Introductory and Advanced Topics on P4 Programmable Data Plane Switches

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Parser Implementation

Lab activities are described in Lab 4, P4 Programmable Data
Plane Switches (BMv2) lab series

Programmable Parser

- The parser enables parsing arbitrary headers with a finite state machine
- The state machine defines the order of the headers within the packets
- The packet is split into the defined headers and the remaining is treated as the payload
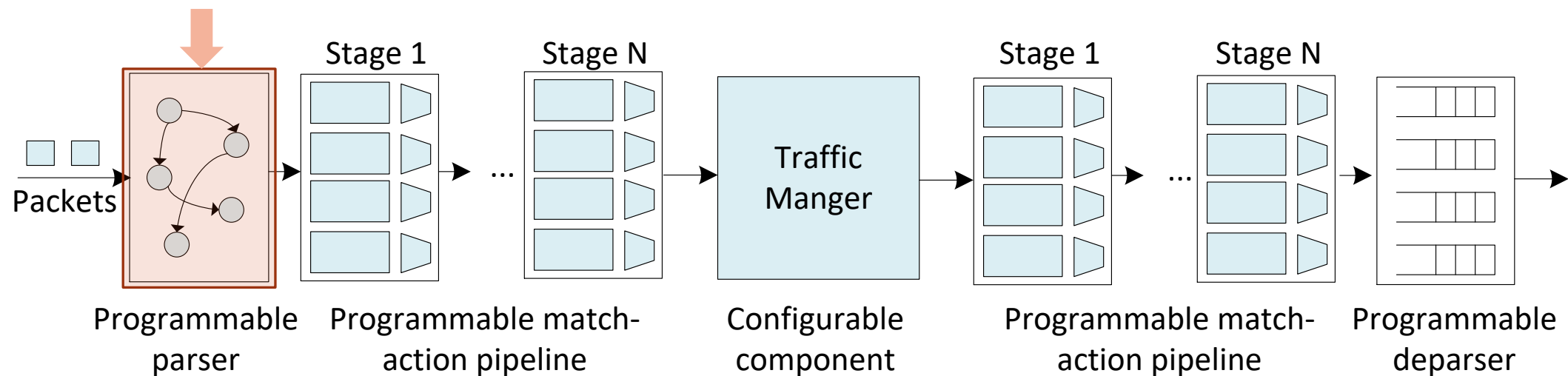
Packet Headers

- The packet headers are specified by the programmer
- The programmer has the flexibility of defining custom/non-standardized headers
- Such capability is not available in non-programmable devices

Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	Version				IHL				DSCP						ECN		Total Length															
32	Identifier																Flags			Fragment Offset												
64	Time To Live								Protocol								Header Checksum															
96	Source IP Address																															
128	Destination IP Address																															
160	Options (if IHL > 5)																															

```
header ipv4_t {
    bit<4> version;
    bit<4> ihl;
    bit<8> diffserv;
    bit<16> totalLen;
    bit<16> identification;
    bit<3> flags;
    bit<13> fragOffset;
    bit<8> ttl;
    bit<8> protocol;
    bit<16> hdrChecksum;
    ip4Addr_t srcAddr;
    ip4Addr_t dstAddr;
}
```
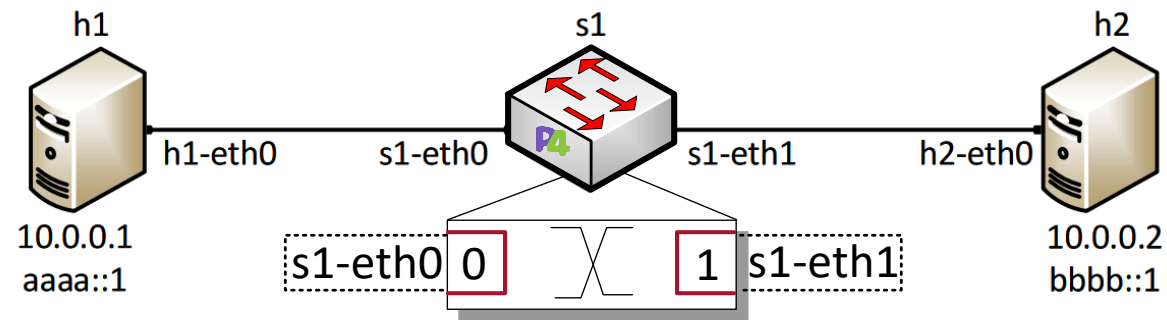
Programmable Parser

