DDoS attacks in CESNET2

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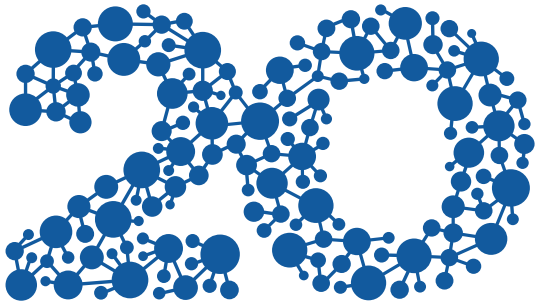

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CESNET

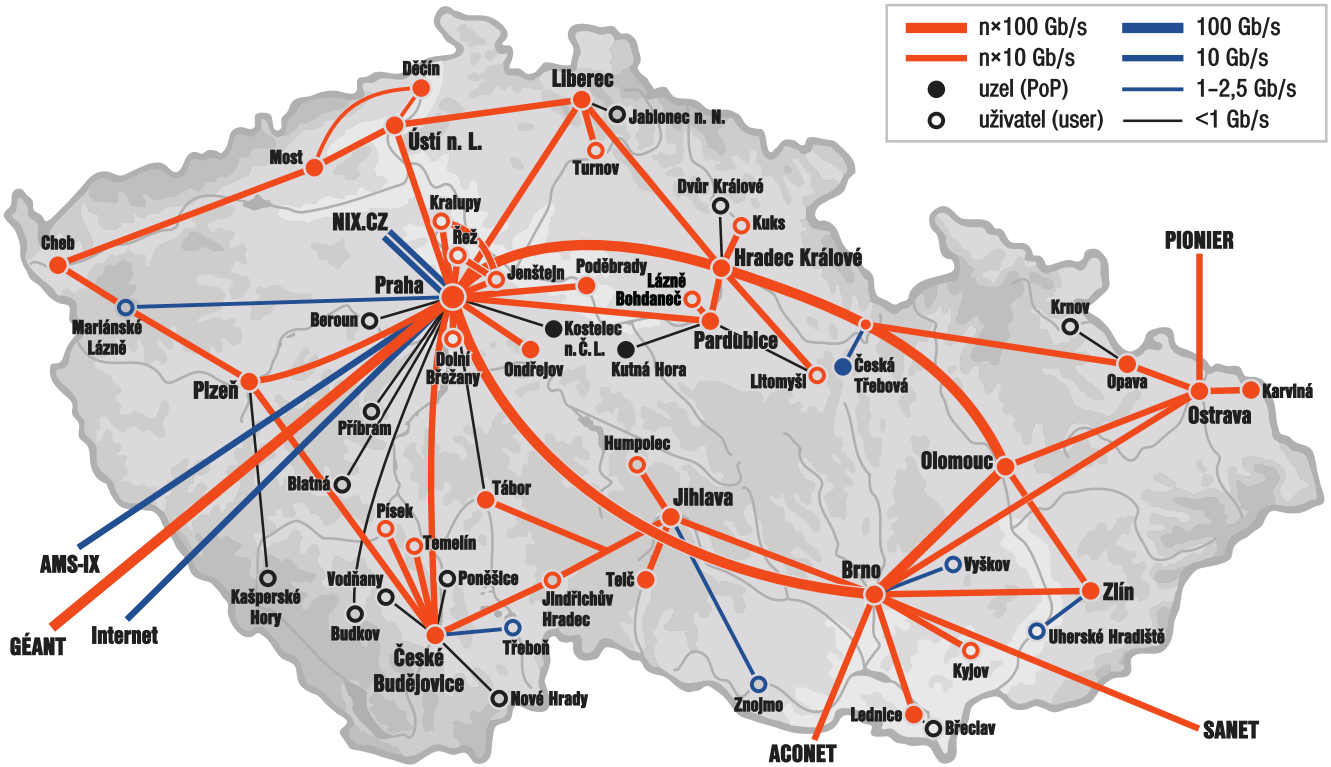
15th March 2016

About CESNET

- association of legal entities, est. 1996
  - public and state universities
  - Academy of Sciences
- non-profit organisation
  - development and operation of **NREN** (CESNET2)
  - advanced network technologies and applications R&D
  - international cooperation – GNx, GN3+, GLIF, EGI, GÉANT shareholder, EGI member, Internet2 affiliate member,...
