

NOTED

Network Optimized Transfer of Experimental Data

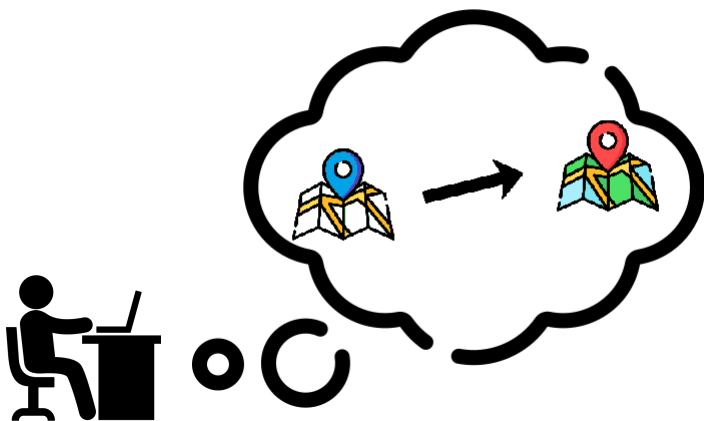
Joanna Waczyńska

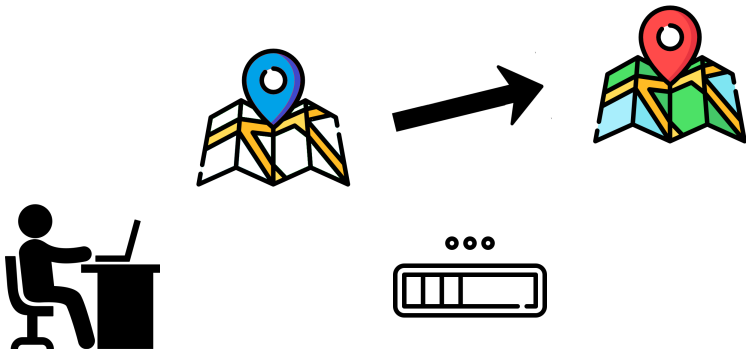
October 12, 2020



Outline

- 1 Problem
- 2 Solution
- 3 Understanding the problem
- 4 Tech side
- 5 Project
- 6 Analyze
- 7 Conclusion v1
- 8 Real-Life Examples
- 9 Conclusion v2





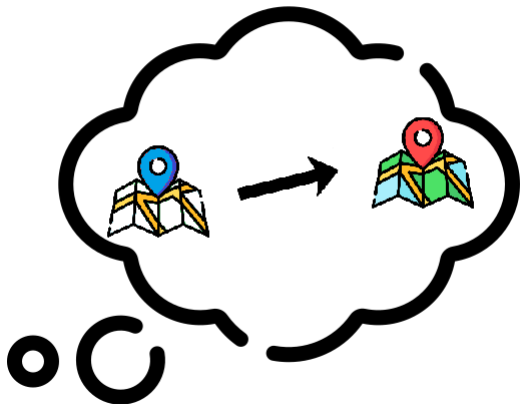
Icons made by Freepik from www.flaticon.com

What happened?



Icons made by Freepik from www.flaticon.com

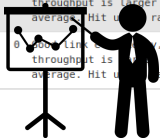
Is it problem with network overloading?



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History of transfer presented in FTS

Timestamp	Decision	Running	Queue	Success rate (last 1min)	Throughput	EMA	Diff	Explanation
2020-09-14T12:59:14Z	100	102	780	100.00%	970.26 MiB/s	960.22 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-09-14T12:58:06Z	100	102	798	100.00%	980.63 MiB/s	959.10 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-09-14T12:56:59Z	100	109	836	100.00%	984.99 MiB/s	956.71 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-09-14T12:55:51Z	100	99	842	100.00%	988.25 MiB/s	953.56 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
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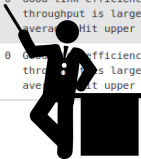
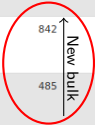


