Building an RCP Test Network

Jiang Zhu, Nandita Dukkipati

High Performance Networking Group
Stanford University

Thanks: Glen Gibb, Nick McKeown

HPNG Group Meeting
4 June, 2007
What stands between RCP and its widespread adoption

- Implementation
- Experiments
- Incremental deployment
  - Coexistence with non-RCP traffic
  - Coexistence with non-RCP enabled routers
- Compelling demo on the benefits of network participating in congestion control
RCP Test Network

RCP End-hosts

RCP hardware router

RCP hardwre router (NetFPGA)

bottleneck router 2

1 GigE
delay 50 ms

RCP Software
Router

100 Mbps

bottleneck router 1

1 GigE
delay 4 ms

RCP Software
Router

100 Mbps

bottleneck router 2

RCP Listening
servers

1 GigE
delay 10 ms

RCP End-hosts

RCP End-hosts

RCP hardware router

bottleneck router 1
RCP End-host: Placement and format of RCP header

- **RCP header placement**: Between IP and transport header
- **Header length**: 12 Bytes
- **rcp_bottleneck_rate**: 4 Bytes, units Bytes/msec, 4.2 GB/msec, 34.3 Tb/sec
- **rcp_reverse_bottleneck_rate**: Feedback from receiver
- **rcp_rtt**: 2 Bytes, units msec, max 65 seconds.
- **rcp_p**: Indicates the next level protocol used (TCP/UDP)
RCP end-host

- Application
- TCP
- Congestion Control: NewReno, R-TCP, BIC
- RCP
- IP
- Link
RCP end-host: Sending packets

**TCP**
- `tcp_v4_send_synack()`  
  `net/ipv4/tcp_ipv4.c`
- `tcp_transmit_skb()`  
  `net/ipv4/tcp_output.c`
- `tcp_v4_send_ack()`  
  `net/ipv4/tcp_ipv4.c`
- `tcp_v4_send_reset()`  
  `net/ipv4/tcp_ipv4.c`

**RCP**
- `rcp_build_and_send_pkt()`  
  `net/ipv4/rcp.c`
- `rcp_queue_xmit()`  
  `net/ipv4/rcp.c`
- `rcp_send_reply()`  
  `net/ipv4/rcp.c`

**IP**
- `ip_build_and_send_pkt()`  
  `net/ipv4/ip_output.c`
- `ip_queue_xmit()`  
  `net/ipv4/ip_output.c`
- `ip_send_reply()`  
  `net/ipv4/ip_output.c`
RCP end-host: Recieving packets

\[
\text{snd\_wnd} = \frac{\text{rcp\_bottleneck\_rate} \times \text{rcp\_rtt}}{\text{MSS} + \text{RCP\_HEADER\_SIZE} + \text{IP\_HEADER\_SIZE}};
\]

\[
\text{packet\_pacing\_interval} = \frac{\text{MSS}}{\text{rcp\_bottleneck\_rate}};
\]
RCP router: NetFPGA
• Per-packet Processing
• Software Control Path