Datagram Control Protocol (DCP)

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http://www.aciri.org/kohler/dcp/

Question

- **How best to deploy congestion-controlled applications that require flow-like unicast semantics, but don't want absolute reliability?**
  - Streaming Media
  - Internet Telephone
  - Unicast Multimedia Conferencing

Issues

- **Different apps want different congestion control dynamics (eg AIMD, TFRC).**
- **Concern about poor application-level congestion control implementations**
- **Firewalls and NATs don't co-exist very well with UDP.**
  - Lack of explicit flow setup and teardown.
  - Lack of well-known ports because UDP setup is usually server-to-client.
- **Concerns about deploying ECN with UDP applications.**

Datagram Control Protocol (DCP)

Key Features:

- **Unreliable transport protocol, intended for kernel implementation on top of IP.**
- **Connection Setup:**
  - Three-way handshake for connection setup.
  - "SYN" has service identifier in additon to src and dst ports.
  - Mandatory support for SYN cookies.
  - Allows negotiation of congestion control algorithm and parameters.
  - Sender-based algorithms can be added with support only at the sender.

Datagram Control Protocol (DCP)

Key Features:

- **Connection Progress:**
  - Bidirectional asymmetric protocol; can use different options (such as CC) in each direction.
  - Provides packet sequence numbers and acks for congestion control.
  - In most uses, can also provide a reliable indication to the app as to which application packets arrived.
  - Supports ECN.
- **Teardown handshake**
  - Two or three way handshake on teardown (depending on initiator)
  - Time-wait state held on client.

Common DCP Packet Header

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Source Port          |          Dest Port            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type  |  Res  |               Sequence Number                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Data Offset  | # NDP | Cslen |             Checksum          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- **Packet types:**
  - 0 DCP-Request packet.
  - 1 DCP-Response packet.
  - 2 DCP-Data packet.
  - 3 DCP-Ack packet.
  - 4 DCP-DataAck packet.
  - 5 DCP-CloseReq packet.
  - 6 DCP-Close packet.
  - 7 DCP-Reset packet.

DCP-Request Packet Format

- **A DCP-Request packet is used to initiate a connection.**

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Source Port           |           Dest Port           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type  |  Res  |               Sequence Number                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Data Offset  | # NDP | Cslen |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          Service Name                         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Options                 |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              data                             |
|                               ...                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

DCP-Response

- **A DCP-Response packet is sent in response to a request.**

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Source Port           |           Dest Port           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type  |  Res  |               Sequence Number                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Data Offset  | # NDP | Cslen |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Reserved    |           Acknowledgement Number              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Options                 |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              data                             |
|                               ...                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

DCP-Data, DCP-Ack, and DCP-DataAck

- **The payload data in a DCP connection is sent in DCP-Data and DCP-DataAck packets. DCP-Data packets look like this:**

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Source Port           |           Dest Port           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Type  |  Res  |               Sequence Number                 |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Data Offset  | # NDP | Cslen |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Options                 |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              data                             |
|                               ...                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- **DCP-DataAck packets have an additional 32 bits including a 24 bit ACK field.**

Feature Negotiation

- **DCP provides a general purpose feature negotiation mechanism.**
  - Multi-way handshake allows either side to initiate.
  - Eg. ask/answer, choose/ask/answer, ask/choose/ask/answer
- **Primary use is negotiation of congeston control algorithms.**
  - Separate feature negotiation happens for each direction.
- **There are currently three DCP congestion control specifications:**
  - TCP-Like AIMD congestion control
  - TFRC congestion control
  - Single-window congestion control
- **Can also negotiate the use of an ACK vector to provide feedback of exactly which packets arrived.**

Questions?

- **Is a new transport protocol the best way to satisfy these requirements?**
  - Can always use UDP.
  - SCTP is also in the process of gaining an unreliable mode.
- **If so, did we get the basic feature set right?**
- **Interaction with RTP.**
  - Both have a sequence space; we'd prefer not to have two in the same packet.
  - Use (or not) of SSRC.

Drafts

- **Datagram Control Protocol (DCP)**
  - draft-kohler-dcp-00.txt,.ps
- **Profile for DCP Congestion Control ID 0:Single-Window Congestion Control**
  - draft-kohler-dcp-ccid0-00.txt,.ps
- **Profile for DCP Congestion Control ID 2:TCP-like Congestion Control**
  - draft-floyd-dcp-ccid2-00.txt,.ps
- **Profile for DCP Congestion Control ID 3:TFRC Congestion Control**
  - draft-padhye-dcp-ccid3-00.txt,.ps