Fairness of BitTorrent

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Outline

- Project Definition
- SCTP Overview
- Experimental Setup
- Problems Encountered
- Conclusion

The Project (cont…)

- Team
  - Jason But
  - Nigel Williams
  - Myself (for winter break)
- Conduct BitTorrent experiments using TCP and SCTP to determine the following:
  - Is BitTorrent a "fair" way of retrieving content
  - Does localised Content Caching improve performance.
  - Does SCTP offer benefits over TCP
- Vary the bandwidths, connection times and delay of torrent clients and observe “swarm” behaviour

Objectives

- Different interpretations of fairness:
  - E.g. Peers should download from and upload to other peers with equal measure (equal pieces served/fetched)
- We define fairness as:
  - Each peer in the swarm - under the same conditions (bandwidth) - should receive equal average download and upload rates (ie. No similar capacity peer should be favoured by the swarm over another.
  - This may mean that some individual peers may download more than they have uploaded.

Objectives (cont…)

- Trials to determine fairness in BitTorrent
  - 82 Jails (1 tracker, 1 seeder, 80 leechers)
  - Base case: 80 peers 512/128
    - Also different access speeds, number of peers, starting times, RTT etc.
  - Some tests with varying RTT ~ simulate peer group of mixed geographic locations
    - How do Australian peers fair with majority US/Europe peers?
    - Could caching at the ISP help?
- Repeat using SCTP

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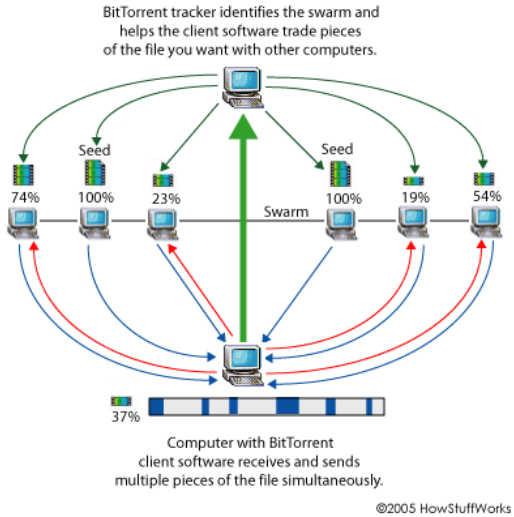
BitTorrent Overview



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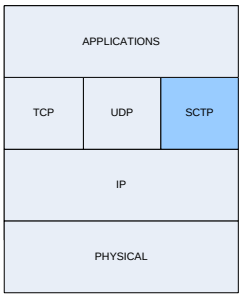
BitTorrent Choke Algorithm

- Determines which peers to download from
  - Peers can have two states – choked and unchoked
- Helps to ensure peers download/upload in equal measures – reduces "freeloading"
  - Should group together like-bandwidth peers
- Periodically assesses the download rate obtained from connected peers:
  - The slowest peers are 'choked' and a new peer is randomly unchoked ("optimistic unchoking")
  - Optimistic unchoke helps discover faster peers, also distributes pieces to new peers

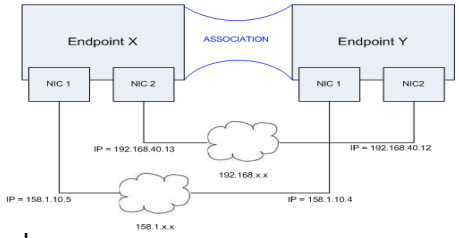
SCTP Overview

- What is SCTP
  - Stream Control Transmission Protocol
  - Sits on the Transport layer of the TCP/IP Reference Model
  - Can be used in the same way as TCP or UDP
  - Features:
    1. Multi Homing
    2. Message-Based
    3. Multi Streaming
    4. Selective Acknowledgement (SACK)
    5. Better Error Correction



SCTP Overview (cont…)

