The strongSwan Project

IPsec Workshop Dresden, March 2018

Tobias Brunner & Andreas Steffen
Institute for Networked Solutions
HSR University of Applied Sciences Rapperswil

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- University of Applied Sciences with about 1500 students
- Faculty of Information Technology (300-400 students)
- Bachelor Course (3 years), Master Course (+1.5 years)

Agenda

- Overview of current strongSwan active/active HA solution
- Proposed XFRM Extensions
  - Enforcing policies for inbound transport mode SAs
  - Different timeouts for acquire states and SPIs
  - Query available algorithms via XFRM
  - ESP in UDP encapsulation for IPv6
  - Proper way to handle virtual IPv6 addresses
  - Marking inbound traffic after decryption

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Current Active/Active HA Solution

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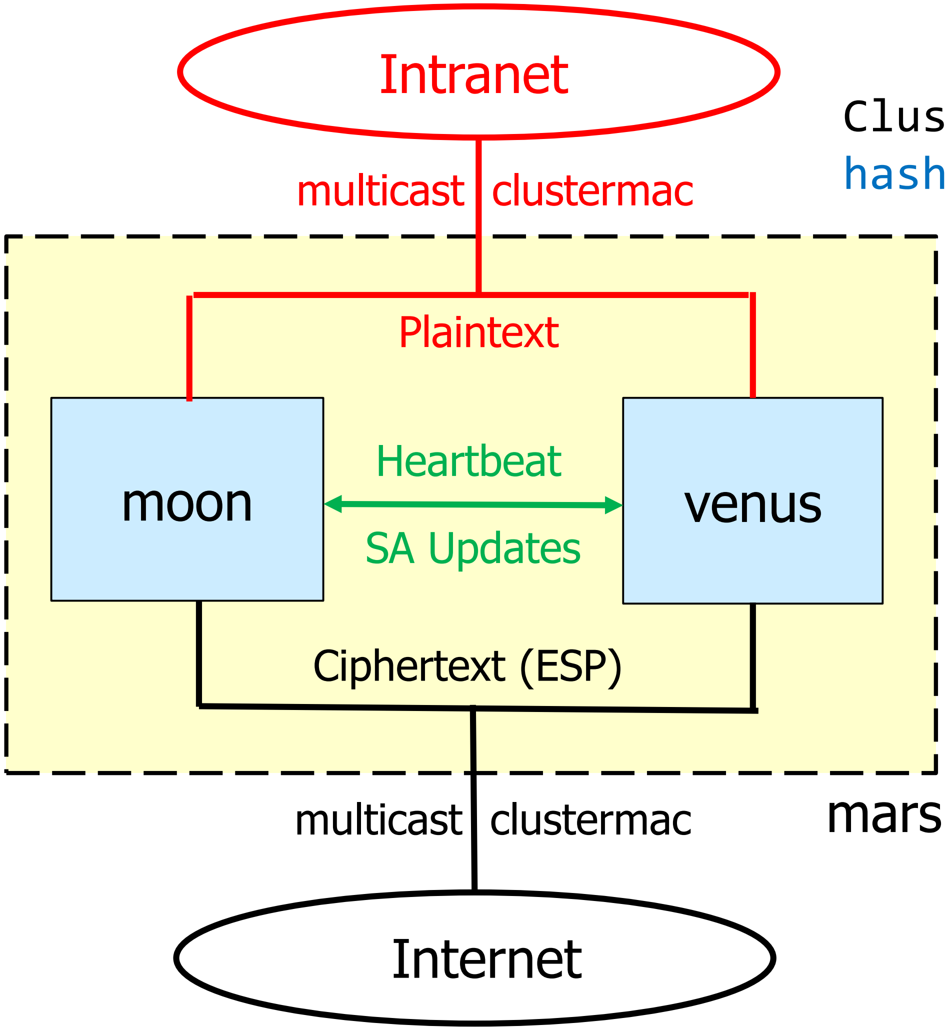
High Availability Design Goals

