Adaptive Video Streaming A Survey and Case Study

HU, Pili

http://personal.ie.cuhk.edu.hk/~hpl011/

December 19, 2011

Landscape of Adaptive Video Streaming

- MDC, MLC.
- Multicast(1996), Unicast(2001), P2P(still chaos)
- ASTRI:
 - Current Version: multi channel layered VoD (real deployment)
 - Simulation platform: single channel fixed initial layer VoD (trial version, [wen, 2010])

Landscape of Adaptive Video Streaming

Version Trees

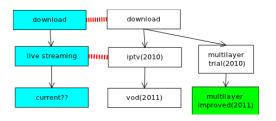


Figure: Version Tree of Real and Simulation

Blue: Real deployment

While: Simulation platform

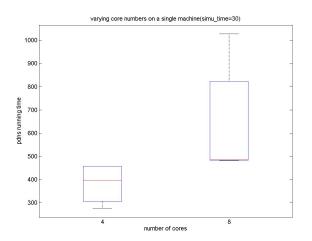
• Green: This work

Red dash: Equivalency



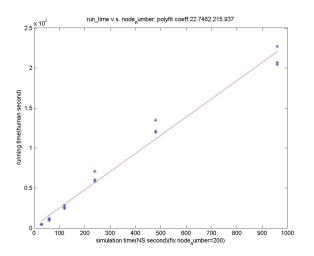
Performance Benchmark

runtime v.s. # of core



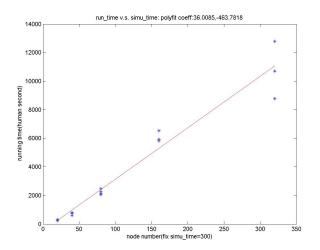
Performance Benchmark

runtime v.s. simulation time



Performance Benchmark

runtime v.s. # of nodes



Simulation Confuguration

Basic Settings

Number of Nodes: 160

Simulation Time: 300 (NS seconds)

Simulation Confuguration

Topology and Capacity

Wen Zheng's configuration:

- Star like, 4 subnet.
- Subnet parameters:
 - Subnet1: down:10Mb; up:10Mb.
 - Subnet1: down:3Mb; up:0.5Mb.
 - Subnet1: down:3Mb; up:0.5Mb.
 - Subnet1: down:3Mb; up:0.5Mb.

Simulation Confuguration

Layers

- 3 Layers. Conform to [wang,2011] QoE study.
- Layer parameters:
 - Layer1: 256Kbit. (per piece)
 - Layer2: 256Kbit. (per piece)
 - Layer3: 512Kbit. (per piece)

Cumulative layer piece size is: 256, 512, 1024 (Kbit).

QoE Model Adopted

[wang, 2011], B-D tradeoff, continuous version.

$$MOS = c_1 \times d + \alpha \times (1 - e^{-b \times \lambda}) + c_2$$
 (1)

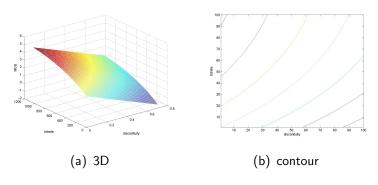
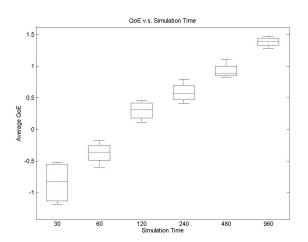


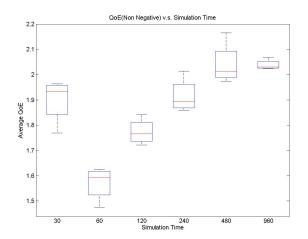
Figure: Conclusion, QoE and Performance

Baseline Test QoE v.s. simulation time



Baseline Test

QoE(nonneg) v.s. simulation time



Baseline Test: A Sample Run

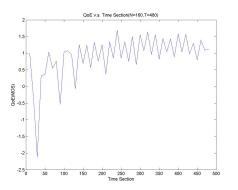
Configuration

- $'count_mr' => 3749$
- 'count_mr_nonneg' => 2601
- 'avg_qoe' =>' 0.871540677419684'
- 'avg_qoe_nonneg' =>' 2.01996612593628'
- 'node_num' =>' 160'
- 'simu_time' =>' 480'
- 'core_num' =>' 4'
- 'task_duration' => 8399
- 'pdns_duration' => 8302



Baseline Test: A Sample Run

QoE v.s. time slot

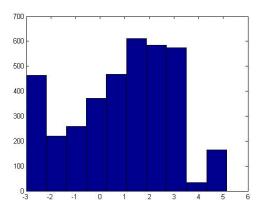


Observations:

- System bootstraping stage.
- Steady after about 250 seconds.