FTS – File Transfer Service at CERN

Icons made by Freepik from www.flaticon.com

History of transfer presented in FTS

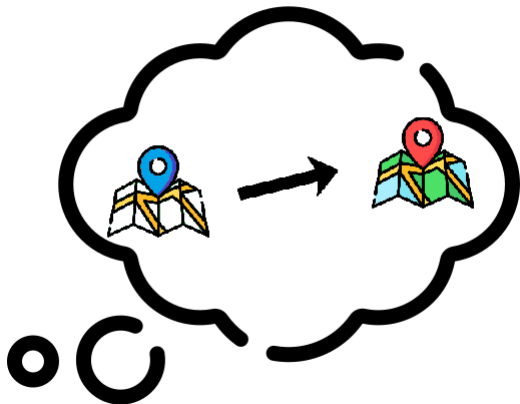
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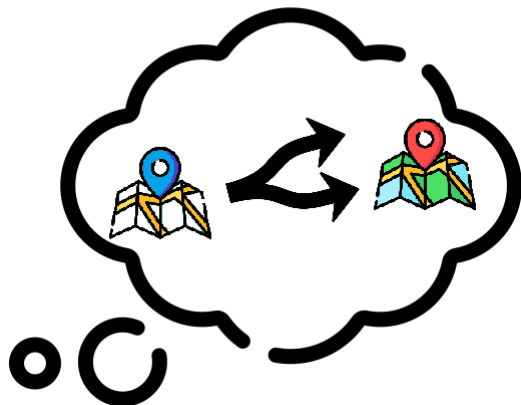
Icons made by Freepik from www.flaticon.com

Idea



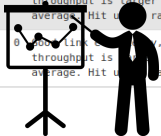
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Idea



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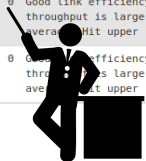
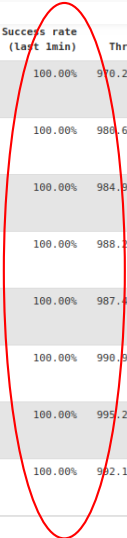
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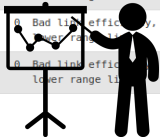
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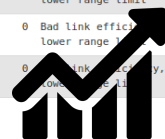
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2020-09-14T12:52:45Z	2	6	1053	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T12:46:16Z	2	4	1034	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T12:40:16Z	2	6	1044	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T12:33:54Z	2	12	1027	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T12:27:23Z	2	4	1034	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T12:20:21Z	2	6	1014	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
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2020-09-14T12:02:49Z	2	6	1053	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit
2020-09-14T11:56:21Z	2	3	963	0.00%	0 bytes/s	0 bytes/s	0	Bad link efficiency, no changes. Hit lower range limit



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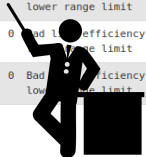
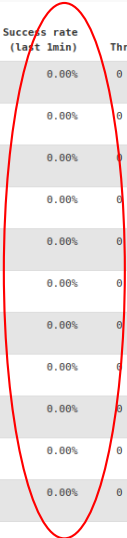
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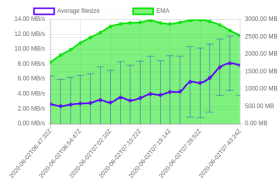
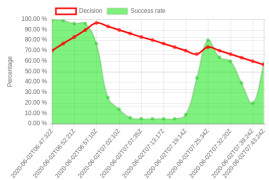
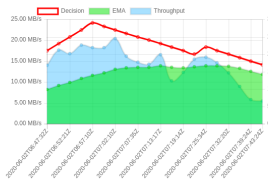


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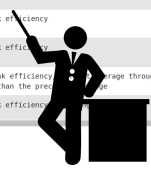
Polling time!

Details for `srm://dcsrm.usatlas.bnl.gov → gsiftp://se-iep-grid.saske.sk`



First Previous 1 Next Last

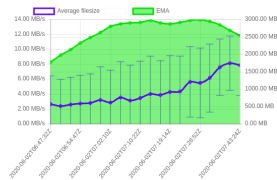
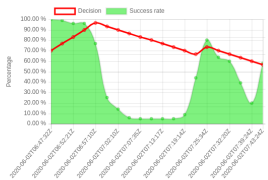
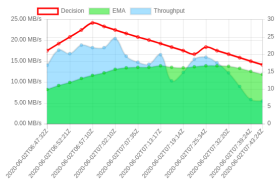
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2020-06-02T07:43:24Z	17	18	1733	58.00%	5.44 MiB/s	11.83 MiB/s	-1	Bad link efficiency, no changes
2020-06-02T07:39:24Z	18	19	1726	20.00%	5.80 MiB/s	12.54 MiB/s	-1	Bad link efficiency
2020-06-02T07:35:51Z	19	21	1719	39.00%	8.99 MiB/s	13.29 MiB/s	-1	Bad link efficiency
2020-06-02T07:32:20Z	20	21	1715	60.00%	12.27 MiB/s	13.76 MiB/s	-1	Bad link efficiency
2020-06-02T07:28:52Z	21	22	1711	64.00%	14.57 MiB/s	13.93 MiB/s	-1	Bad link efficiency
2020-06-02T07:25:34Z	22	22	1705	80.00%	15.97 MiB/s	13.86 MiB/s	2	Good link efficiency, average throughput is larger than the previous
2020-06-02T07:22:19Z	20	24	1704	44.00%	15.51 MiB/s	13.62 MiB/s	-1	Bad link efficiency



