Linux 2.6.20: Current Status of DCCP

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with code from
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Outline

1. Status so far:
   - *RFC Compliance / Gaps*
   - *Recent updates*
2. Experiences (additional information)
   - *Performance tests*
   - *Scheduling limitations*
   - *Idle Periods*
   - *Accumulation of send credits*
3. Next Steps & Conclusions

Scope of Work

- Our work so far has focused on *matching*
  - RFC compliance to specifications
  - TFRC performance to theory
  - behaviour to user expectation

Areas of the code

- Arnaldo's DCCP framework: very mature and high quality – few changes required
- CCID 2 (Andrea) – seems to work / not touched
- CCID 3 – code & specification needs work

RFC Compliance

- Original merged DCCP code based on revision 00 of *DCCP Internet Drafts*!
- Combines and integrates latest updates from
  - RFC 3448
  - rfc3448bis
  - RFC 4340/2 + errata
- Numerous *bug fixes* (total of > 100 patches)

Additions to match RFC

- Service Codes and Partial Checksums
- Larger initial windows (RFC 4342, 5.)
- Idle and application-limited periods (RFC 4342)
  - rfc3448bis provides more detailed information on the `how' and is used as basis of implementation
- Use RTT estimate from *Request* exchange
  - as suggested in erratum to RFC 4342
  - again detailed documentation is missing, so rfc3448bis is used as basis of implementation

RFC Compliance Gaps

- ECN support (globally)
- CCID3
  - Loss Intervals Option (RFC 4342)
  - History Discounting (RFC 3448 optional)
  - Preventing Oscillations (RFC 3448 optional)
- Need to complete gap analysis with RFC
  - to show what is still missing
  - or wrong.

Next Steps

- documentation & extension for socket API
- e.g. changing CCIDs via socket options
- ...

