NetConf - IPv6 Developments

USAGI/WIDE Project / Keio University

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USAGI Project

Universal Playground forIPv6 / Rabbit

- Since fall, 2000
- Sponsored by WIDE Project
- Core members from research institutes and companies
- Collaborating with KAME, TAHI and Nautilus
  - KAME (turtle) IPv6, IPsec,... for BSDs
  - TAHI: Verification technology
  - Nautilus: Network Mobility (NEMO)
- Goal
  - To provide high quality IPv6 stack based on Linux

USAGI Project's Target Areas

Target Areas (Past - Present)

- IPv6 API
- IPv6 core protocols
- IPsec
- Routing
- Packet filtering (Netfilter)
- Mobile IP

Current Status (1)

- IPv6 API
  - New RFCs available
    - Basic API (RFC3493 aka RFC2553bis)
      - probably done
    - Advanced API (RFC3542 aka RFC2292bis)
      - not yet

Current Status (2)

- IPv6 Core Protocols
  - USAGI Linux 2.6 (snapshot on Jan 19, 2004) got "IPv6 Ready Logo"(tm) from IPv6 forum
    - http://www.ipv6ready.org
  - We see no grave issues

Current Status (3)

- IPsec
  - basically done
  - Random fixes and improvements
  - Racoon v2
  - new specs are coming
    - ESPv2, IKEv2
- Routing
  - Router Selection / Load Sharing
    - halfly done
  - Policy Routing
    - done (by ville) but check required
  - Multicast Routing
    - not yet

Current Status (4)

- Packet filtering (nf_conntrack)
  - Protocol independent netfilter infrastructure
  - basically done
  - do we need NAT? :-)
- Mobile IPv6
  - under development
  - will be available in this fall
    - before ESTI in October
  - Nautilus Project (another project of WIDE Project) are going to develop NEMO on Linux

Planned Changes

IPv6 Core Protocol

- NDP
  - Accuracy of timing
    - run timer in NUD_REACHABLE
    - eliminate neigh_sync()
  - Neighbor state transition does not confrom to the spec.
- Fragmentation / MTU
  - amount of "fragment header" (8 bytes) are always eaten in case fragmentation is required.

It’s time to remove "EXPERIMENTAL" and say Y!

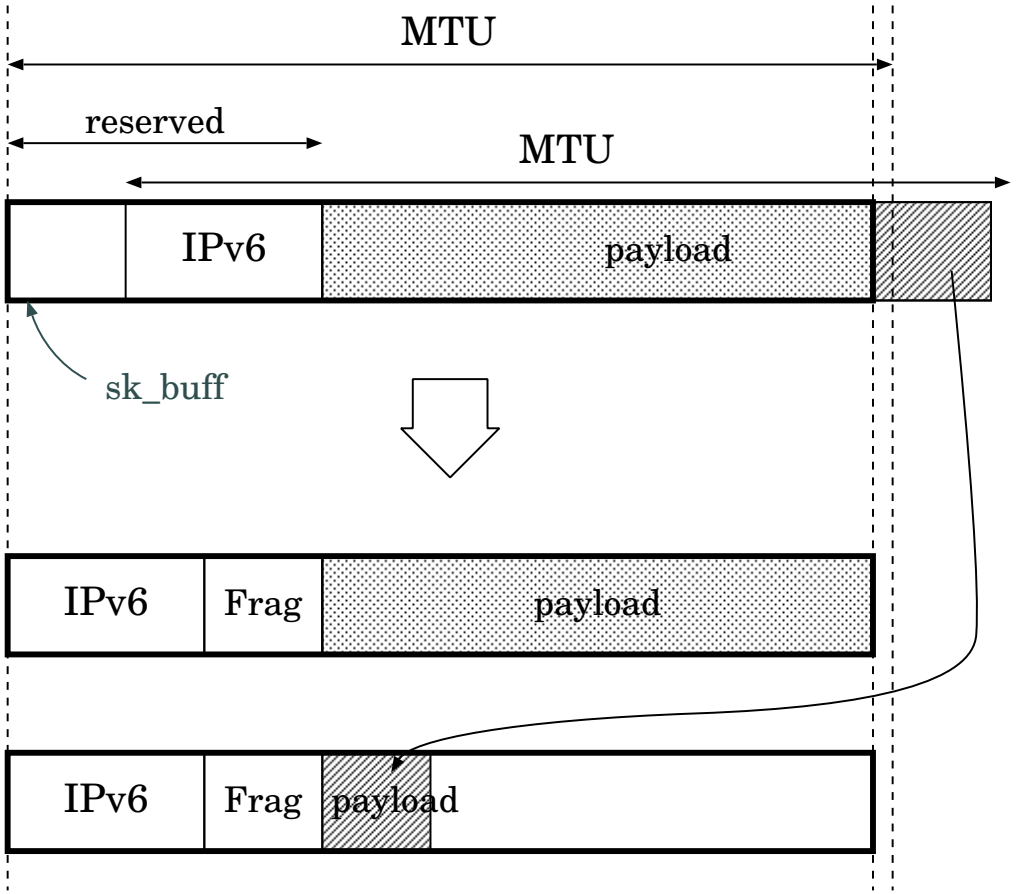
Planned Changes (cont.)