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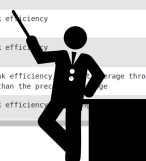
Problematic situations

Details for `srm://dcsrm.usatlas.bnl.gov → gsiftp://se-iep-grid.saske.sk`



First Previous 1 Next Last

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Active transfers

- Average of the last quarter success Rate is higher than the set limit (now 74%), or the last success Rate was higher than the set limit (now 74%).
- Last decision was higher than 2.
- The last report about transfer was observed in the last 15 minutes.

What do we need to take action?



- Source
- Destination
- Vo
- History queue:
 - Time
 - Information about files (Submitted and Active)
 - Information about success rate and throughput



- Sitename
- SeName
- IP prefixes (IPv4, IPv6)



FTS – File Transfer Service at CERN

CRIC – Computing Resource information Catalog

FTS - Tech side



Grafana



elasticsearch

+

`./jq`

CRIC - Tech side



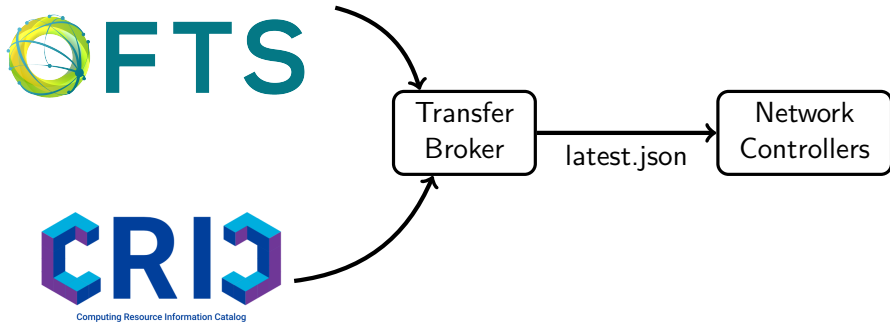
Computing Resource Information Catalog

+

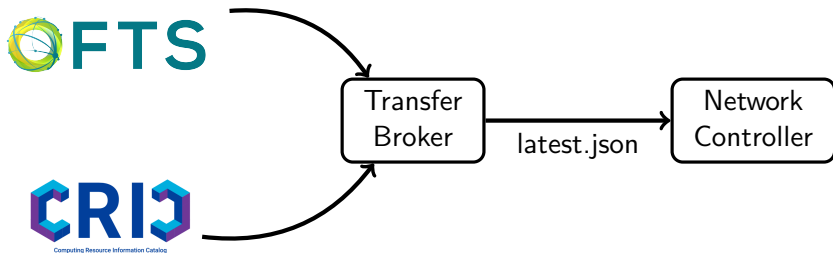
`./jq`

Project

Web site that publishes the json file with all the active transfers, so network controllers can take optimization actions on their network.



My previous work



- Obtain transfer start & size information about transfers.
- Find large data transfers.
- Identification transfers.
- Analyze data and add extra estimators.

