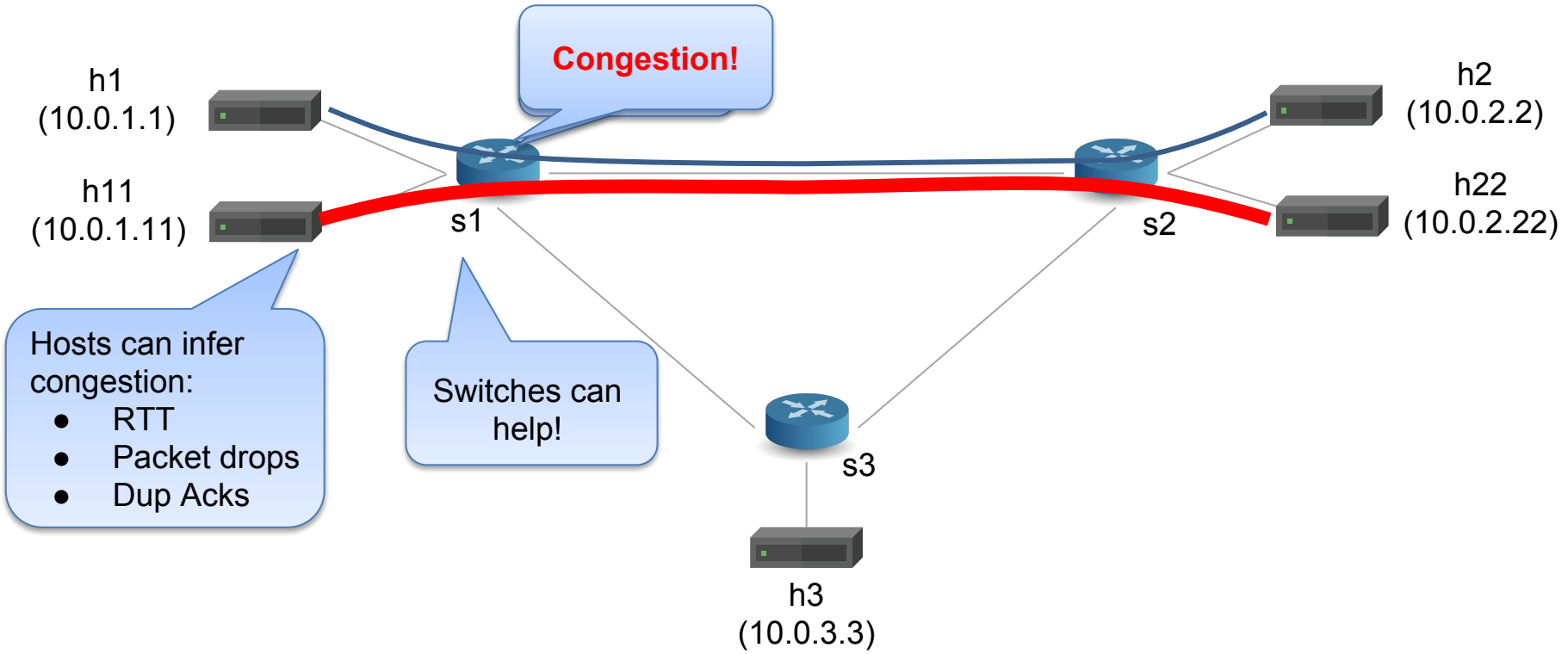
