IPv6 DOTS Signal Option

draft-francois-dots-ipv6-signal-option-01

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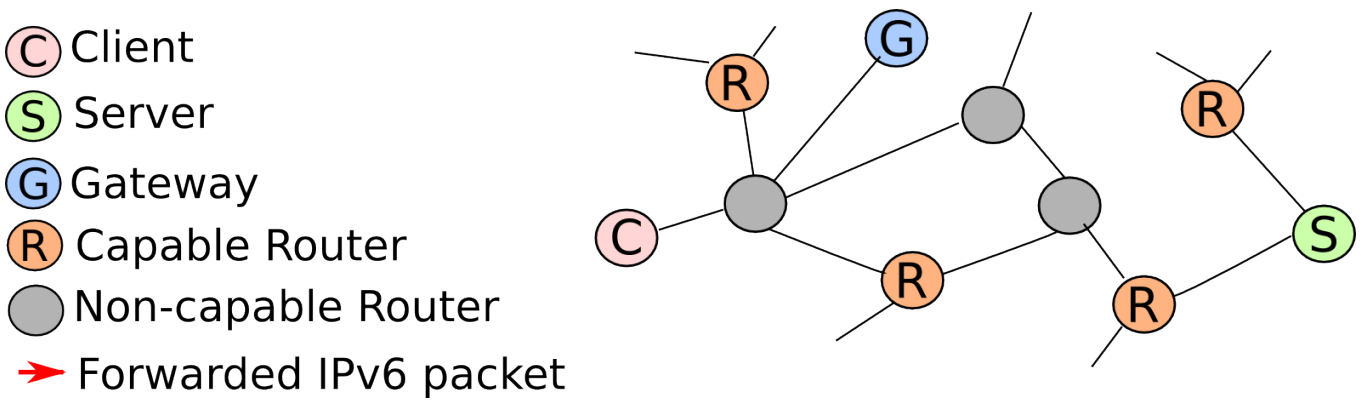
Key idea

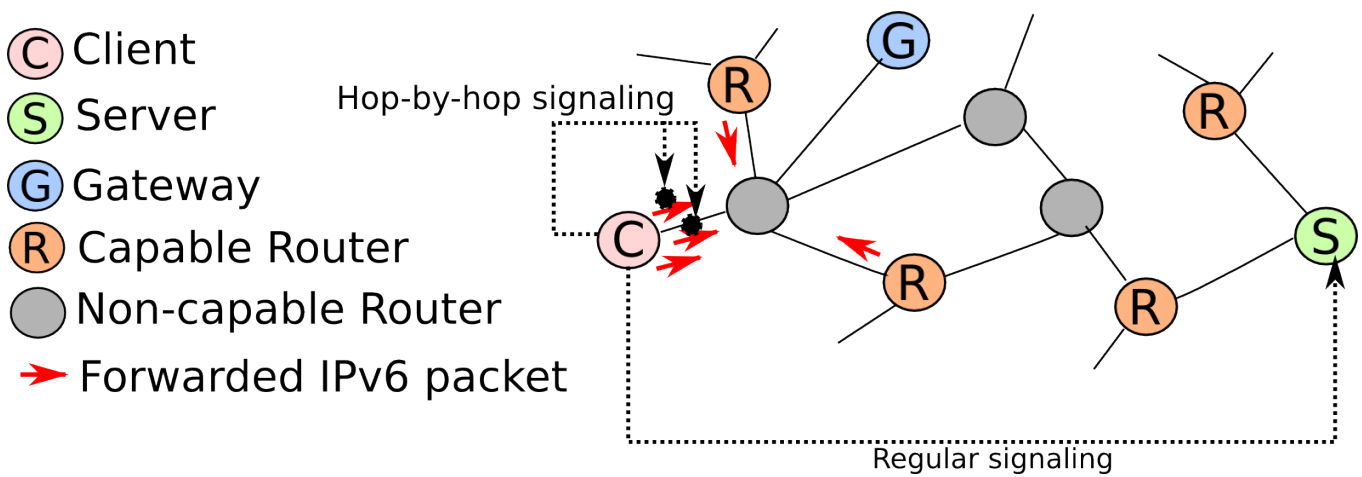
- Objective: signal DDoS attacks from a DOTS client (detection) to DOTS server (mitigation)
- Regular signalling paths for delivering DOTS signals might be also affected by the DDoS $\rightarrow$ Adding an auxiliary mechanism for signaling (does not substitute)
- Use IPv6 Hop-by-Hop Option Header [RFC2460]
  - Embed the information into pre-existing packet
  - signaling information is embedded into outgoing IPv6 packets
  - in an opportunistic manner (not all packets, not only those outgoing to the DOTS server... but some well chosen)
  - the DOTS client initiate this process, intermediate capable routers can store the information and embed it into other packets