Result

```

1  },
2  "SourceSiteName": "CERN-PROD",
3  "DestinationSiteName": "RAL-LCG2"
4  },
5  "Transfers": {
6  "Active": {
7  "SubmittedCount": 1,
8  "ActiveCount": 32,
9  "Throughput": 60423596,
10 "ETN": 561907070.55522,
11 "Size": 1144028957.32383,
12 "Queues": {
13 "Source": "gsiftp://essatlasfpp.cern.ch",
14 "Destination": "gsiftp://gridftp.ectd.ed.ac.uk",
15 "EndPoint": "fts3-atlas.cern.ch",
16 "Last": {
17 "SubmittedCount": 0,
18 "ActiveCount": 16,
19 "AvgFileSize": 3975186207.2821275,
20 "Comment": "Queue emptying. In",
21 "Decision": 100,
22 "Throughput": 182917046,
23 "ThroughputEta": 546351878.307
24 },
25 "BulkTime": {
26 "Value": 359709130981,
27 "StringVal": "2020-08-12 22:09:24.445 +0000 UTC",
28 "UpdateTime": {
29 "Value": 3597272200000,
30 "StringVal": "2020-08-12 22:09:24.445 +0000 UTC",
31 "SuccessRate": 100
32 },
33 "PredictEndTime": "",
34 "AvgFileSize": 3975186207.2821275,
35 "AvgSuccessRateLastQuarter": 100,
36 "ETN": 3118347221.704375
37 },
38 "Inactive": {
39 "SubmittedCount": 0,
40 "ActiveCount": 11,
41 "Throughput": 59815621,
42 "ETN": 60423767.3190662,
43 "Size": 114402895770.32383,
44 "Queues": {
45 "Source": "gsiftp://essatlasfpp.cern.ch",
46 "Destination": "gsiftp://sm.glate.ecdf.ed.ac.uk",
47 "EndPoint": "fts3-atlas.cern.ch",
48 "Last": {
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692 "AvgSuccessRateLastQuarter": 100,
693 "ETN": 561907070.55522,
694 "Size": 1144028957.32383,
695 "Queues": {
696 "Source": "gsiftp://essatlasfpp.cern.ch",
697 "Destination": "gsiftp://gridftp.ectd.ed.ac.uk",
698 "EndPoint": "fts3-atlas.cern.ch",
699 "Last": {
700 "SubmittedCount": 0,
701 "ActiveCount": 16,
702 "AvgFileSize": 3975186207.2821275,
703 "Comment": "Queue emptying. In",
704 "Decision": 100,
705 "Throughput": 182917046,
706 "ThroughputEta": 546351878.307
707 },
708 "BulkTime": {
709 "Value": 359709130981,
710 "StringVal": "2020-08-12 22:09:24.445 +0000 UTC",
711 "UpdateTime": {
712 "Value": 3597272200000,
713 "StringVal": "2020-08-12 22:09:24.445 +0000 UTC",
714 "SuccessRate": 100
715 },
716 "PredictEndTime": "",
717 "AvgFileSize": 3975186207.2821275,
718 "AvgSuccessRateLastQuarter": 100,
719 "ETN": 3118347221.704375
720 },
721 "Inactive": {
722 "SubmittedCount": 0,
723 "ActiveCount": 11,
724 "Throughput": 59815621,
725 "ETN": 60423767.3190662,
726 "Size": 114402895770.32383,
727 "Queues": {
728 "Source": "gsiftp://essatlasfpp.cern.ch",
729 "Destination": "gsiftp://sm.glate.ecdf.ed.ac.uk",
730 "EndPoint": "fts3-atlas.cern.ch",
731 "Last": {
732 "SubmittedCount": 0,
733 "ActiveCount": 1,
734 "AvgFileSize": 5700794839,
735 "Comment": "Bad link efficiency. Too many streams",
736 "Decision": 40,
737 "Throughput": 7118280,
738 "ThroughputEta": 9050105.406375548,
739 "BulkTime": {
740 "Value": 0,
741 "StringVal": "
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Result

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Result

```

},
"Destination": {
  "SeName": "UK-T1-RAL",
  "Sites": [
    {
      "Name": "LCG.RAL.uk",
      "Vo": "lhcb",
      "TierLevel": 0
    },
    {
      "Name": "RAL-LCG2",
      "Vo": "lhcb",
      "TierLevel": 0
    }
  ],
  "Site": "RAL-LCG2",
  "Prefixes": [
    "IPV4": [
      "130.246.152.240/28",
      "130.246.176.0/22"
    ],
    "IPV6": [
      "2001:630:58:1820::/64"
    ]
  ]
}

```