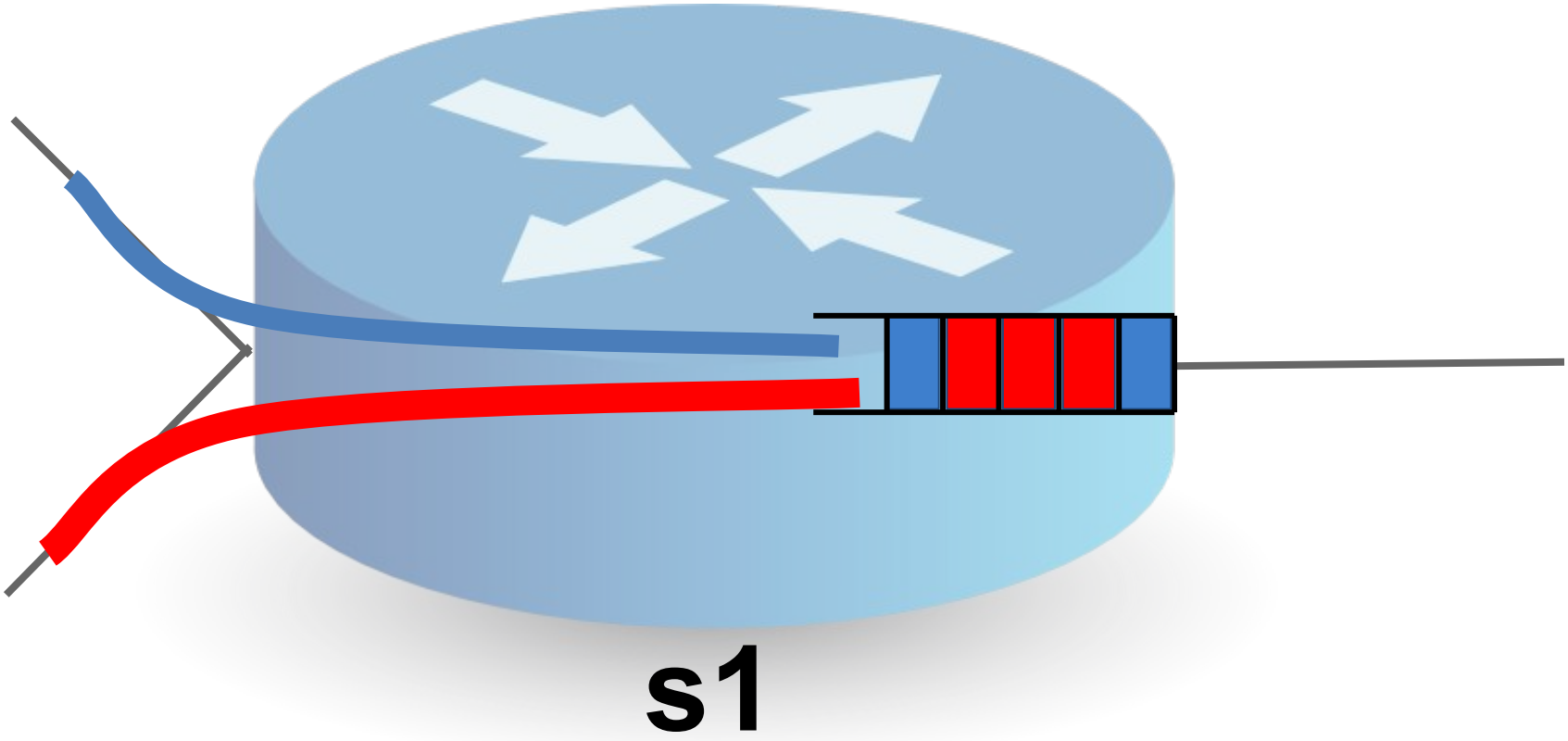
Lab 3: Monitoring & Debugging