- The parser enables declaring arbitrary headers with a finite state machine
- The state machine defines the order of the headers within the packets
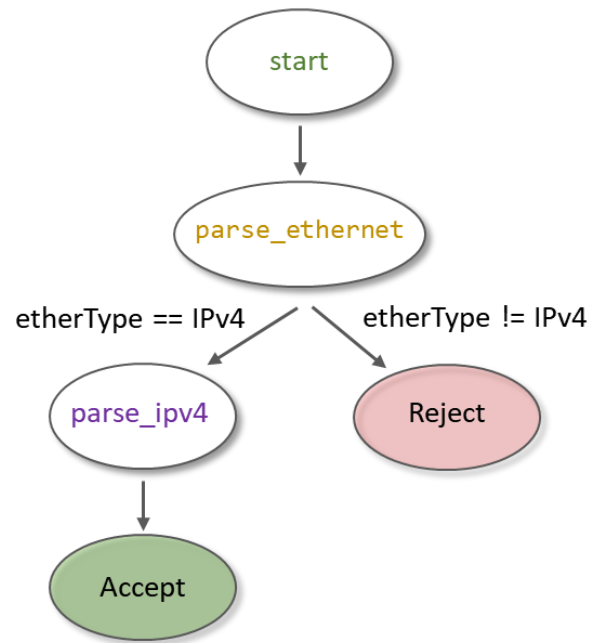

```
state start {
    transition parse_ethernet;
}
state parse_ethernet {
    packet.extract(hdr.ethernet);
    transition select(hdr.ethernet.etherType) {
        TYPE_IPV4: parse_ipv4;
        default: reject;
    }
}
state parse_ipv4 {
    packet.extract(hdr.ipv4);
    transition accept;
}
```
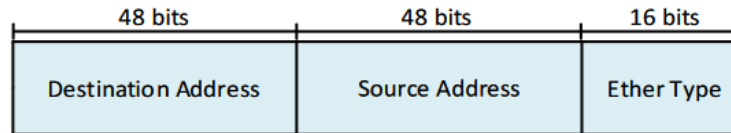
Lab Topology and Objectives

- The topology consists of two hosts: h1 and h2; one P4 switch: s1
- Defining the headers for Ethernet, IPv4 and IPv6
- Implementing the parser
- Testing and verifying the switch behavior when IPv4 and IPv6 packets are received
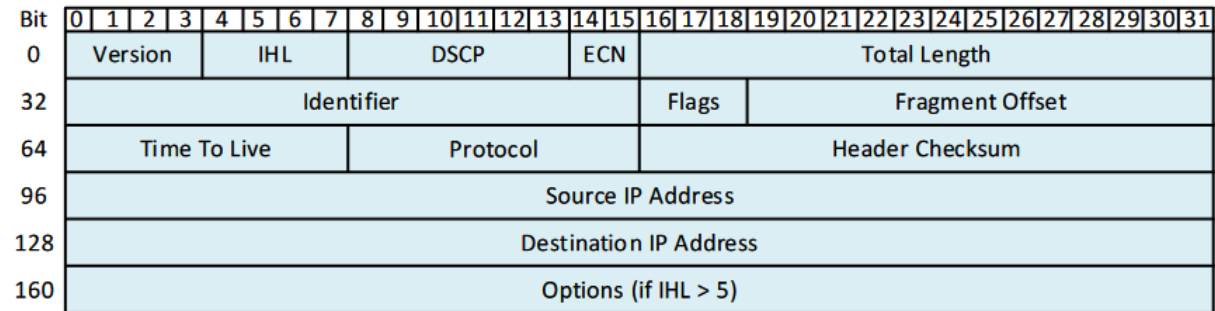
Headers Format

- Ethernet header:

48 bits	48 bits	16 bits
Destination Address	Source Address	Ether Type

- IPv4 header:

Bit	0 1 2 3	4 5 6 7	8 9 10 11 12 13	14 15	16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
0	Version	IHL	DSCP	ECN	Total Length
32	Identifier			Flags	Fragment Offset
64	Time To Live		Protocol		Header Checksum
96	Source IP Address				
128	Destination IP Address				
160	Options (if IHL > 5)				

- IPv6 header:

Bit	0 1 2 3	4 5 6 7 8 9 10 11	12 13 14 15 16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31
0	Version	Traffic Class	Flow Label	
32	Payload Length		Next Header	Hop Limit
64	Source IP Address			
192	Destination IP Address			