Multi Homing



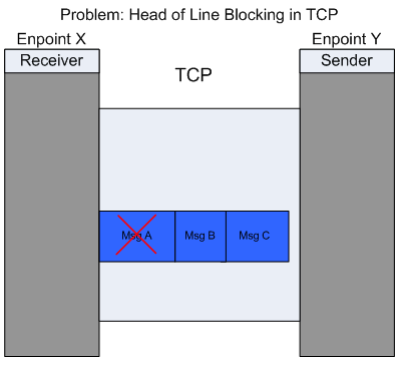
Message Based

- TCP uses byte streams
  - Application needs to do the work
- SCTP deals in message streams
  - More logical

SCTP Overview (cont…)

Multi Streaming

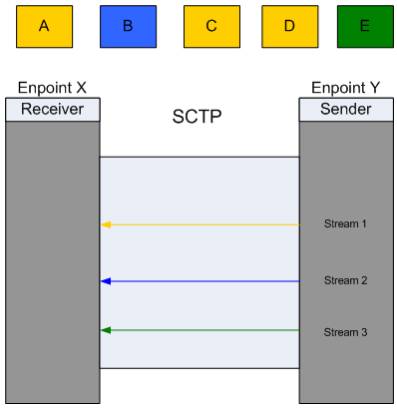
- Send 3 independent messages
- Error occurs on Msg A
- B and C in kernel waiting to be processed.
- TCP ensures dependency on the 3 independent messages
- Application needs to wait until A is retransmitted (or all 3) before it can receive B and C



SCTP Overview (cont…)

Multi Streaming

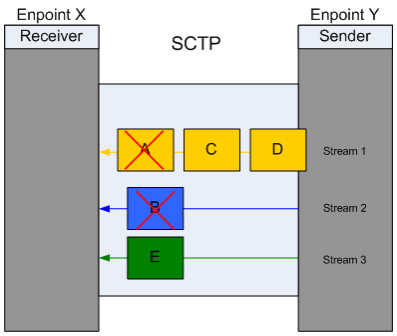
- SCTP allows messages to be sent on different streams
  - Stream 1: A, C, D (order preserved)
  - Stream 2: B
  - Stream 3: E
- If one stream has an error, other streams not affected.
- Order affected only within each stream



SCTP Overview (cont…)

Multi Streaming

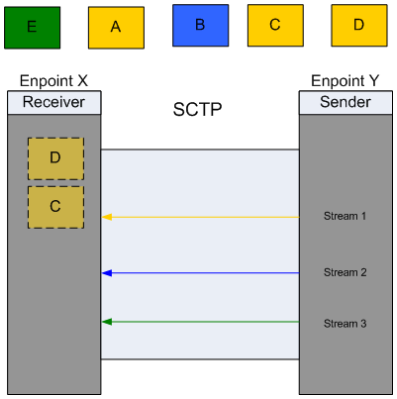
- If Msg A and B are dropped
- Stream 3 can still be sent to the application
- Retransmit Msg A and B (SACK)



SCTP Overview (cont…)

Multi Streaming

- Msg E can still be passed to the application and msg A and B retransmitted.
- Msg D and C are buffered in the kernel.
- Only the order of the individual stream needs to be preserved.



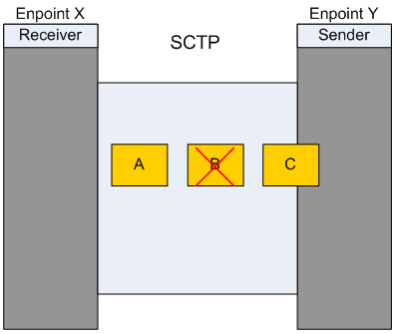
SCTP Overview (cont…)