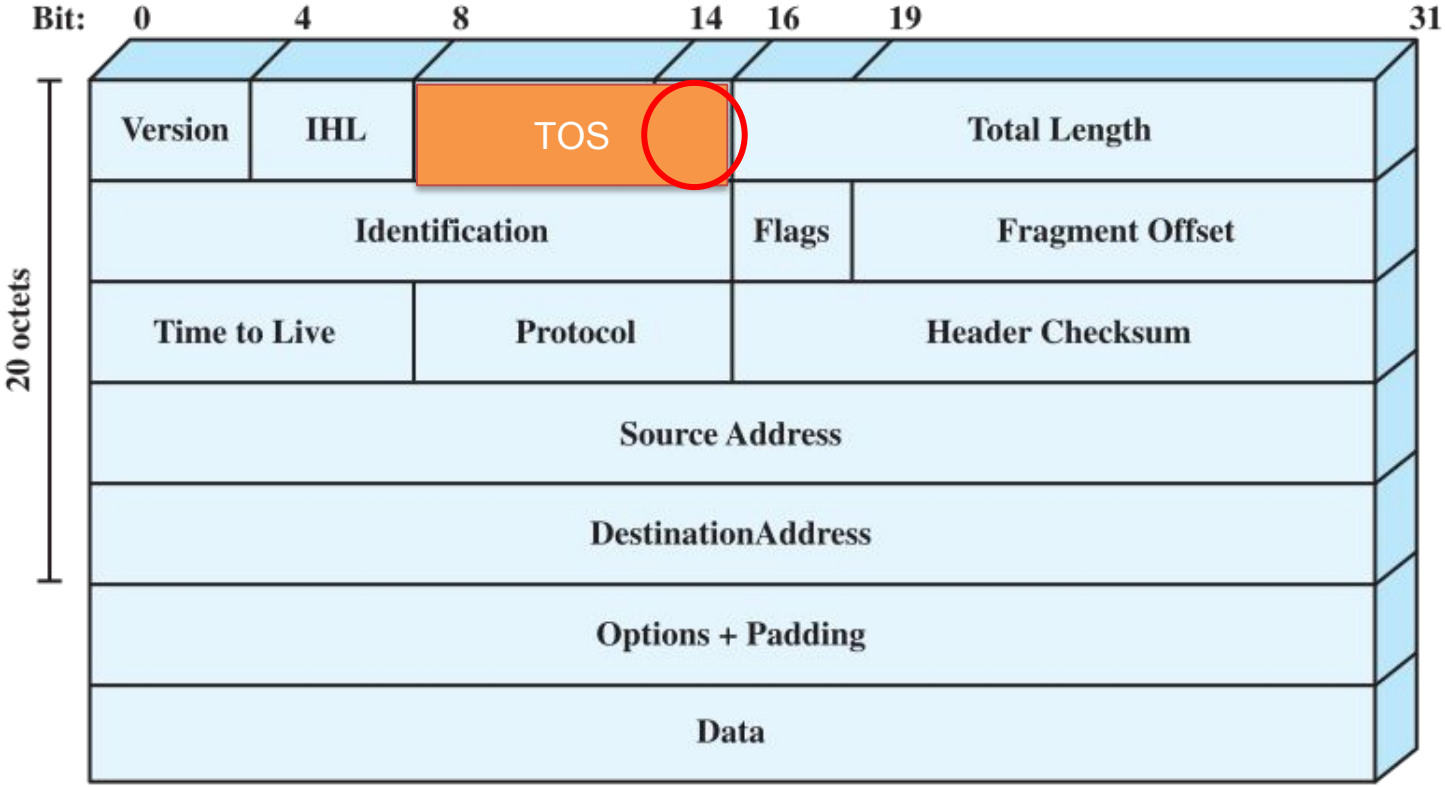
Monitoring & Debugging



Monitoring & Debugging



Explicit Congestion Notification



Explicit Congestion Notification

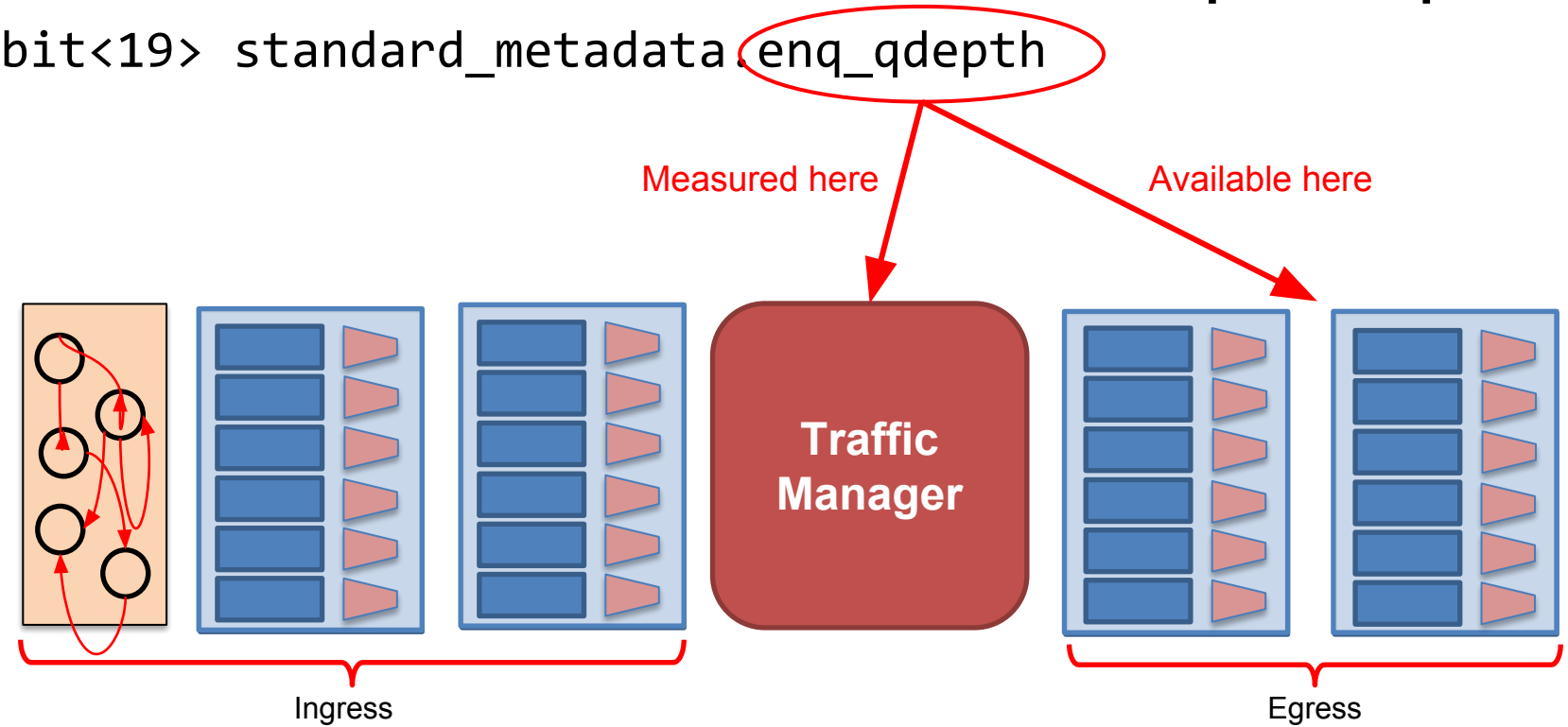
- **Explicit Congestion Notification**
  - `00`: Non ECN-Capable Transport, Non-ECT
  - `10`: ECN Capable Transport, ECT(0)
  - `01`: ECN Capable Transport, ECT(1)
  - `11`: Congestion Encountered, CE

- **For packets originating from ECT, ECN-capable switches set the CE bit upon congestion**
  - E.g., observed queue depth > threshold