```

"SubmittedCount": 0,
"ATP": 1,
"AvgFileSize": 5700796839,
"Comment": "Bad link efficiency - too many streams",
"Decision": 40,
"Throughput": 7118200,
"ThroughputEst": 9050105.406375548,
"BulkTime": {
  "Value": 0,
  "StringValue": "2020-08-12 21:57:43.17 +0000 UTC"
},
"UpdateTime": 4

```

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},
"UpdateTime": {
  "Value": "2020-08-12 22:09:24.445 +0000 UTC"
},
"SuccessRate": 1
},
"PredictEndTime": "",
"AvgFileSize": 5700796839,
"AvgsuccessRateLastQuarter": -1,
"ETN": -1
},
"Traffic": 12597215232,
"Source": {
  "SeName": "CN-CERN",
  "Site": {
    "Name": "CERN",
    "Vo": "alice",
    "TierLevel": 0
  },
  "Site": "CERN-PROD",
  "Prefixes": [
    "IPV4": [
      "129.130.0.0/16",
      "188.185.128.0/17",
      "188.185.128.0/17",
      "188.185.48.0/20"
    ],
    "IPV6": [
      "2001:1458:301::/48",
      "2001:1458:302::/48",
      "2001:1458:303::/48",
      "2001:1459:301::/48",
      "2001:1459:303::/48"
    ]
  ]
},
"Destination": {
  "SeName": "UK-T1-RAL",
  "Sites": [
    {
      "Name": "LCG.RAL.uk",
      "Vo": "lhcb",
      "TierLevel": 0
    },
    {
      "Name": "RAL-LCG2",
      "Vo": "lhcb",
      "TierLevel": 0
    }
  ],
  "Site": "RAL-LCG2",
  "Prefixes": [
    "IPV4": [
      "130.246.152.240/28",
      "130.246.176.0/22"
    ],
    "IPV6": [
      "2001:630:58:1820::/64"
    ]
  ]
}

