Datagram Congestion Control Protocol (DCCP) Overview

Eddie Kohler
UCLA/ICIR

IETF 58 AVT Meeting
November 12, 2003

DCCP is

- A congestion-controlled, unreliable flow of datagrams
- "UDP plus congestion control"

- Also a modern transport protocol

  Partial checksums, mobility, DoS resistance, fast connections, . . .

Target applications

- Long-lived flows that prefer timeliness to reliability

  Streaming media, Internet telephony, on-line games, . . .

- UDP not congestion controlled, apps must implement CC
- Apps want

  Buffering control: don't deliver old data

  Different congestion control mechanisms (TCP vs. TFRC)

  Low per-packet byte overhead

DCCP's attractions for applications

- Congestion control implementation

  Experience shows CC is difficult to get right

- Integrated acknowledgements, reliable feature negotiation
- Access to ECN

  ECN capable flows must be congestion controlled

  UDP APIs would find this difficult to enforce

- Different congestion control mechanisms ⟶

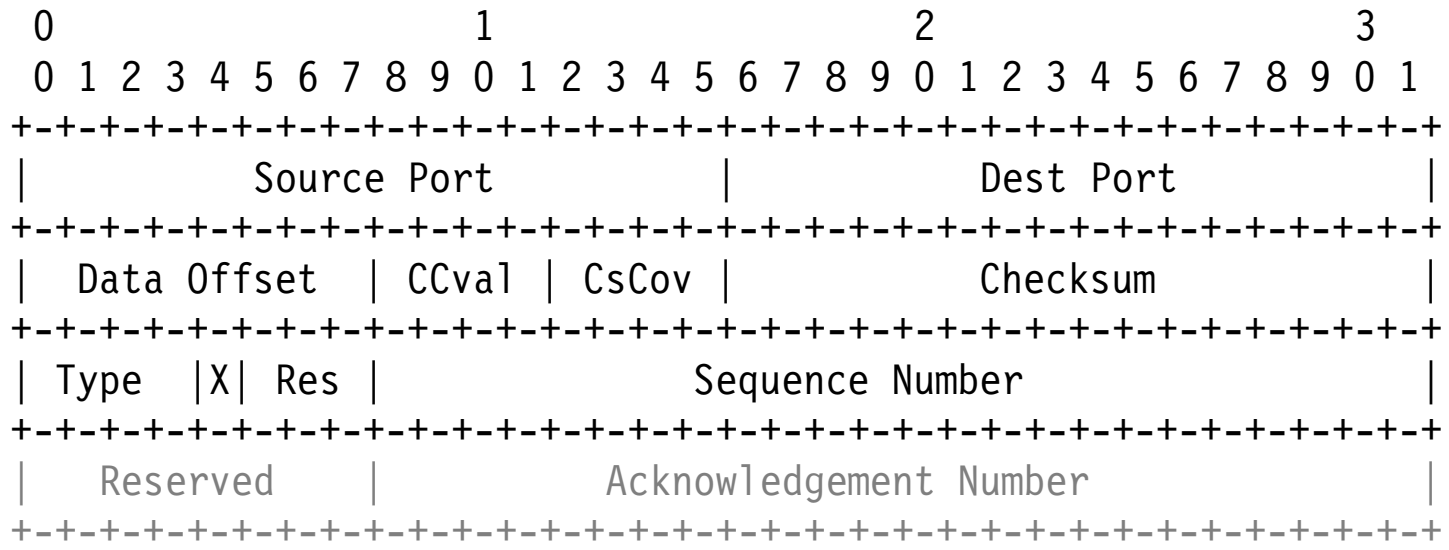
TCP-like vs. TFRC congestion control

- TCP-like: quickly get available B/W
  - Cost: sawtooth rate—halve rate on single congestion event
  - May be more appropriate for on-line games
  - More bandwidth means more precise location information; UI cost of whipsawing rates not so bad
- TFRC [RFC 3448]: respond gradually to congestion
  - Single congestion event does not halve rate
  - Cost: respond gradually to available B/W as well
  - May be more appropriate for telephony, streaming media
  - UI cost of whipsawing rates catastrophic