Explicit Congestion Notification in P4

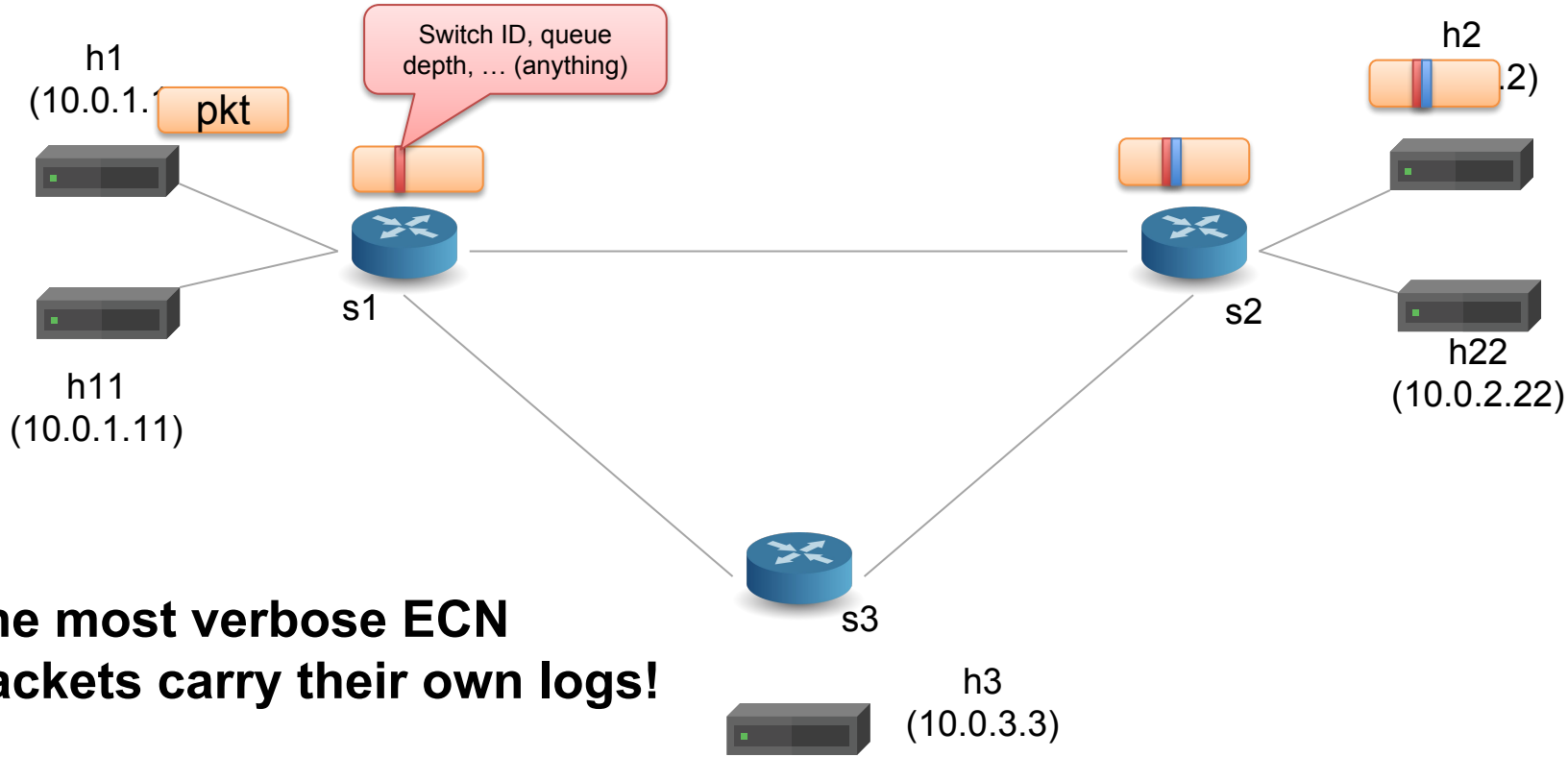
- **The standard data for the V1Model includes the queue depth:**

```
bit<19> standard_metadata.enq_qdepth
```



Coding Break

Multi-Route Inspection



The most verbose ECN
Packets carry their own logs!

Multi-Route Inspect: Packet Format

```
header mri_t {
  bit<16>  count;
}
```

```
header switch_t {
  switchID_t  swid;
  qdepth_t    qdepth;
}
```

```
struct headers {
  ethernet_t          ethernet;
  ipv4_t              ipv4;
  ipv4_option_t       ipv4_option;
  mri_t               mri;
  switch_t[MAX_HOPS]  swtraces;
}
```

- **Header validity opertions:**
  - `hdr.setValid()`: add_header
  - `hdr.setInvalid()`: remove_header
  - `hdr.isValid()`:test validity

- **Header Stacks**
  - `hdr[CNT] stk;`
- **Header Stacks in Parsers**
  - `stk.next`
  - `stk.last`
  - `stk.lastIndex`
- **Header Stacks in Controls**
  - `stk[i]`
  - `stk.size`
  - `stk.push_front(int count)`
  - `stk.pop_front(int count)`

Header verification

```
/* Standard errors, defined in core.p4 */
error {
   NoError,           // no error
   PacketTooShort,    // not enough bits in packet for extract
   NoMatch,           // match expression has no matches
   StackOutOfBounds,  // reference to invalid element of a header stack
   OverwritingHeader, // one header is extracted twice
   HeaderTooShort,    // extracting too many bits in a varbit field
   ParserTimeout      // parser execution time limit exceeded
}
/* Additional error added by the programmer */
error { IPv4BadHeader }
...
state parse_ipv4 {
  packet.extract(hdr.ipv4);
  verify(hdr.ipv4.version == 4, error.IPv4BadHeader);
  transition accept;
}
```

Coding Break