```


Result

```

1
2
3
4 "Path": {
5   "SourceSiteName": "CERN-PROD",
6   "DestinationSiteName": "RAL-LCG2"
7 },
8 "Transfers": {
9   "Active": {
10    "SubmittedCount": 1,
11    "ActiveCount": 32,
12    "Throughput": 369823596,
13    "ETN": 5619870720.553522,
14    "Size": 114402095770.32303,
15    "Queues": [
16     {
17      "Source": "gsiftp://eosatlassf
18      "Destination": "gsiftp://grid
19      "FtsEndpoint": "fts3-atlas.co
20     },
21     "Last": {
22      "SubmittedCount": 0,
23      "ActiveCount": 16,
24      "AvgFileSize": 3975186207.2021275,
25      "Comment": "Queue emptyin
26      "Decision": 100,
27      "Throughput": 182917046,
28      "ThroughputEma": 546351878.3872554,
29      "BulkTime": {
30       "Value": 1597269136981,
31       "StringVal": "2020-08-12 21:52:16.981 +0000 UTC"
32      },
33      "UpdateTime": {
34       "Value": 1597272206580,
35       "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
36      },
37      "SuccessRate": 100
38     },
39     "PredictEndTime": "",
40     "AvgFileSize": 3975186207.2021275,
41     "AvgSuccessRateLastQuarter": 100,
42     "ETN": 3118347221.7604375
43    ],
44   },
45   "Inactive": {
46    "SubmittedCount": 0,
47    "ActiveCount": 11,
48    "Throughput": 59815621,
49    "ETN": 60223767.3196562,
50    "Size": 14402095770.32303,
51    "Queues": [
52     {
53      "Source": "gsiftp://eosatlassf
54      "Destination": "gsiftp://sm
55      "FtsEndpoint": "fts3-atlas.co
56     },
57     "Last": {
58      "SubmittedCount": 0,
59      "ActiveCount": 1,
60      "AvgFileSize": 5700794839,
61      "Comment": "Bad link eff
62      "Decision": 100,
63      "Throughput": 118290,
64      "ThroughputEma": 1050105,
65      "BulkTime": {
66       "Value": 0,
67       "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
68      },
69      "UpdateTime": {
70       "Value": 0,
71       "StringVal": ""
72      },
73      "SuccessRate": 100
74     },
75     "PredictEndTime": "",
76     "AvgFileSize": 5700794839,
77     "AvgSuccessRateLastQuarter": 100,
78     "ETN": 5700794839.0
79    ],
80   },
81   "Inactive": {
82    "SubmittedCount": 0,
83    "ActiveCount": 11,
84    "Throughput": 59815621,
85    "ETN": 60223767.3196562,
86    "Size": 14402095770.32303,
87    "Queues": [
88     {
89      "Source": "gsiftp://eosatlassf
90      "Destination": "gsiftp://sm
91      "FtsEndpoint": "fts3-atlas.co
92     },
93     "Last": {
94      "SubmittedCount": 0,
95      "ActiveCount": 1,
96      "AvgFileSize": 5700794839,
97      "Comment": "Bad link eff
98      "Decision": 100,
99      "Throughput": 118290,
100     "ThroughputEma": 1050105,
101     "BulkTime": {
102      "Value": 0,
103      "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
104     },
105     "UpdateTime": {
106      "Value": 0,
107      "StringVal": ""
108     },
109     "SuccessRate": 100
110    ],
111   }
112 }

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```

"Active": {
  "SubmittedCount": 1,
  "ActiveCount": 32,
  "Throughput": 369823596,
  "ETN": 5619870720.553522,
  "Size": 114402095770.32303,
  "Queues": [
    {
      "Source": "gsiftp://eosatlassf
      "Destination": "gsiftp://grid
      "FtsEndpoint": "fts3-atlas.co
    },
    "Last": {
      "SubmittedCount": 0,
      "ActiveCount": 16,
      "AvgFileSize": 3975186207.2021275,
      "Comment": "Queue emptying. Hold on.. Too many streams",
      "Decision": 100,
      "Throughput": 182917046,
      "ThroughputEma": 546351878.3872554,
      "BulkTime": {
        "Value": 1597269136981,
        "StringVal": "2020-08-12 21:52:16.981 +0000 UTC"
      },
      "UpdateTime": {
        "Value": 1597272206580,
        "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
      },
      "SuccessRate": 100
    },
    "PredictEndTime": "",
    "AvgFileSize": 3975186207.2021275,
    "AvgSuccessRateLastQuarter": 100,
    "ETN": 3118347221.7604375
  ],
  "Inactive": {
    "SubmittedCount": 0,
    "ActiveCount": 11,
    "Throughput": 59815621,
    "ETN": 60223767.3196562,
    "Size": 14402095770.32303,
    "Queues": [
      {
        "Source": "gsiftp://eosatlassf
        "Destination": "gsiftp://sm
        "FtsEndpoint": "fts3-atlas.co
      },
      "Last": {
        "SubmittedCount": 0,
        "ActiveCount": 1,
        "AvgFileSize": 5700794839,
        "Comment": "Bad link eff
        "Decision": 100,
        "Throughput": 118290,
        "ThroughputEma": 1050105,
        "BulkTime": {
          "Value": 0,
          "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
        },
        "UpdateTime": {
          "Value": 0,
          "StringVal": ""
        },
        "SuccessRate": 100
      },
      "PredictEndTime": "",
      "AvgFileSize": 5700794839,
      "AvgSuccessRateLastQuarter": 100,
      "ETN": 5700794839.0
    ],
    "Inactive": {
      "SubmittedCount": 0,
      "ActiveCount": 11,
      "Throughput": 59815621,
      "ETN": 60223767.3196562,
      "Size": 14402095770.32303,
      "Queues": [
        {
          "Source": "gsiftp://eosatlassf
          "Destination": "gsiftp://sm
          "FtsEndpoint": "fts3-atlas.co
        },
        "Last": {
          "SubmittedCount": 0,
          "ActiveCount": 1,
          "AvgFileSize": 5700794839,
          "Comment": "Bad link eff
          "Decision": 100,
          "Throughput": 118290,
          "ThroughputEma": 1050105,
          "BulkTime": {
            "Value": 0,
            "StringVal": "2020-08-12 22:43:26.58 +0000 UTC"
          },
          "UpdateTime": {
            "Value": 0,
            "StringVal": ""
          },
          "SuccessRate": 100
        },
        "PredictEndTime": "",
        "AvgFileSize": 5700794839,
        "AvgSuccessRateLastQuarter": 100,
        "ETN": 5700794839.0
      ],
    }
  ]
}