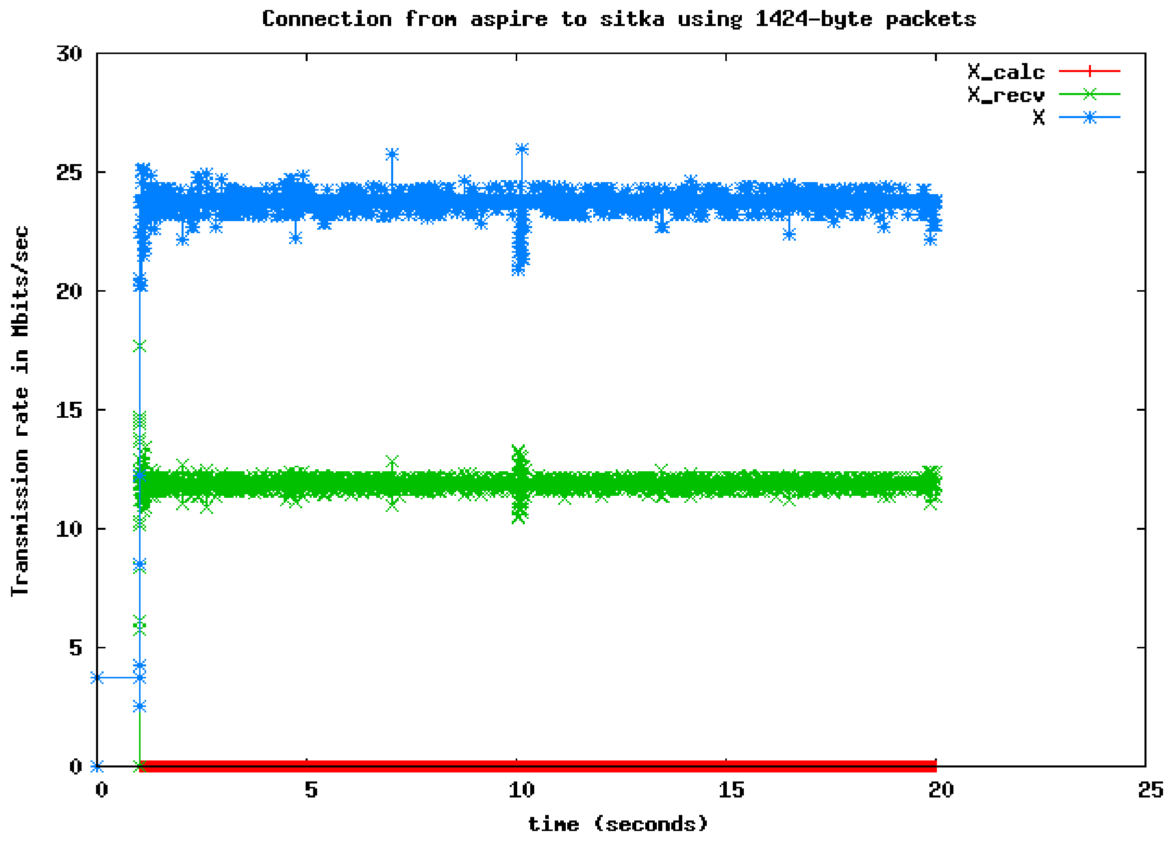
Availability

- merging of further fixes planned for March
- about *75 patches in the pipeline*
- on list/website, but won't be in 2.6.21

Experiences

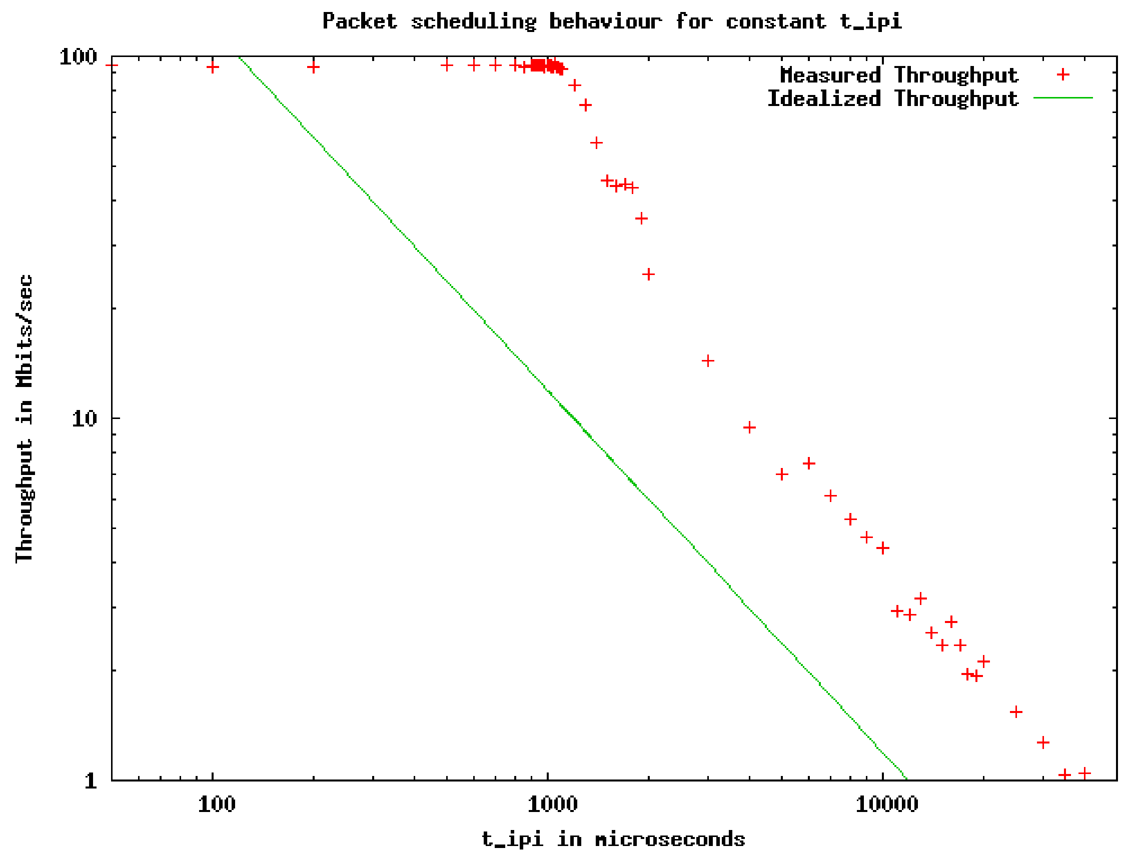
(Additional Information)