Baseline Test: A Sample Run

histogram of 3749 QoE reports



Version2: Unified Architecture

original framework

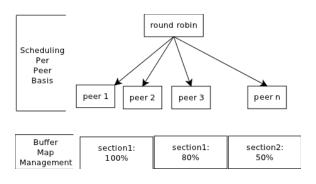


Figure: Original Architecture

Version2: Unified Architecture

unified framework

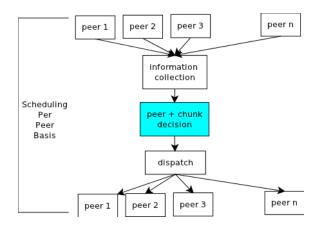


Figure: Improved Architecture

Version2: Unified Architecture

PALS like strategy

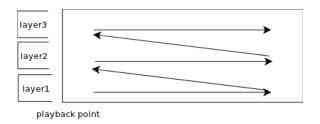


Figure: Improved Architecture

Effect:

• QoE: $0.7 \to 3.3$

Version3: Priority Based

framework

Table: A Sample Priority Table with Window Size = 5

	t1	t2	t3	t4	t5
layer3	11	12	13	14	15
layer2	6	7	8	9	10
layer1	1	2	3	4	5

Result:

- QoE: nearly the same.
- Performance: decrease slightly.

Version4: Scalable Window

Reason

Reason:

- From trace, many powerful peeers can get full 3 layers in the whole window.
- Give them a chance to download more, and their data far from playback pointer can server others.

Table: A Sample Priority Table with Window Size = 5+5

	t1	t2	t3	t4	t5	t6-t10
layer3	11	12	13	14	15	
layer2	6	7	8	9	10	
layer1	1	2	3	4	5	

Version4: Scalable Window

Table: A Sample Priority Table with Window Size = 5+5

	t1	t2	t3	t4	t5	t6-t10
layer3	11	12	13	14	15	
layer2	6	7	8	9	10	
layer1	1	2	3	4	5	

Result:

Framework

- QoE: nearly the same.
- Performance: decrease drastically.



Version5: Performance Optimization

running profile

```
===10213===profile====
Each sample counts as 0.01 seconds.
    cumulative
                 self
                                    self
                                              total
       seconds
                 seconds
                             calls ms/call ms/call name
7.13
         49.60
                  49.60
                                                      TclExecuteByteCode
5.34
         86.75
                  37.15
                                                      Tcl FindHashEntry
2.96
        107.37
                  20.61
                                                      Tcl NewStringObj
2.57
        125.23
                  17.86
1.91
        138.56
                  13.32
                                      8.49
                                                3.75 DownloadApp::requestData3(
1.63
        149.91
                  11.36
1 49
        160.28
                  10.37
                                                      ResetObiResult
```

```
====10215===prifile====
Each sample counts as 0.01 seconds.
    cumulative
                 self
                                   self
                                            total
time
       seconds
                 seconds
                            calls ms/call ms/call name
7.29
         47.95
                                                     TclExecuteByteCode
                  47.95
5.42
         83.61
                  35.67
                                                     Tcl FindHashEntry
3.01
        103.42
                  19.80
                                                     Tcl NewStringObi
                                                     TclLookupSimpleVar
        121.84
                  18.42
        133.40
                  11.55
                                               3.59 DownloadApp::collect inforan
                           24660
                                     0.47
tion 1(int, int, int, BufferMapStatus (*) [120], std::set<unsigned int, std::le
ss<unsigned int>, std::allocator<unsigned int> >&, int&, int&)
0.15
        544.08
                   1.00
                           27045
                                               3.69 DownloadApp::requestData4()
        639.08
                           24660
                                     0.00
                                               0.10 DownloadApp::check request a
nd_collect_inforamtion_2(_BufferMapStatus (*) [120], int, int, int&)
```

Figure: GNU Profile, Output

Version5: Performance Optimization

Result:

QoE: nearly the same.

Performance: $4.5h \rightarrow 3.5h$.

Version6: Random Second Window Section

strategy

Result:

- QoE: worse.
- Performance: worse.

Conclusion

6 big versions comparison

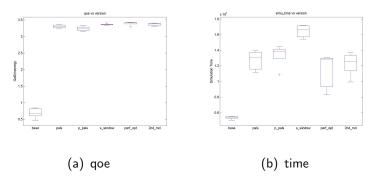


Figure: Conclusion, QoE and Performance

Conclusion

5 enhanced versions comparision(detail)

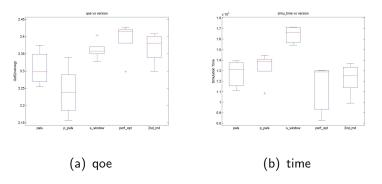


Figure: Conclusion, QoE and Performance

Closing Remarks

- Engineering approach v.s. academic approach: where is the biggest cake?
- Time distribution:
 - 70%, literature survey.(30+ papers)
 - 15%, bugfix of the platform, environment setup.
 - 5%, first unified version(QoE:0.7→3.3, biggest improvement in this study)
 - 10%, scalable window, performance optimization, random 2nd section. (little outcome)