Sample connection

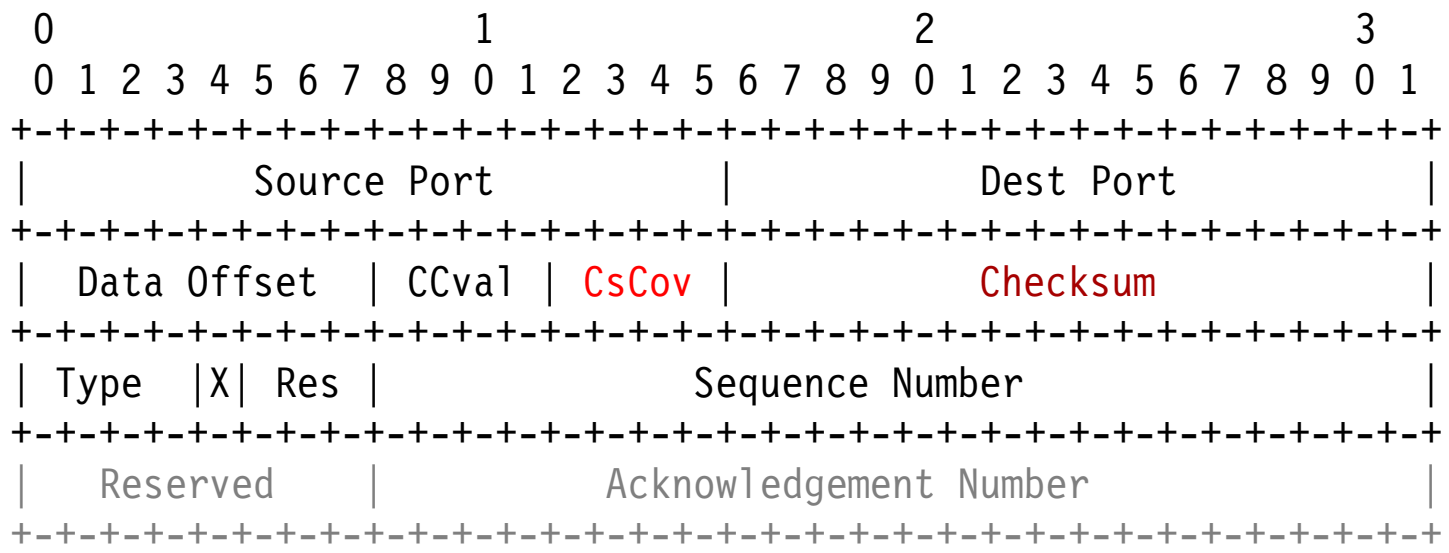
	DCCP A				DCCP B
0.	CLOSED				LISTEN
1.	App opens				
	REQUEST	⟶	DCCP-Request	⟶	RESPOND
2.	OPEN	⟵	DCCP-Response	⟵	RESPOND
3.	OPEN	⟶	DCCP-Ack	⟶	OPEN
4.	Initial feature negotiation (CC mechanism, . . .)				
	OPEN	⟷	DCCP-Ack	⟷	OPEN
5.	Data transfer				
	OPEN	⟷	DCCP-Data, -Ack, -DataAck	⟷	OPEN
6.	App closes				
	CLOSING	⟶	DCCP-Close	⟶	CLOSED
7.	TIME-WAIT	⟵	DCCP-Reset	⟵	CLOSED

Packet header



- Gray portion not on all packet types
  - Different headers for different packet types (unlike TCP)
  - Reduce byte overhead for unidirectional connections

Packet header



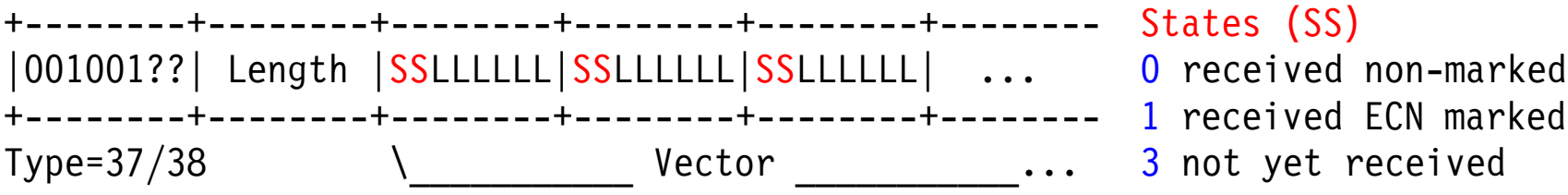
- CsCov supports partial checksums
  - Errors in header result in packet drop
  - Errors outside Checksum Coverage ignored
  - 0–56 bytes of payload can be covered, or all payload