- founding member – **CZ.NIC, NIX.CZ, FENIX**

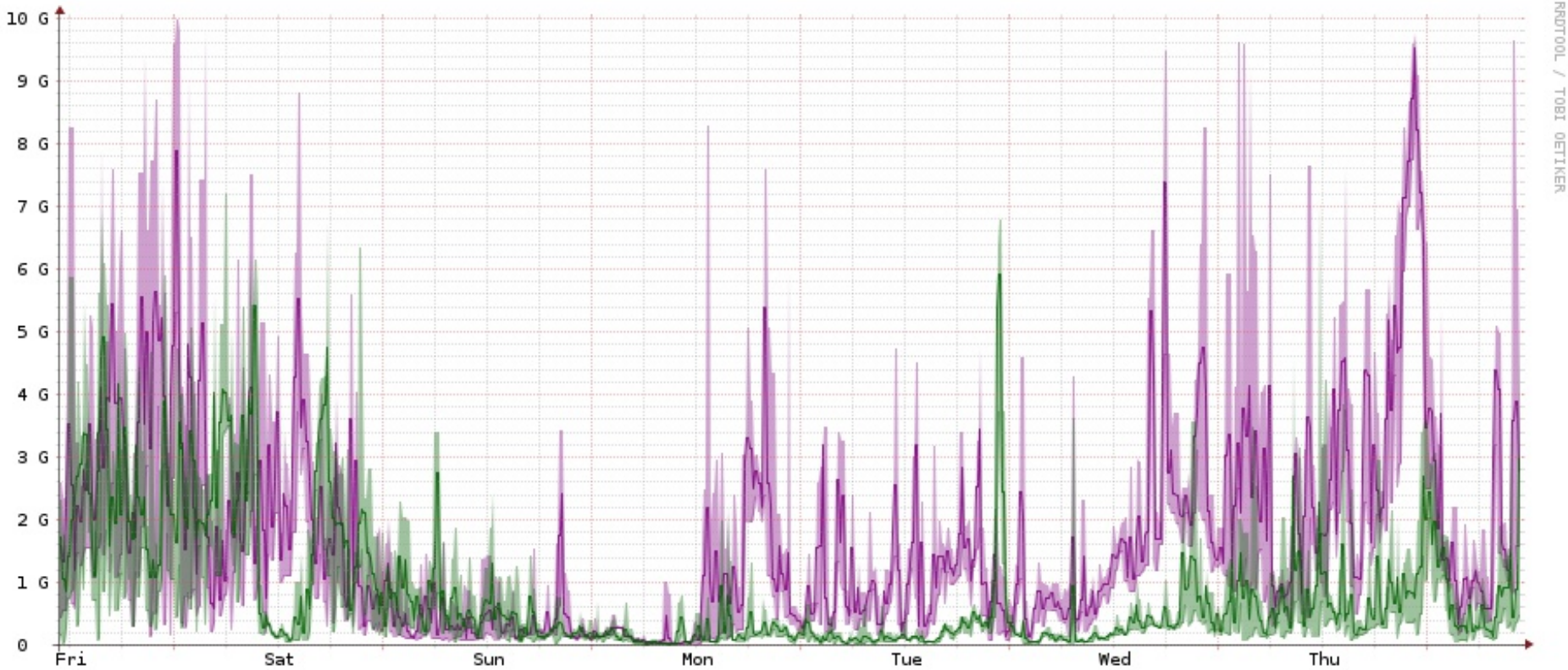
NREN specifics

- very well provisioned backbone
- big variation of legitimate traffic
- **no filtering by default**[1]



[1] unless required (BCP 38) or requested by client

Typical weekly traffic variation



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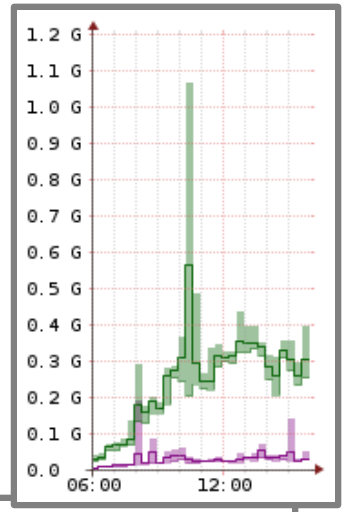
DoS as a phenomenon

- hobby of todays' teenagers
  - spending allowances for DDoS-as-a-service
  - targetting classmates' internet services
  - especially gaming and TeamSpeak servers
  - big issue especially for cheap VPS providers
- hacktivism
  - DoSing unpopular services
  - possible target later this year in CZ:
    on-line POS sales records collection
- shorter attack times (less than five minutes)
  - often undetected by monitoring tools
  - can break badly designed services
  - bad eyeball experience

Short-lived UDP flood example

```
Notification                  : UDP from external networks and port 0,53,123,161 to internal IPS,
bytes>=1024, targets - DETECTED traffic anomaly
Detected                      : 195.113.[redacted] (dest. IP) - found 878 (limit 250) flows within