```



Many transfers were matched on the same Path

```

"Path": {
  "SourceSiteName": "CERN-PROD",
  "DestinationSiteName": "RAL-LCG2"
},
"Transfers": {
  "Active": {
    "SubmittedCount": 1,
    "ActiveCount": 13,
    "Throughput": 60940021,
    "ETW": 359480269.150575,
    "Size": 3145384043.47393,
    "Queues": [
      {
        "Source": "gsiftp://eosatlasftp.cern.ch",
        "Destination": "gsiftp://gridftp.echo.stfc.ac.uk",
        "FtsEndpoint": "fts3-atlas.cern.ch",
        "Last": {
          "SubmittedCount": 1,
          "ActiveCount": 2,
          "AvgFileSize": 97719060.5,
          "Comment": "Queue emptying. Hold on.. Too many streams",
          "Decision": 100,
          "Throughput": 37635882,
          "ThroughputEma": 39140072.6185891,
          "BulkTime": {
            "Value": 1597743527929,
            "StringVal": "2020-08-18 09:38:47.929 +0000 UTC"
          },
          "UpdateTime": {
            "Value": 1597743527929,
            "StringVal": "2020-08-18 09:38:47.929 +0000 UTC"
          },
          "SuccessRate": 100
        },
        "PredictEndTime": "New bulk. Can not predict time.",
        "AvgFileSize": 97719060.5,
        "AvgSuccessRateLastQuarter": 100,
        "ETW": 88356285.24252993
      }
    ],
    "Source": "gsiftp://eoscesftp.cern.ch",
    "Destination": "srm://srm-cms.gridpp.rl.ac.uk",
    "FtsEndpoint": "lcf1s3.gridpp.rl.ac.uk",
    "Last": {
      "SubmittedCount": 0,
      "ActiveCount": 11,
      "AvgFileSize": 2681672937.49763,
      "Comment": "Queue emptying. Hold on.. Too many streams",
      "Decision": 10,
      "Throughput": 571844519,
      "ThroughputEma": 577679564.5600574,
      "BulkTime": {
        "Value": 1597741121830,
        "StringVal": "2020-08-18 09:58:41.83 +0000 UTC"
      },
      "UpdateTime": {
        "Value": 1597743532303,
        "StringVal": "2020-08-18 09:38:52.303 +0000 UTC"
      },
      "SuccessRate": 100
    },
    "PredictEndTime": "",
    "AvgFileSize": 2681672937.49763,
    "AvgSuccessRateLastQuarter": 100,
    "ETW": 3914136745.116865
  }
}

```

Many transfers were matched on the same Path

```

"Path": {
  "SourceSiteName": "CERN-PROD",
  "DestinationSiteName": "RAL-LCG2"
},
"Transfers": {
  "Active": {
    "SubmittedCount": 1,
    "ActiveCount": 13,
    "Throughput": 60940021,
    "ETW": 358480269.150375,
    "Size": 31453840433.47393,
    "Queues": [
      {
        "Source": "gsiftp://eosatlasftp.cern.ch",
        "Destination": "gsiftp://gridftp.echo.stfc.ac.uk",
        "FtsEndpoint": "fts3-atlas.cern.ch",
        "Last": {
          "SubmittedCount": 1,
          "ActiveCount": 2,
          "AvgFileSize": 977710608.57,
          "Comment": "Queue emptying. Hold on... Too many streams",
          "Decision": 100,
          "Throughput": 37635882,
          "ThroughputEma": 39140072.6185891,
          "BulkTime": {
            "Value": 1597743527929,
            "StringValue": "2020-08-18 09:38:47.929 +0000 UTC"
          },
          "UpdateTime": {
            "Value": 1597743527929,
            "StringValue": "2020-08-18 09:38:47.929 +0000 UTC"
          },
          "SuccessRate": 100
        },
        "PredictEndTime": "New bulk. Can not predict time.",
        "AvgFileSize": 977710608.5,
        "AvgSuccessRateLastQuarter": 100,
        "ETW": 88356285.24252993
      }
    ]
  },
  "Source": "gsiftp://eosatlasftp.cern.ch",
  "Destination": "srm://srm-cms.gridpp.rl.ac.uk",
  "FtsEndpoint": "lcf1s3.gridpp.rl.ac.uk",
  "Last": {
    "SubmittedCount": 0,
    "ActiveCount": 11,
    "AvgFileSize": 2681672937.49763,
    "Comment": "Queue emptying. Hold on... Too many streams",
    "Decision": 10,
    "Throughput": 571844519,
    "ThroughputEma": 57767964.5608574,
    "BulkTime": {
      "Value": 1597741121839,
      "StringValue": "2020-08-18 09:58:41.83 +0000 UTC"
    },
    "UpdateTime": {
      "Value": 1597743523203,
      "StringValue": "2020-08-18 09:38:52.303 +0000 UTC"
    },
    "SuccessRate": 100
  },
  "PredictEndTime": "",
  "AvgFileSize": 2681672937.49763,
  "AvgSuccessRateLastQuarter": 100,
  "ETW": 3934136745.116865
}
}
    
```

"ActiveCount": 13

=

"ActiveCount": 2

+

"ActiveCount": 11

Queue decreases

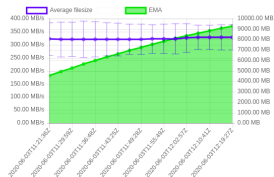
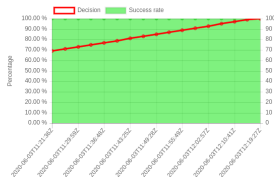
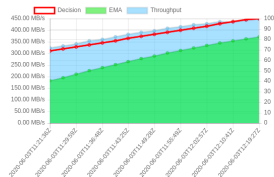


Why would we want to predict the finish time?