Option processing (Example)



Option processing (Example)

- The client tries to initialize the regular signaling
- The client initializes the Hop-by-hop based signaling → outgoing IPv6 are selected for *marking*



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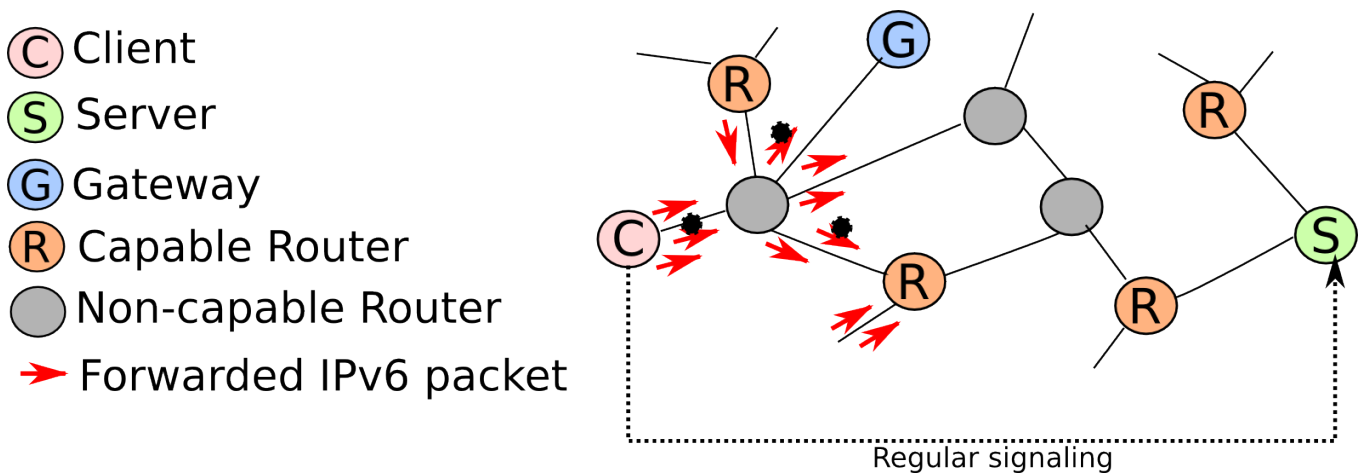
- Non-capable routers ignore the option and forward the packets
- The client continues the *marking*



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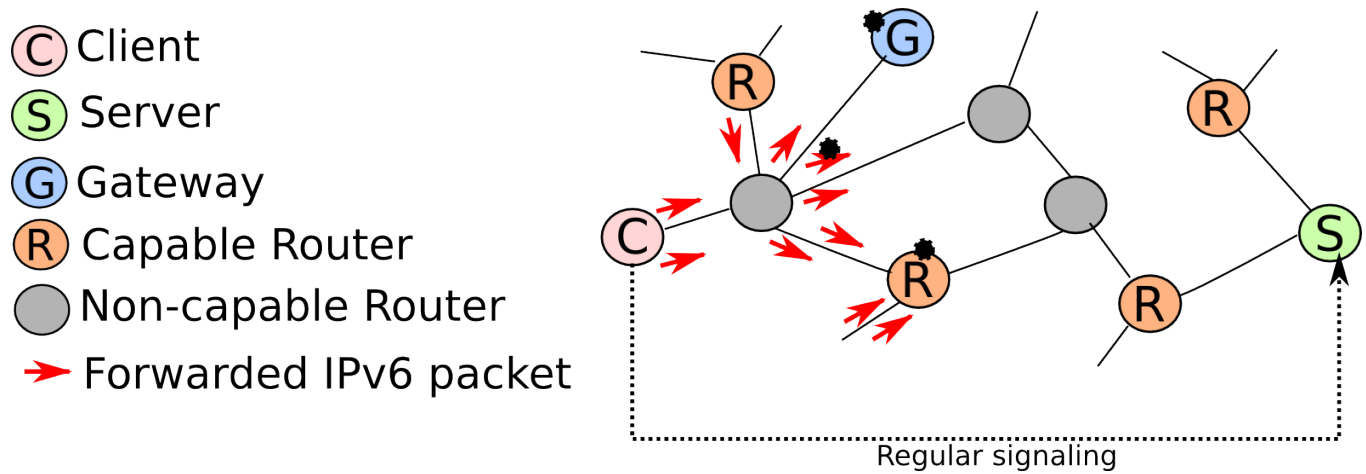