period of 5 seconds

Flows time range [GMT]        : 15/12/17 09:33:02-15/12/17 09:34:03
Flows time range [local]      : 15/12/17 10:33:02-15/12/17 10:34:03
```




```
50.241.253.129  udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  6113015 B,   5436 p, 1124.54286239882 Bpp,
186.215.207.138 udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  4732764 B,   4694 p, 1008.25820195995 Bpp,
46.188.59.141   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  1576588 B,   1330 p, 1185.4
61.85.1.79      udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  3466937 B,   3132 p, 1106.9
202.114.238.116 udp(17)/0  --> 195.113.[redacted]  udp(17)/0 : 13477647 B,  11460 p, 1176.0
117.102.65.174  udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  9227596 B,   7946 p, 1161.2
217.128.111.66  udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :   367793 B,    331 p, 1111.1
219.222.224.6   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 : 13262153 B,  11194 p, 1184.7
163.29.216.61   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  4589202 B,   4038 p, 1136.5
96.90.226.11    udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  2143761 B,   2038 p, 1051.8
112.160.7.249   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :   952083 B,    819 p, 1162.4
219.223.18.20   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 : 13569874 B,  11424 p, 1187.8
123.57.177.192  udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  2836849 B,   2499 p, 1135.1
218.244.142.146 udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :   749959 B,    688 p, 1090.05668604651 Bpp,
24.111.41.107   udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :  5840435 B,   5325 p, 1096.79530516432 Bpp,
187.141.38.238  udp(17)/0  --> 195.113.[redacted]  udp(17)/0 :   620221 B,    479 p, 1294.82463465553 Bpp,
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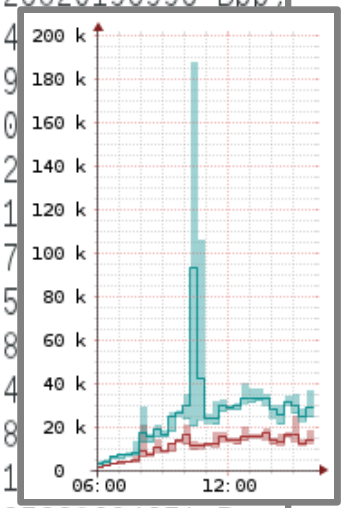


DDoS trends

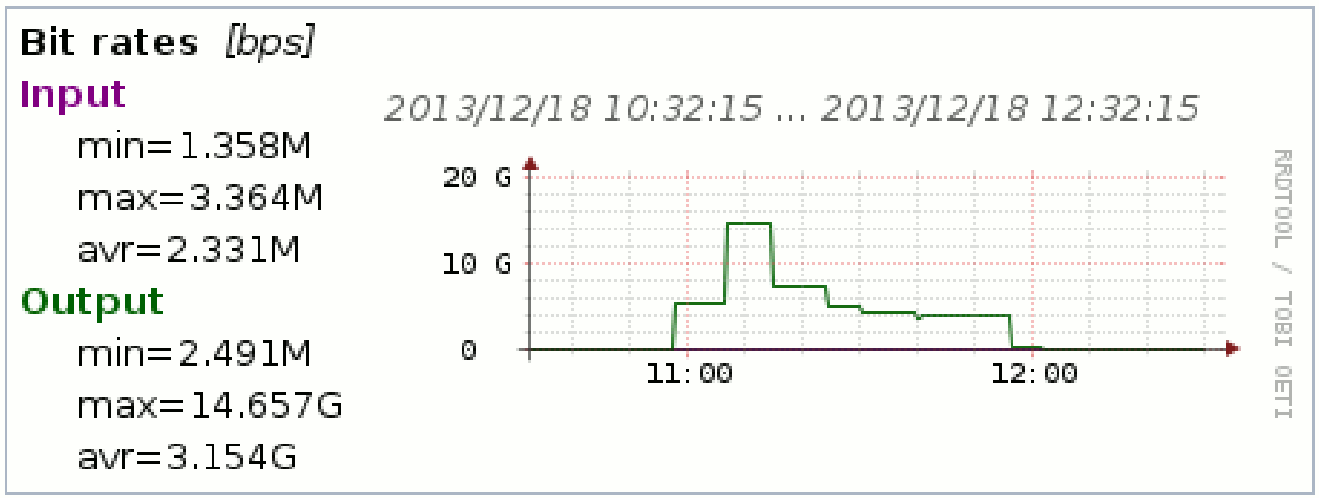
- using connection-less protocol and IP source spoofing for reflection/amplification attack
  - TCP SYN flood
  - DNS
  - NTP
  - SNMP
  - SSDP
- DNS random subdomain queries
  - using spoofed source IP or botnet and open resolvers
  - targets authoritative DNS servers
  - eating resources on recursive DNS servers