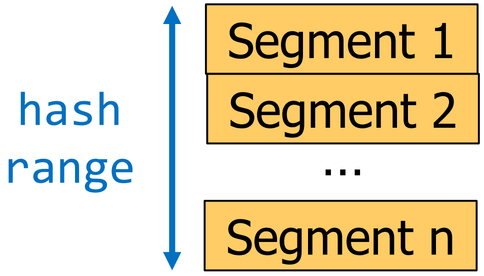
- Transparent to VPN clients
- No extensions to the IKEv2 protocol required
- No explicit synchronization of ESP sequence numbers between redundant gateways
- Both Active/Passive (Hot-Standby) and Active/Active (Load Sharing) scenarios to be supported

HA Solution using ClusterIP Mechanism

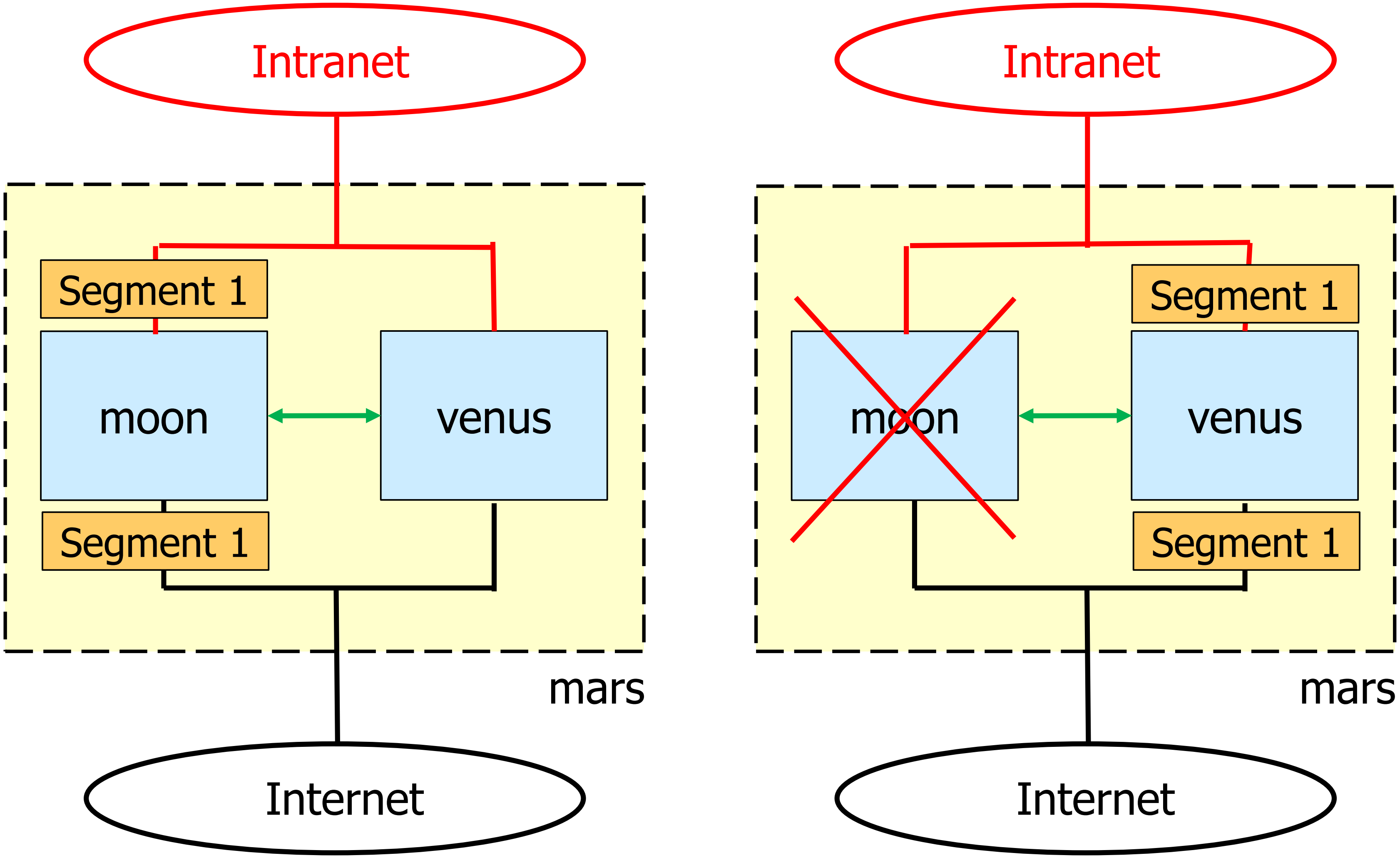


mars (Virtual VPN Gateway)

```
ClusterIP:
hash = jhash_2words(daddr.a4, spi)
```