Ack Vector option

- Run-length encoded history of data packets received

  Cumulative ack not appropriate for an unreliable protocol

  Steroidal SACK

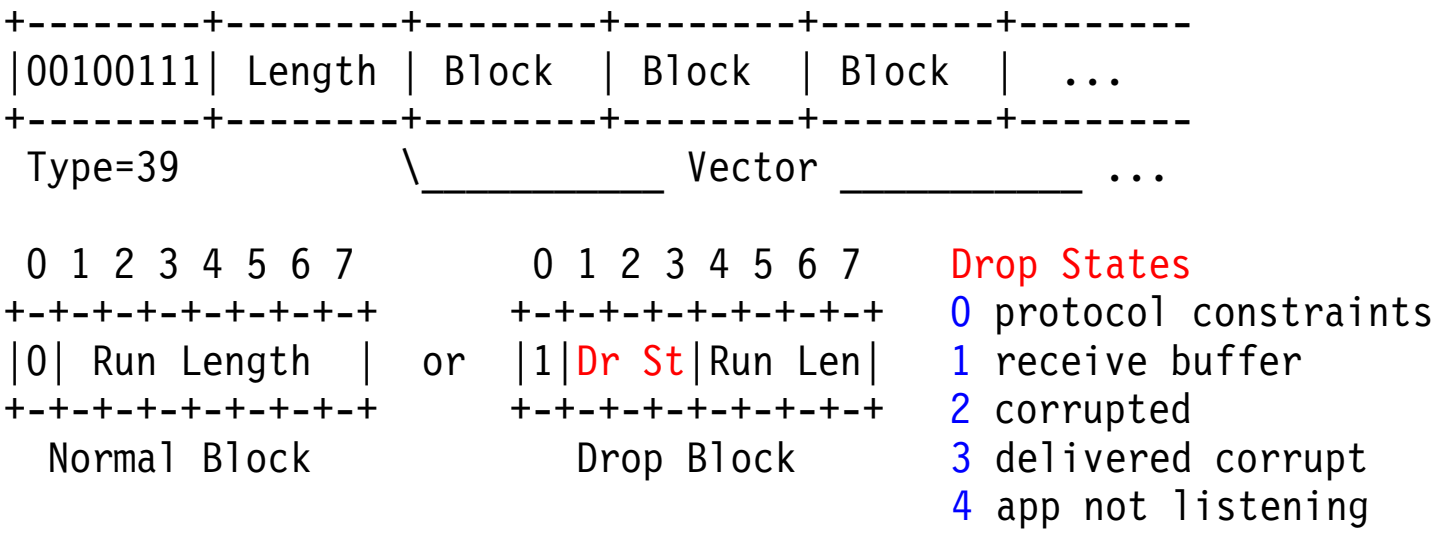


  Up to 16192 data packets acknowledged per option

  Includes ECN nonce

Data Dropped option

- Ack Vector says whether a packet's *header* was processed
  - Not whether packet's data will be delivered to application
  - Supports drop-from-head receive buffers, . . .
- Data Dropped says whether a packet's data was delivered
  - And if not, why not
  - Enables richer [non-]congestion response functions



"VoIP issues" with CCID 3 (TFRC) and DCCP

- Protocol complexity

  New draft, CCID 3-Thin, enables a low-complexity subset

- Slow start?

  Now allow 4 packets/RTT (4380 payload bytes/RTT)

  40ms initial packetization interval for RTT $\leq$ 160ms

- Rate slows down during idle periods

  Example: two-way phone

  TFRC limits sending rate to twice your actual sending rate in the last RTT

  Send idle packets?

"VoIP issues" 2

- Rate does not increase during app-limited period
  - Again, can send up to twice your app-limited rate
  - Don't get to reserve bandwidth
- Variable rate considered harmful
  - *[Meaning: Continuously variable reference rate problematic for apps with discrete sending rates]*
  - Apps might have discrete rates
  - Seems fine to allow sending at slightly above the reference rate (up to 2×?)
  - New draft needed
- Rate changes considered harmful *[by some apps]*
  - Apps work at fixed rates, hard to switch
  - App-specific

Conclusion

- http://www.icir.org/kohler/dccp/

  draft-ietf-dccp-spec-05.txt: main specification

  draft-ietf-dccp-ccid{2,3}-04.txt: CCID specs

  draft-ietf-dccp-ccid3-thin-00.txt: CCID 3-Thin option

- New drafts coming by the end of the month
- WGLC in December

  Comments welcome!