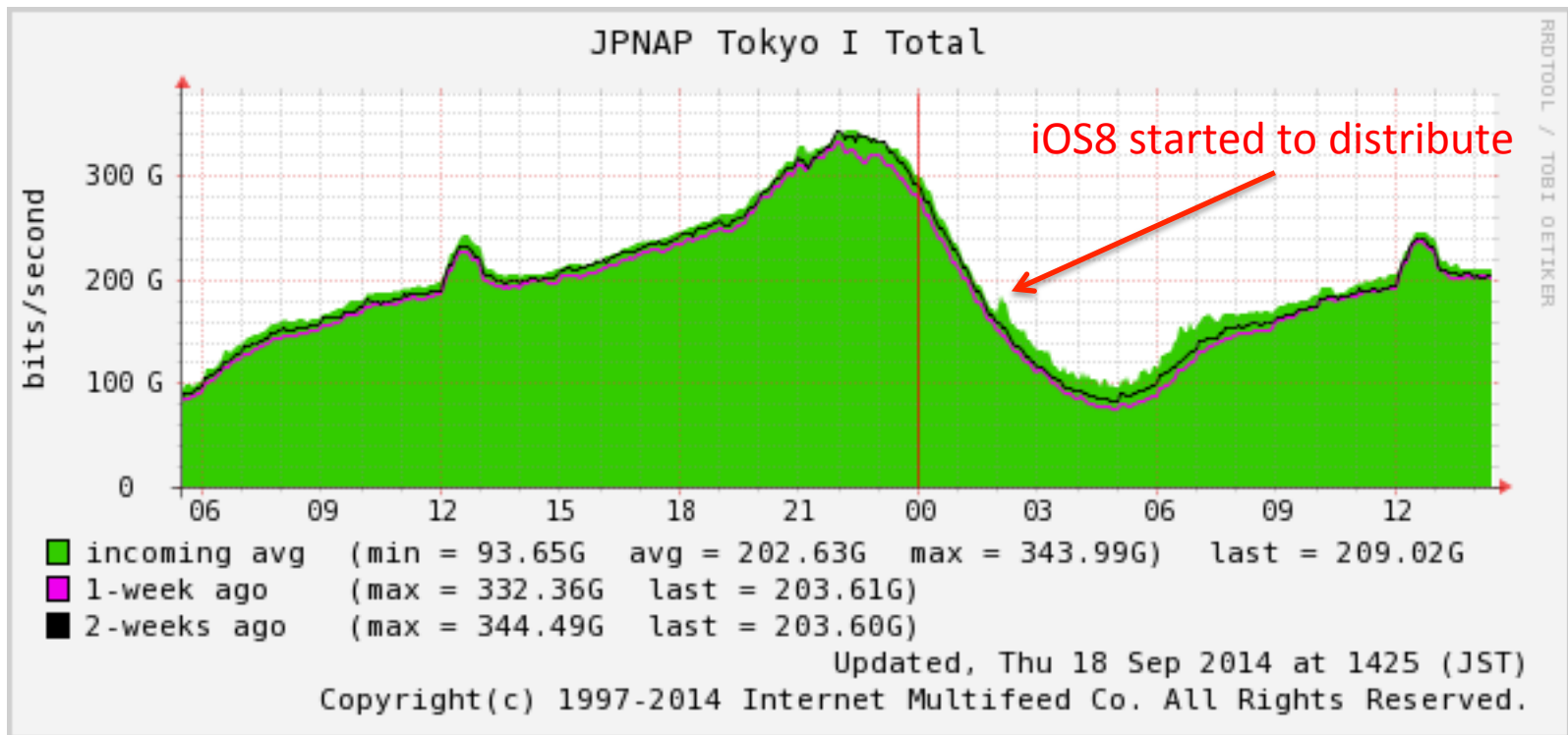
- January 1st 00:00-02:00
 - phone call
 - SMS
 - e-mail
 - SNS
- about 7 times more messages than usual
- mobile operators have asked users to avoid such messages during the peak time

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