Why only few operators deploy BCP 38?

- the closer to the edge the simpler to deploy
- simple automatic `urpf-checks` don't work well with multihoming
- network equipment vendors still don't offer an easy to deploy solution for multihomed clients (Feasible Reverse Path Forwarding – BCP 84)
- loose RPF has no use against most spoofing attacks
- our solution: ACLs on customer ports
  - managed manually
  - prone to operator errors
  - probably too resource demanding for many ISPs

DoS experience in CESNET

- client router announces /16 but only /17 is routed
  - packets to remaining /17 ping-pongs between routers
  - last mile link saturated
- received UDP floods from transit can saturate target's 10Gbps link



Mitigation strategies in CESNET

- RTBH for clients
  - attacks targetted to small number of IP addresses
  - without RTBH, the last mile link is easily saturated with malicious traffic
  - BGP Flowspec-based RTBH in development
- per-protocol QoS on the network perimeter
  - for connection-less protocols like NTP, SNMP,...
  - sum of NTP flows typical ~2 Mbps
  - different packet sizes of legitimate and attack flows
- DNS QoS on the inner-egde of the core network
  - crucial service for *eyeball* experience
  - hard to recognize attack on the perimeter
  - filtering UDP packets without either port 53

The FENIX project of NIX.CZ

- response to DoS attacks to major websites in 2013
- attack sourced from transit carrier RETN via NIX.CZ
- no technical nor organisational countermeasures available inside the IXP at that time

Idea of secure peering VLAN inside NIX.CZ

- as a last resort in case of some massive attack
- only for those that **trust each other**
- so **Czech users can access Czech services**

FENIX foundation

- founded by 6 operators in January 2014
  - **Active 24** (hosting)
  - **CESNET** (NREN)
  - **CZ.NIC** (TLD operator)
  - **Dial Telecom** (ISP)
  - **O2 CZ** (ISP, incumbent)
  - **Seznam.cz** (Czech Google)
- 13 members today

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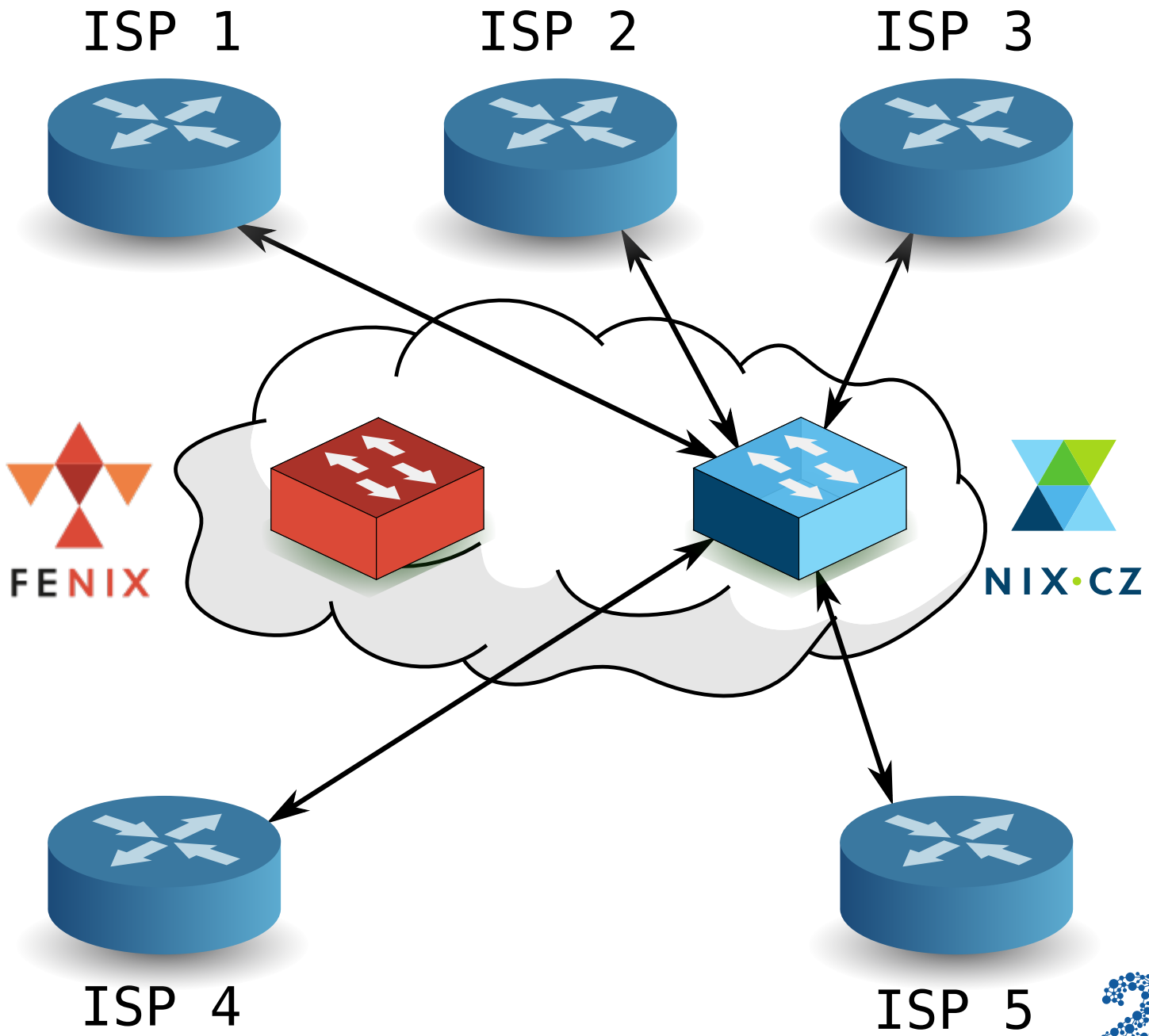
FENIX criteria

- Terms and Conditions allowing to disconnect customer originating malicious traffic
- 24×7 NOC, no Interactive Voice Response machine
- Trusted Introducer listed CSIRT team
- recommendation from 2 FENIX members, no veto
- **BCP 38**/SSAC 004 network ingress filtering