Built-in Kernel Instrumentation



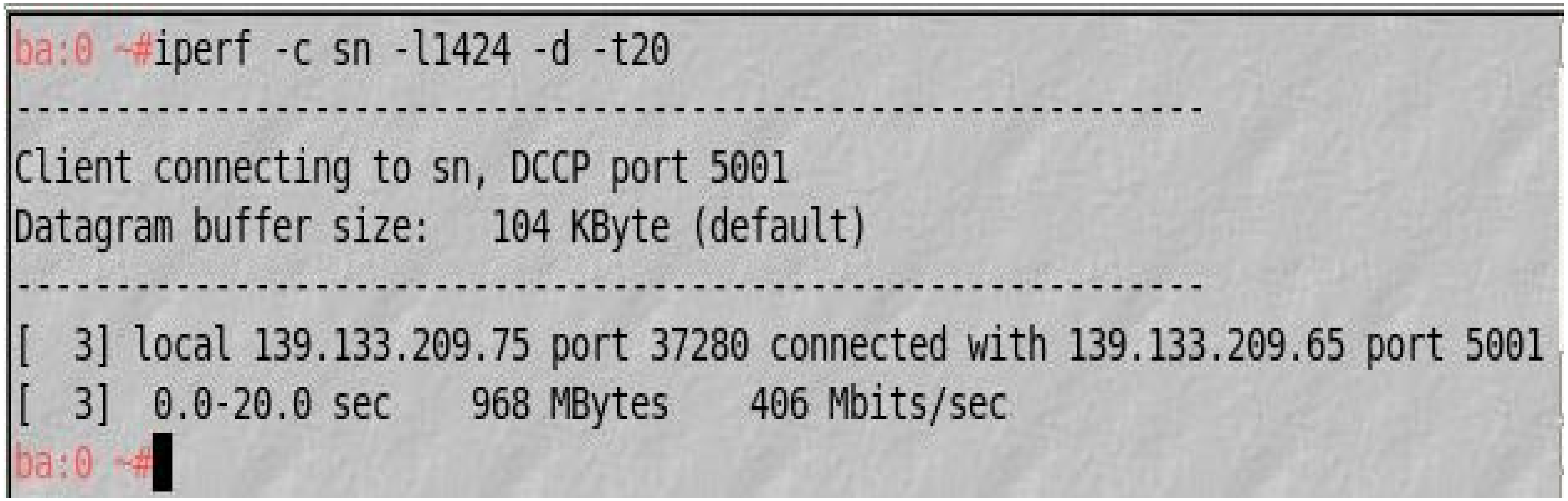
- *<u>shown</u>:* plot from a kernel run using dccp_probe
- for *performance analysis* and *fine-tuning*

Limits of Scheduling Granularity



- *shown*: throughput = f(fixed *t_ipi*)
- no control below *t_ipi* = 1000ms = *t_gran*.

Uncontrollable Speeds in CCID 3



```
ba:0 ~#iperf -c sn -l1424 -d -t20
------------------------------------------------------------
Client connecting to sn, DCCP port 5001
Datagram buffer size:   104 KByte (default)
------------------------------------------------------------
[  3] local 139.133.209.75 port 37280 connected with 139.133.209.65 port 5001
[  3]  0.0-20.0 sec    968 MBytes    406 Mbits/sec
ba:0 ~#
```

- admits of GB speed, but no (congestion) control
- limit of controllable speed given by *t_gran*
- *live with this limitation or use (real-time) fix?*

Idle Periods

- RFC3448: **if p >0 then**
  X = max(min(X_calc, 2*X_recv), s/t_mbi)
- If feedback given once per RTT then
  - after 1 RTT of no transmission **X_recv** close to 0;
  - therefore **X** becomes close to 0
- RFC3448 says
  - feedback rate is *at least once per RTT* or if interval is slower then one packet per RTT, *feedback every packet*
  - So if application idle occurs, basically start again
- TFRC Faster-Restart will help

Open Issues

- Accumulation of Send Credits
  - Basically $t\_nom_{n+1} = t\_nom_{n} + t\_ipi$
  - If idle or not sending slower than allowed
    - then t_nom will be way behind current time
    - which allows unlimited sending for a period
  - Proposals discussed on list ==> rfc3448bis
- Window Counter RTT Sampling (RFC 4342)
  - RTT needed for computing *first loss interval* / X_recv
  - receive times differ from send times (high variance)
  - time (ACK) compression (Zhang '91 / Mogul '92) ?

Conclusions

- Many bug fixes so far
  - not all committed to mainline yet
  - latest patch sets kept online
  - see mailing list (dccp@vger.kernel.org)
- User / application experience missing
  - but interest is perceivable (growing?)
  - paraslash audio streamer runs on dccp
- In good shape and getting better