Selective Acknowledgement

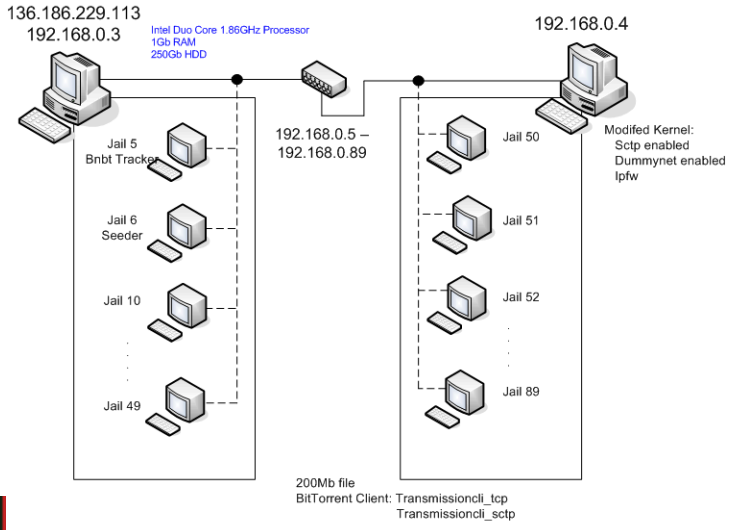
- More descriptive
- Allows for less retransmissions.
- An option in TCP, built into SCTP so payload is less.
- Error occurs in B.
  - Only resend B, not the entire stream.

Stronger Checksum (CRC32c)

- TCP uses 16 bit checksum
- SCTP uses 32 bit so is more reliable



Experimental Setup



Experimental Setup (cont...)

- Scripts Used
  - Jail_setup.sh
    - setups N jails on a system
  - Torrent_setup.sh (only script called)
    - Sets up the torrent client
    - Copies the torrent
    - Sets the dummynet limits
    - Sets the cron jobs to automatically start the client
    - Sets up the tcpdump session
    - Sets up the tracker & seeder

Experimental Setup (cont…)

- Scripts Used
  - Progress Script (called by torrent_setup.sh)
    - Determines the progress of the experiment
    - If seeding, start torrent_teardown.sh script
  - Torrent_teardown.sh (called by Progress script)
    - Kills tcpdump, transmission and tracker
    - Copies all log files into single directory
- Data Collected
  - Tcpdump logs
  - Bnbt tracker logs
  - Transmission client logs

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SCTP and BitTorrent

- We are exploring the affect of BitTorrent using SCTP.
- Multi Streaming
  - Send the data on one stream, the protocol chatter on another stream
    - Packet loss on data stream won't interfere with protocol information and vice-versa. (Due to head-of-line blocking)
- Selective Acknowledgment (SACK)
    - Less bandwidth consumed. With our lossy experiments
- Better detection of transmission errors earlier due to SCTP error checking
- Better kernel resources, a native implementation would use less socket and file descriptors

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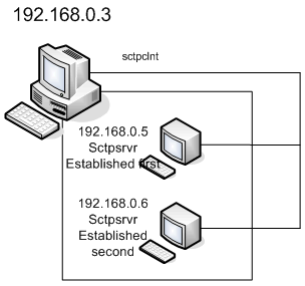
Problems Encountered

- Implementation Problems…..
  - SCTP sctp_recvmsg
    - Causes system restart on FreeBSD if 'flags' parameter not initialised
  - SCTP for jails (work in progress)
    - Binding with ADDR_ANY – listens to IP addresses belonging to other Jail hosts
  - Issues with SCTP and SMP kernel – cause is under investigation. SMP currently disabled for SCTP tests.



Problems Encountered (cont…)

- Maximum number of file descriptors concurrently running exceeded.
  - Kern.maxfiles increased to 100000
- Maximum number of mbufs available to the networking stack exceeded.
  - Kern.nmbclusters increased to 100000

Thanks Lawrence

Results

- Hope to determine if ISP content caching could benefit torrent users
- Can SCTP enhance the overall experience of BitTorrent.

Conclusion

- Tests are currently in progress
- Many thanks to all who have helped with my 6 weeks at CAIA
  - Jason But
  - Nigel Williams
  - Lawrence Stewart
  - Adam Black
  - Everyone else.