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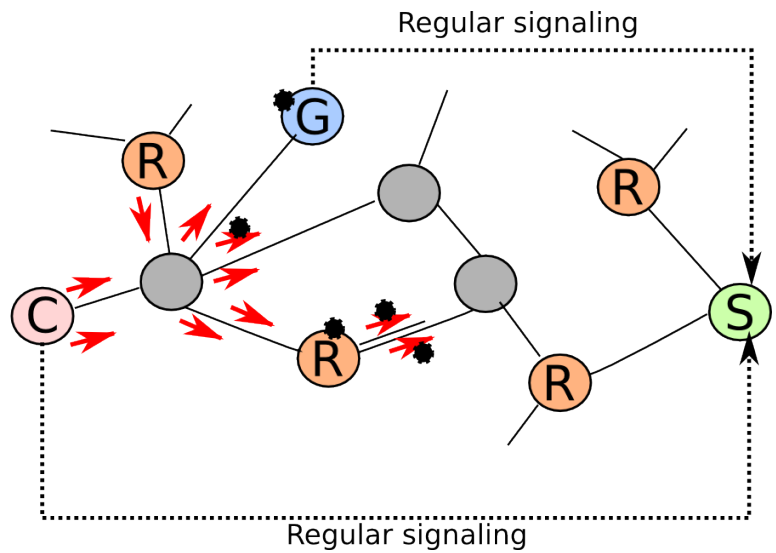
- The gateway tries to initialize the regular signaling
- The capable router having saved the information embeds it again in other IPv6 packets

C Client
S Server
G Gateway
R Capable Router
Non-capable Router
Forwarded IPv6 packet



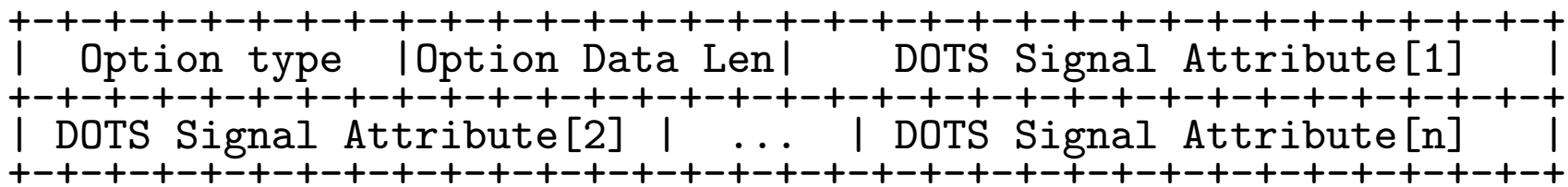
Option processing

- Selection of packets is rule-based to only consider a subset
- A sequence of rules where each is defined by
  - 1st level: a filter on IPv6 header to be matched
  - 2nd level: a ratio of previously matched packets
  - + a timeout
- When a rule expires (timeout) the next one is applied
- Rules are manually configured
- Recommendation: firs rules should select more packets (taking benefit of the first instant before loosing connectivity)

```
1: all outgoing IPv6 packets with a 10 second timeout
2: all outgoing IPv6 packets with a ratio of 10% and a 1 minute
   timeout
3: all outgoing multicast IPv6 packets with a ratio of 10% and a 1
   minute timeout
4: all outgoing anycast IPv6 packets with a ratio of 10% and a 5
   minute timeout
5: all outgoing IPv6 packets heading to the DOTS server with a
   ratio of 100% and a one hour timeout
```