Toolset

find it on my homepage

```
File Edit View Search Terminal Help
                                    s./task-show.pl
                                              '5dfc5da1cb9d4eb6ecf0aea26ad65245d43c1b04' => -
                                                                                             'time start' => '111219-132423-1324272263',
File Edit View Search Terminal Help
                                                                                             'time' => '111219-132358-1324272238'
                                                                                             'status' => 'running'.
S./make.sh &> /dev/null
                                                                                              'name' => '18241
                                                                                              'uuid' => '5dfc5dalcb9d4eb6ecf8aea26ad65245d43c1b84'.
                                                                                             'machine' => 'me'
                                                                                              'exec' => ' ./run.sh
$./newtask.sh "showcase"
                                              '6c497889382de55daef84238397ce66d9f9e28e2' => {
[master 7f0f6ec] [simulation counter......
1 files changed, 1 insertions(+), 1 deletions(-)
                                                                     File Edit View Search Terminal Help
          'time' => '111219-132357-1324272237'.
                                                                     top - 13:26:08 up 158 days, 21:43, 6 users, load average: 9.64, 3.36, 1.24
          'name' => '10248'.
                                                                     Tasks: 491 total, 14 running, 477 sleeping, 0 stopped, 0 zombie
          'uuid' => '6c497889382de55daef84238397ce66d9f9e28e2'.
                                                                    Cpu(s): 75.0%us, 0.4%sy, 0.0%ni, 24.5%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
          'exec' => ' ./run.shi
                                                                    Mem: 12388856k total, 16827636k used, 1553220k free, 316732k buffers
                                                                     Swap: 14483452k total. 258288k used, 14225244k free, 6575876k cached
$ /newtask sh "showcase"
[master 8908aa0] [simulation counter: 10241][user message:showcase]
                                                                                                                        1:42.54 pdns.10241
1 files changed, 1 insertions(+), 1 deletions(-)
                                                                     7496 plhu
                                                                                        0 76412 61m 4860 R 99.2 8.5
                                                                                                                        1:42.48 pdns.18241
SVAR1 = {
                                                                                                                        1:42.59 pdns.18241
                                                                                                 75m 4880 R 99.2 0.6
          'time' => '111219-132358-1324272238'.
                                                                     7498 plhu
                                                                                                  75m 4888 R 99.2 8.6
                                                                                                                        1:42.67 pdns.18241
          'name' => '10241',
                                                                                                                        1:36.21 pdns.10240
                                                                     7616 plhu
                                                                                                 59m 4860 R 99.2 8.5
          'uuid' => '5dfc5da1cb9d4eb6ecf0aea26ad65245d43c1b04'
                                                                                                 71m 4880 R 99.2 0.6
                                                                                                                        1:36.30 pdns.10240
          'exec' => ' ./run.sh'
                                                                     7619 plhu
                                                                                                 72m 4860 R 99.2 0.6
                                                                                    20 0 71532 57m 4860 R 99.2 0.5
                                                                                                                        1:29.77 pdns.10242
$. /newtask.sh "showcase"
                                                                     7740 plhu
                                                                                    20 0 71532 57m 4860 R 99.2 0.5
                                                                                                                        1:29.64 pdns.18242
                                                                                    20 0 74164 59m 4880 R 98.9 0.5
                                                                                                                        1:36.23 pdns.18248
[master 7e5196e] [simulation counter: 10242][user message:showcase]
                                                                                    20 0 71532 57m 4860 R 98.9 0.5
                                                                                                                        1:29.58 pdns.18242
1 files changed, 1 insertions(+), 1 deletions(-)
                                                                     7738 plhu
                                                                                        0 71528 57m 4860 R 98.9 0.5
                                                                                                                        1:29.78 pdns.18242
                                                                     18167 kmchan
                                                                                    20 0 3800m 1.9g 1.9g S 3.0 15.8 5854:55 VirtualBox
          'time' => '111219-132359-1324272239',
                                                                                    20 0 210n 4348 3116 S 1.3 0.0 8:29.30 smbd
                                                                     29149 plhu
                                                                     15110 plhu
                                                                                    20 0 15508 1624 936 S 1.0 0.0 23:07.49 top
          'uuid' => 'le9d808leea726f75aafcae19c2fd5572d0447b7'.
          'exec' => ' ./run.sh
```

Figure: Lightweight Distributing Toolset

Thanks some statistics

Thanks!

Some statistics:

- 6 big versions / 240 runs.
- Auxilary Scripts:
 - .sh:298 lines
 - .pl:791 lines
 - .m:133 lines
- Simulation Code Difference:
 - download_agent.cc: 1940 lines
 - download_agent.h: 301 lines
 - labtesting.tcl: 84 lines