Active/Passive Scenario with 1 ClusterIP Segment



Active/Active Scenario with 2 ClusterIP Segments

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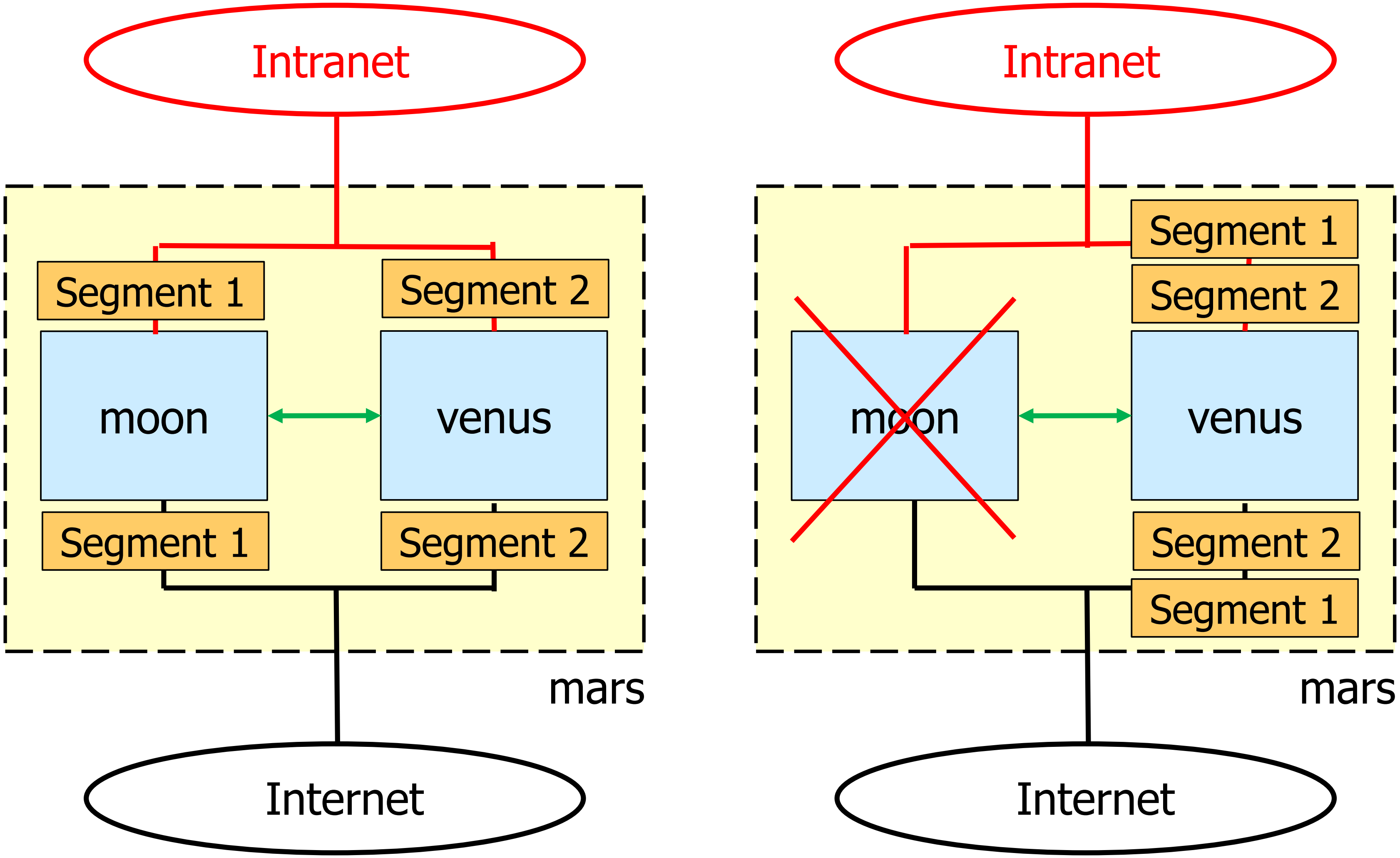
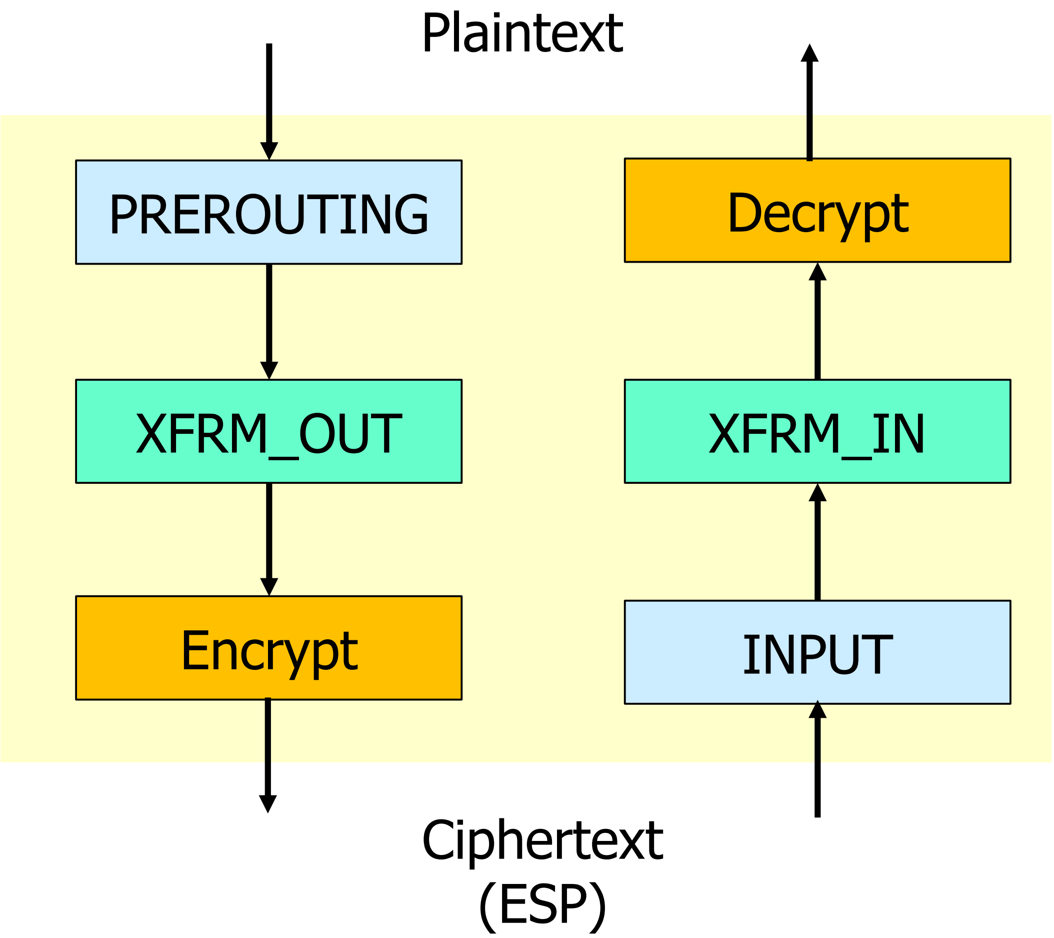