Routing

- Router Selection / Load Sharing
  - select preferred route from routes of same metric
- Policy Routing
  - rule table
  - default source address selection
  - source address determination when looking up route

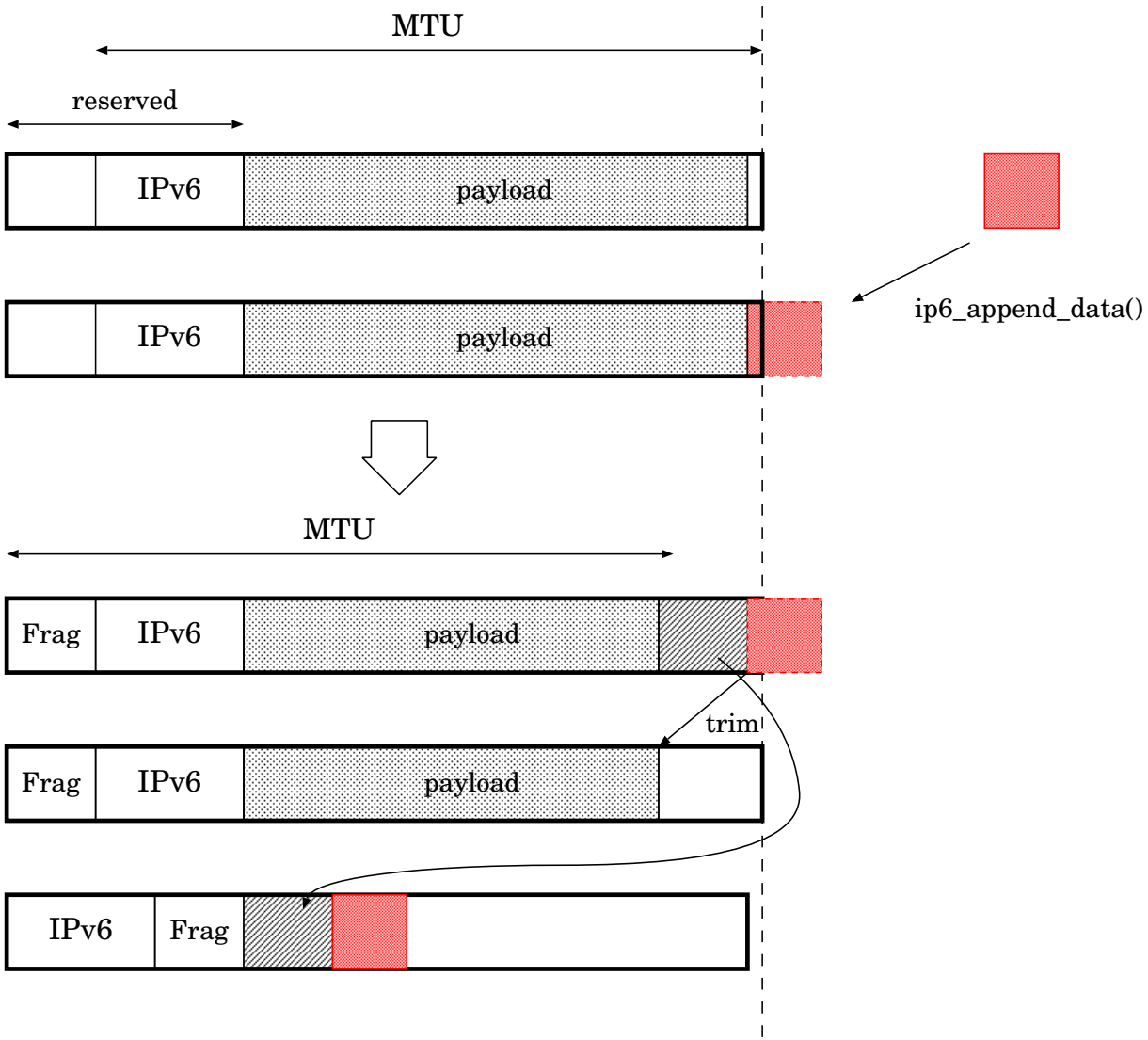
Fragmentation / MTU Issue

"Fragment header" (8 bytes) is always reserved.



Fragmentation / MTU Fix

When the packet size are reaching MTU, move tail of current fragment to new one



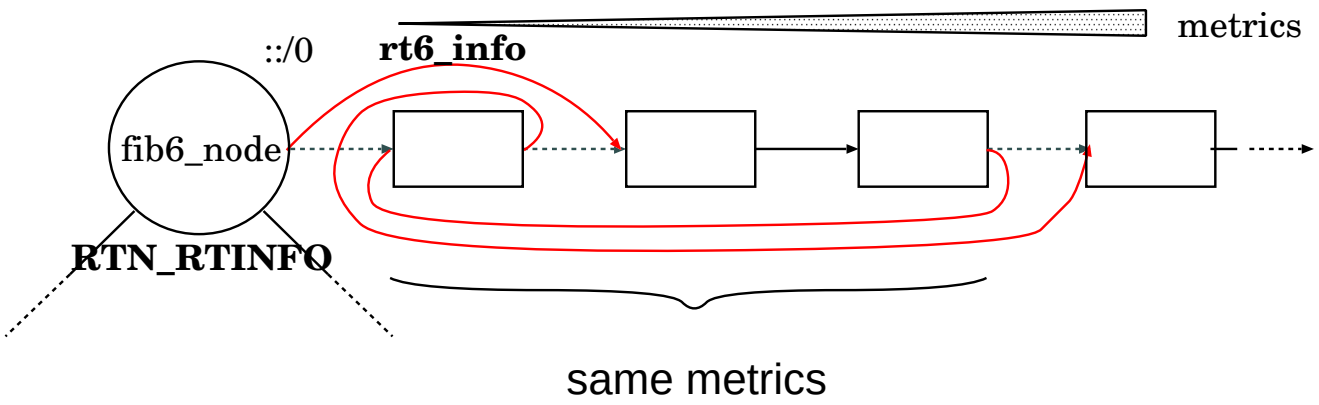
Router Selection

Issue

- select one route from multiple routes of same metric
- rt6_dflt_pointer is too static and only for default routes

Solution

- round-robin routes of same metric
- use "highest" preferred route



Router Selection (cont.)

- Remaining Issue
  - standard specifies hash-based selection
    - how to select an entry in the list?
  - Probably we always need to create host route for stable route

Policy Routing

Discussed with HUT GO/Core Project

- search first rule what the request conforms to.
- (*)if rule not found, route not found. (end)
- lookup route in the table which is specified by the rule
- if returned route conforms to the rule, use it. (end)
- otherwise, search next rule what the request conforms to.(repeat from *)

IPsec

- Add icmp type/code to selector
- Fix AH calculation w/ routing header
- Reply window seems strange
- Parse flow when sending messages via raw socket

Current / Future Items

- Mobile IPv6
- Multicasting
  - Copy "ipv4/ipmr.c" is not good, I think.
- Advanced API
  - new API overrides the definition...
    - probably we allocate new sockopt and provide old sockopt for compatibility
- Introduce u64 counters
  - update unsigned long internally, and update u64 periodically
- everything-over-ipv{4,6} tunnel
  - ipv{4,6} over ipv4 (tunl), replaces sitX (and greX?)
  - ipv{4,6} over ipv6 (ip6tnl)