Option encoding

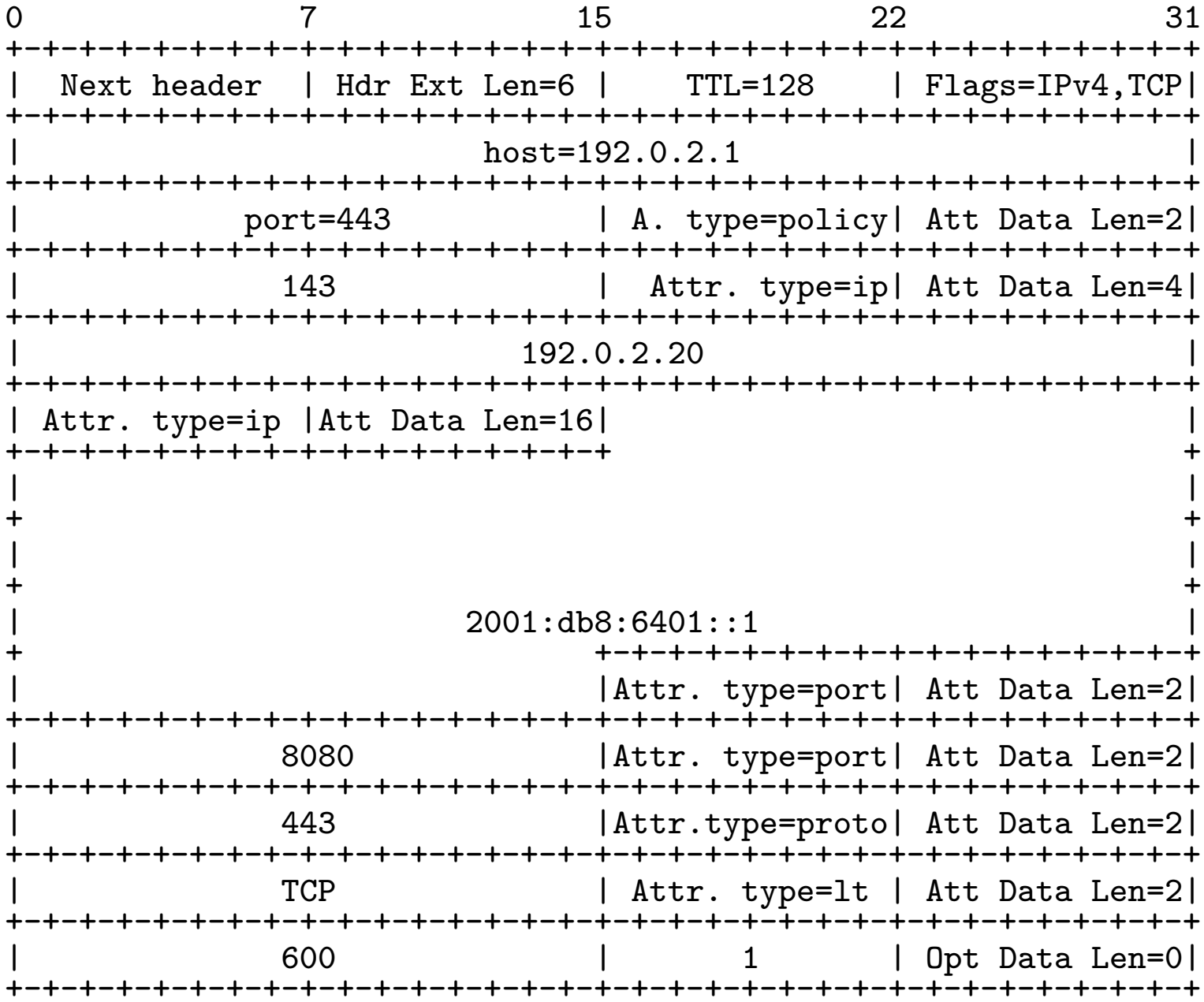
- TLV-encoded in the IPv6 header



- DOTS attributes
  - from draft-reddy-dots-transport
  - + a specific TTL value to avoid embedding the information into new packets indefinitely
  - + address and port of the DOTS server to reach (+ flags)
  - a mix between TLV and fixed-length fields

Attribute type	value
policy-id	0
target-ip	1
target-port	2
target-protocol	3
lifetime	4

Example


0 7 15 22 31
Next header
Hdr Ext Len=6
TTL=128
Flags=IPv4,TCP
host=192.0.2.1
port=443
A. type=policy
Att Data Len=2
143
Attr. type=ip
Att Data Len=4
192.0.2.20
Attr. type=ip
Att Data Len=16
2001:db8:6401::1
Attr. type=port
Att Data Len=2
8080
Attr. type=port
Att Data Len=2
443
Attr.type=proto
Att Data Len=2
TCP
Attr. type=lt
Att Data Len=2
600
1
Opt Data Len=0

Deployment considerations 1/2

- IPv6 extension headers are often rate-limited or dropped entirely
  - One reason is the overhead of processing
  - Our proposed option is only used under a DDoS attack and performance might be so already degraded
  - Keep limited the use to tne intra-domain use case
- Modification to IP layers implementations
  - capable routers: need to extract store and embed signaling information
  - clients: need to create the specific option header to be embedded then
  - servers and gateways: all DOTS signaling information contained in IPv6 headers has to transmitted to the application layer

Deployment considerations 2/2

- Need an interface for modifying/listening IPv6 packets
  - use of Hop-by-Hop option for applications $\rightarrow$ header violation
  - advanced socket API (RFC3542)
- Header insertion issue (rfc2460bis)
  - considered as harmful
  - potential solution by encapsulating into new packets
  - keep the use limited to routers under the same authority and make transparent packet modifications $\rightarrow$ fits well the intra-domain use case

Security considerations

- Forged option headers from non legitimate sources to entail additional processing on routers
  - Source-based filtering to discard those since we know which sources can emit such IPv6 packets
  - The option can be signed by the clients and verified by the servers and gateways (intermediate capable routers do not for efficiency reason $\rightarrow$ exclude TTL from the signature calculation)
- Replay attack from a compromised router to inject more packets
  - Thanks to the id and TTL, other agents will not consider the header