Two New Netfilter Hooks: XFMR_IN/XFRM_OUT



Netfilter Flow

Changes to ClusterIP Module

- Extended ClusterIP hash: `jhash_2words(daddr.a4, spi)`
- Inbound packet handling
  - SA lookup to determine SPI
  - Responsible for segment:
    Decrypt ESP packet and update anti-replay window
  - Not responsible for segment:
    Decrypt every 16th ESP packet, update anti-replay window and drop packet
- Outbound packet handling
  - Policy/SA lookup to determine SPI and destination address
  - Increase sequence number
  - Responsible for segment: Encrypt packet
  - Not responsible for segment: Drop packet

Next Generation HA?

- IPv6 not supported by ClusterIP
- HA kernel patch against a moving Linux kernel target
- Possibility of a Linux kernel upstream solution?
- Switch from ClusterIP to xt_cluster which supports IPv4 and IPv6
- Other ideas?

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Proposed XFRM Extensions

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Enforcing Policies for Inbound Transport Mode SAs

- Currently the Linux kernel does not enforce policies for IPsec transport mode.
- Policy: TCP *:80 -> Peer can send other protocols or to other ports
- Patch by Tobias posted 2014 on netdev mailing list.

Different Timeouts for Acquire States and SPIs

- Currently, SPIs allocated with XFRM_MSG_ALLOCSPI expire after the same timeout that is also used for the temporary states allocated after sending an acquire to the IKE daemon (/proc/sys/net/core/xfrm_acq_expires).
- However, keeping acquire states around that long might not be desired (e.g. in the trap-any scenario, although a populate-from-packet feature could help here too).
- Using the lifetime config on struct xfrm_usersa_info that's part of struct xfrm_userspi_info this could easily be implemented.
- Patch by Tobias sent a year ago to Steffen Klassert.

Query Available Algorithms via XFRM

- To prepare an automatic ESP proposal it would be necessary to query the algorithms the kernel supports via XFRM.
  Similar to the feature provided by PF_KEY via xfrm_probe_algs(), however, that's not actually that useful because it's based on a static list.
- Ideally, we'd get a list of actually usable algorithms (modules? FIPS mode?)

UDP Encapsulation of ESP for IPv6

- UDP encapsulation of ESP is supported for IPv4 but strangely not for IPv6 even though natting IPv6 has been possible for a while.
- For us it is mainly of interest because our Android app requires UDP encapsulation to work in userland.
- With the upcoming TCP encapsulation this might be less of a problem, but it's usually preferable to use UDP encap over TCP encap.
- POC patch by Tobias available.
- Handling of UDP header checksum (RFC 6935/RFC 6936)?

Proper Way to Handle Virtual IPv6 Addresses

- We currently install virtual IPv6 addresses received from a server on a local interface and install specific source routes with that address and the remote subnets.
- The address is marked deprecated, the idea being that the kernel will only use this address for the explicit routes but not when doing address selection for other destinations.
- The question is whether this is the proper way of doing this.

Marking Inbound Traffic After Decryption

- Similar to the new outbound mark that's applied after encryption (XFRMA_OUTPUT_MARK) we'd like to discuss the possibility of adding a similar feature that applies a mark to inbound packets right after decryption.
- This would simplify applying a mark to specific tunnels (e.g. for QoS) without having to mark before encryption or based on possibly dynamic values like SPI/reqid.
- Patch by Steffen Klassert exists.