Current / Future Items (random)

- Introducing expiration list for purging entries
  - sorted by expiration time
  - e.g. routing
- Introduce "long term" timer
  - timer in HZ precision often overflows
- Restructuring ip directory

Mobile IP

- Mobile IPv6 is now RFC
  - RFC3775 "Mobility Support in IPv6"
  - RFC3776 "Using IPsec to Protect Mobile IPv6 Signaling Between Mobile Nodes and Home Agents"
- Packet Delivery Framework
  - Bidirectional Tunneling
  - Route Optimization

Mobile IP (cont.)

- MH (Mobility Header)
  - signaling
  - extension header but nexthdr = NONE
- HoA option (in (special) destination header)
  - for source HoA; source is MN
- Routing header option of type 2
  - for destination HoA; destination is MN

Basic Design

Designed by

- USAGI and HUT (Helsinki Univ. of Tech.)

Packet modifications, such as Bi-Tunnel, RO and IPsec, are done inside kernel

- XFRM framework
  - Build XFRM state respectively
    - it manages packet mangling.
    - like Binding Cache, but it is not the same.
- Standard IPv6-IPv6 tunnel
  - for link-local protocol

Signaling is handled in userspace daemon

- manages binding cache and XFRM policy/state

Kernel User API

- XFRM
  - ~1500 lines
- PF_MOBILITY(?)
  - under discussion w/KAME

XFRM State Management API

- current keys: (family, daddr, spi, proto)
- not sufficient (especially for mobile ip)
  - userland daemon need to add/delete with specific source address

```
struct xfrm_usersa_id {
        xfrm_address_t  daddr;
        __u32           spi;
        __u16           family;
        __u8            proto;
        xfrm_address_t  saddr;     // NEW
};
```

- This is probably good for xfrm6_tunnel management, too.
  - We see "hashed" spi for xfrm6_tunnel.
- Mobile IP is a kind of tunnel, anyway.

Binding Error Notification

- Binding Error will be pased to the userspace using new XFRM_MSG_MIP6NOTIFY message
  - Unexpected set of CoA and HoA
  - unknown MH type
    - this can be handled in userspace, directly

Remaining issue

- HA shall not accept Home Registration without IPsec while HA (Home Agent) may receive BU from MN as if HA is CN, which is valid, without IPsec
  - XFRM Selector extension, which allow us to use H bit in BU as a selector
    - pros: easy to impleent
    - cons: MH "flag" is very local to BU (is a type of MH); a kind of layer violation
  - Refer sec_path[] at in-kernel MH receiver
    - pros: easy to implement
    - cons: still needs in-kernel MH receiver

Remaining issue (cont.)

- If we had IPsec information (such as protocol and algorithm) notification mechanism, we could do everything in userspace
  - pros: simpler and generic features in kernel
  - cons: no such standards

Remaining issue (cont.)

- IPsec and Mobile IP co-existence
  - How to allow coexistence of IPsec and Mobile IP for same destination?
    - Combining IPsec / Mobile IP Policies
    - Allow multiple type of templates
    - Merge them according to "meta-template"
    - still under discussion

Restructuring ip directory

- net/ip/ipv4
  - - tcp.c, tcp_diag.c, tcp_input.c, tcp_minisocks.c, tcp_output.c, tcp_timer.c + sctp_ipv4.c
- net/ip/ipv6
  - + sctp_ipv6.c
- net/ip/tunnel
- net/ip/tcp
  - + tcp.c, tcp_diag.c, tcp_input.c, tcp_minisocks.c, tcp_output.c, tcp_timer.c
- net/ip/sctp
  - - ipv6.c

Request to Other Maintainers

Please, please keep IPv6 in your mind.

- Expect extension headers
- Please do not make things depend on seeing inner "things" (including headers)

When you define API and/or see API, keep the viewpoint of "protocol independency"

- use protocol independent address structures
  - pointer to sockaddr{}
  - sockaddr_storage{}
- sockaddr_in{}? hmm...
- u32? in_addr? What is it? :-)