- RTBH using route servers
- fully redundant connection to NIX.CZ
- protected BGP sessions with TCP MD5
- DNS, NTP, SNMP amplification protection
- deployed IPv6 and DNSSEC

Secure peering VLAN

- former work title for the FENIX
- separate peering VLAN of last resort
- accessible by FENIX members only
- prepared for island-mode of operation
- no data during *peace time*
- each member decides on their own when to use it



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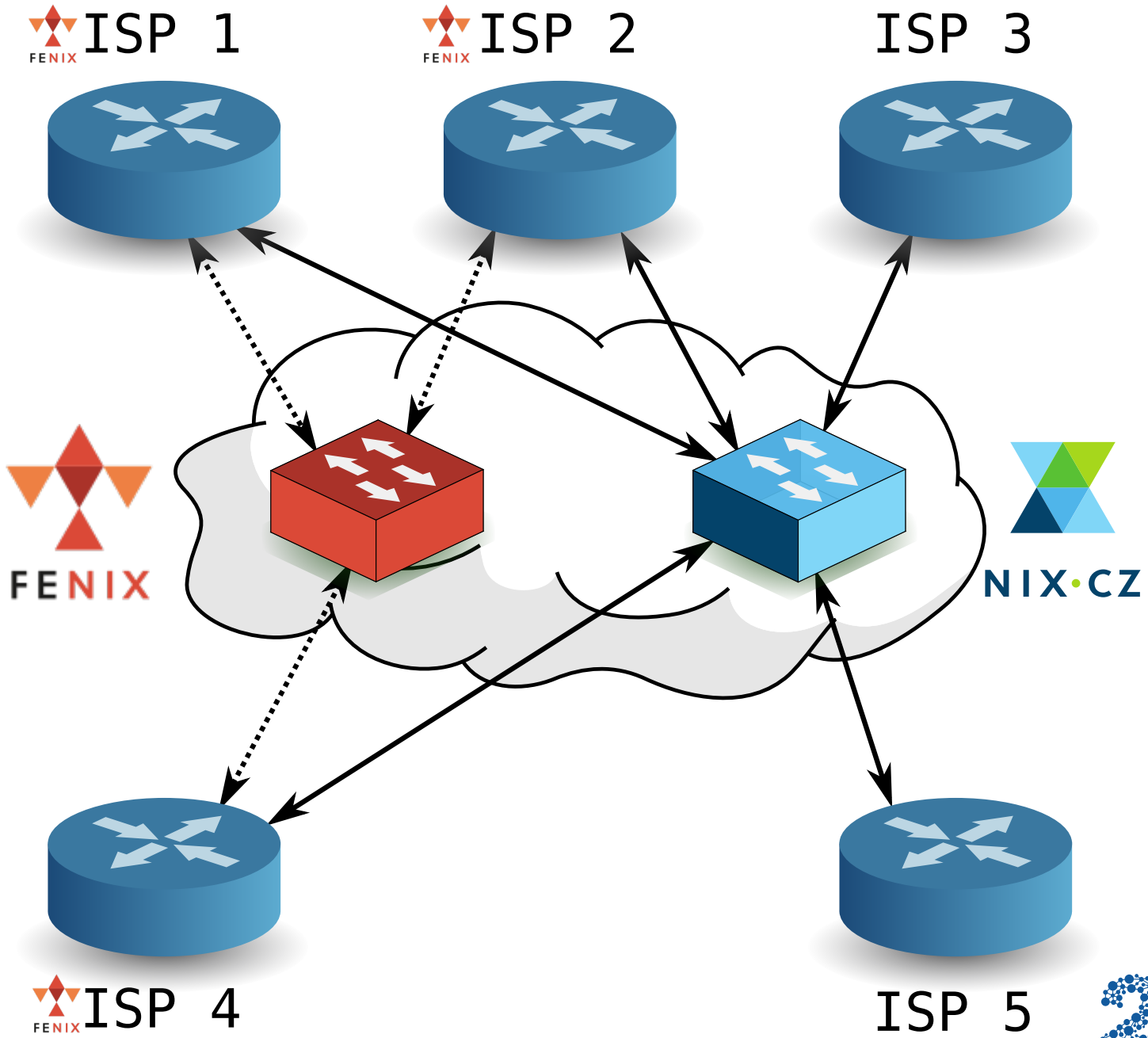
ISP 1
ISP 2
ISP 3
FENIX
NIX·CZ
ISP 4
ISP 5
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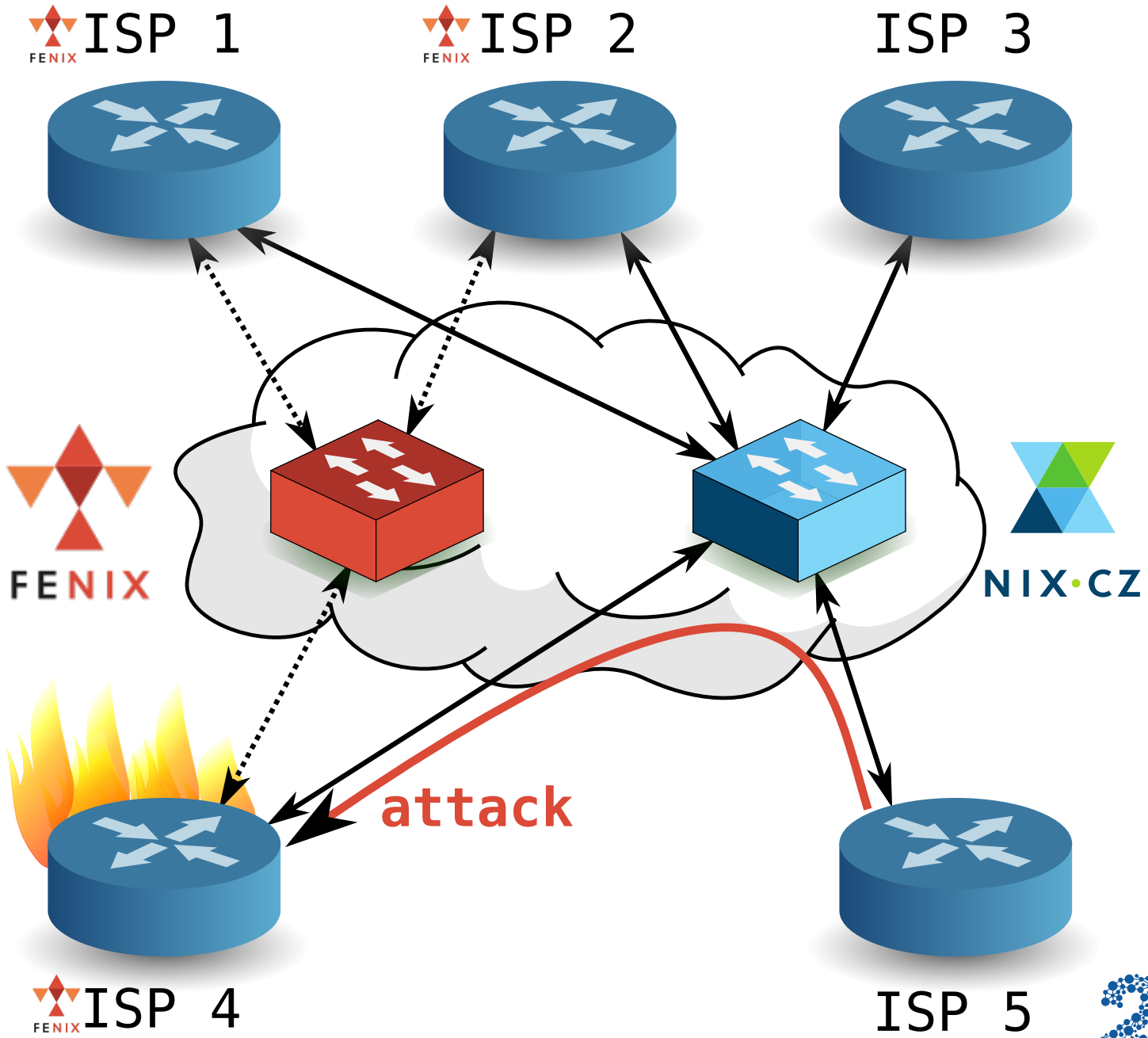
ISP 1
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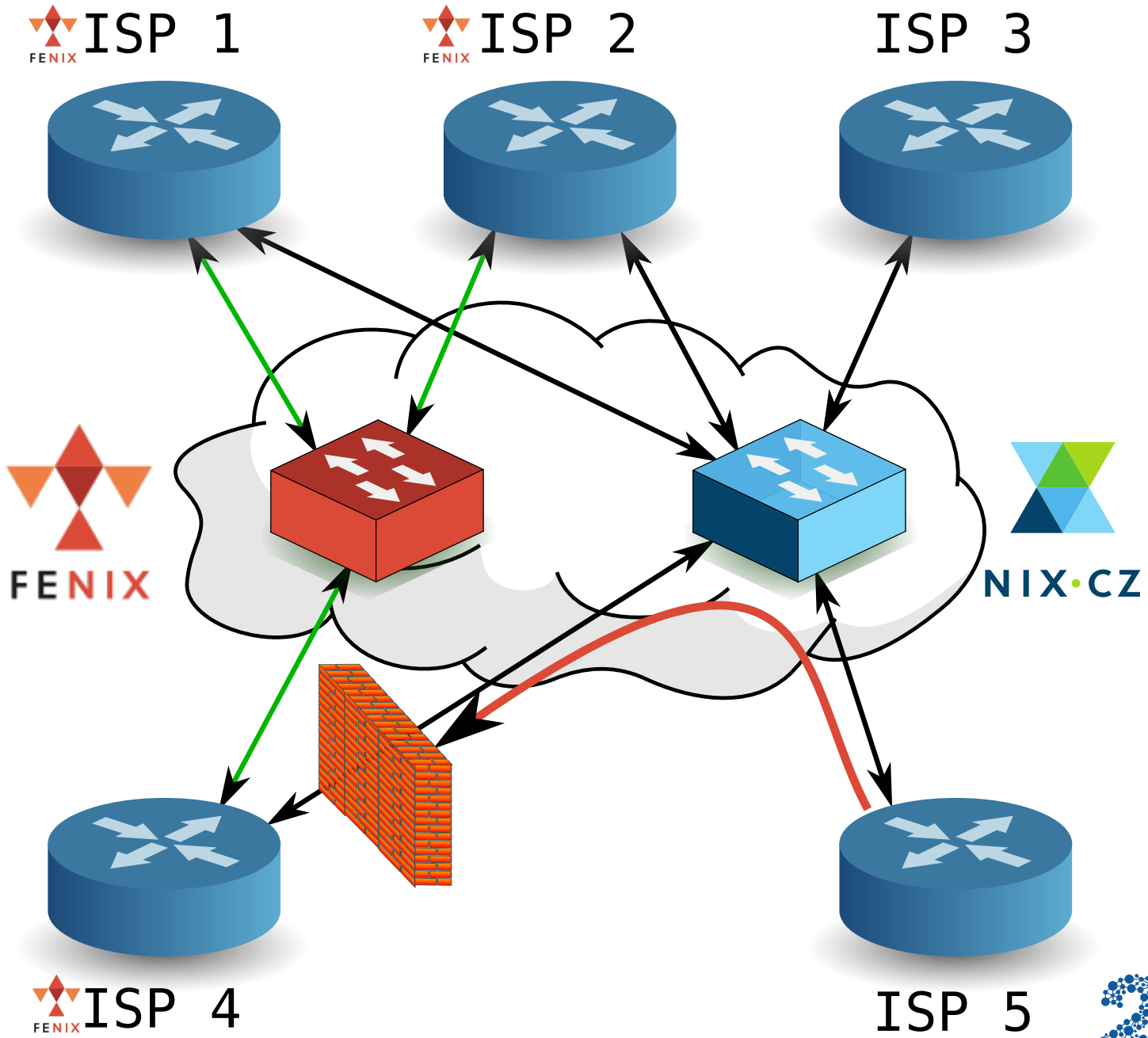
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Key concepts of FENIX VLAN

- only prefixes guaranteed to be clean of spoofing can be announced into FENIX VLAN
- public peering VLAN used for everything by default
- once a FENIX member decides to switch to island mode, they disconnect all other peerings – traffic flows only from/to other FENIX members via the FENIX VLAN
- instead of disconnecting, malicious traffic could be blackholed or sent to a scrubber/filter device

CESNET mission in FENIX

- we believe in FENIX principles
  - which brings benefits to **every single network**
- we are pushing our clients to adopt similar rules
  - IP spoofing protection – do not rely on upstream to do the filtering
  - amplification attack protection
  - incident handling
- we do our best **not to source** or support any attack
  - as we could be dangerous to other networks
- we offer tools for monitoring clients' networks – **Security Tools as a Service**

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Conclusion

- DDoSes are more and more common
  - shorter attack times make them harder to mitigate
  - the future is probably in *automatic DDoS mitigation*
- FENIX-like communities very useful
  - consensual view
  - mutual help and assistence
  - sharing best practices
  - **personal trust**
- higher standards make networks **more reliable**
  - avoids possible goverment regulation
  - making the whole industry a better place

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Thank You!

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