Can we predict the finish time?

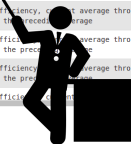
Clear situation

Details for srm://latlassrm-kit.gridka.de → srm://ccsrm.in2p3.fr



First Previous 1 Next Last

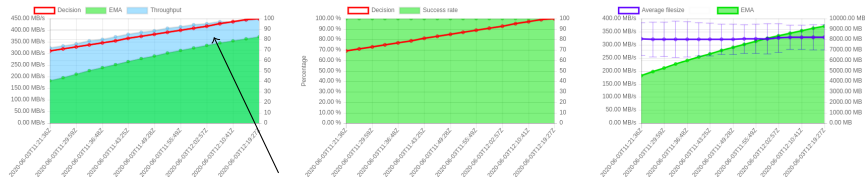
Timestamp	Decision	Running	Queue	Success rate (last 1min)	Throughput	EMA	Diff	Explanation
2020-06-03T12:19:27Z	100	108	551	100.00%	448.34 MiB/s	371.37 MiB/s	1	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-06-03T12:15:09Z	99	97	563	100.00%	442.48 MiB/s	362.82 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T12:10:41Z	97	96	567	100.00%	436.65 MiB/s	353.98 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T12:06:39Z	95	93	572	100.00%	436.42 MiB/s	344.79 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T12:02:57Z	93	91	583	100.00%	428.05 MiB/s	334.61 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T11:59:17Z	91	92	607	100.00%	422.95 MiB/s	324.23 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T11:55:49Z	89	87	626	100.00%	414.37 MiB/s	313.26 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T11:52:07Z	87	86	646	100.00%	408.32 MiB/s	302.03 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average



Icons made by Freepik from www.flaticon.com

Clear situation

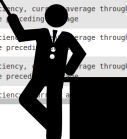
Details for srm://latassrm-kit.gridka.de → srm://ccsrm.in2p3.fr ↗



Throughput was increasing

First Previous 1 Next Last

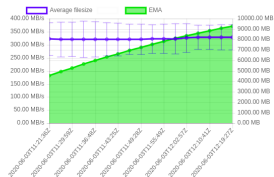
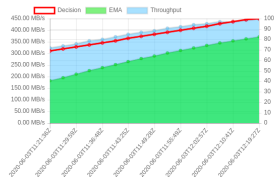
Timestamp	Decision	Running	Queue	Success rate (last 1min)	Throughput	EMA	Diff	Explanation
2020-06-03T12:19:27Z	100	108	551	100.00%	448.34 MiB/s	371.37 MiB/s	1	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
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Icons made by Freepik from www.flaticon.com

Clear situation

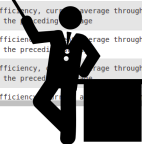
Details for srm://latlassrm-kit.gridka.de → srm://ccsrm.in2p3.fr



First Previous 1 Next Last

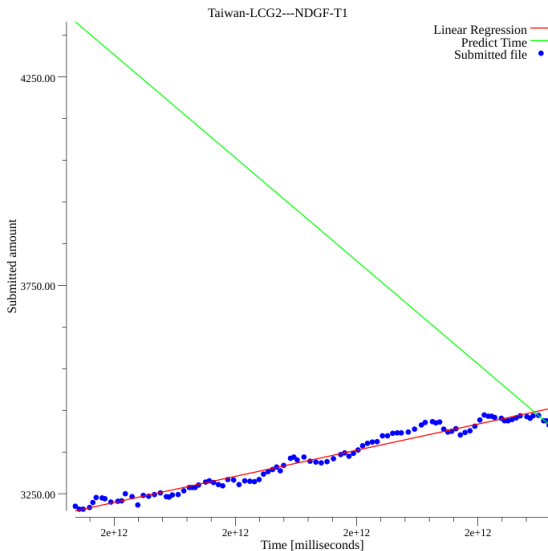
Success rate > 74 %

Timestamp	Decision	Running	Queue	Success rate (last 1min)	Throughput	EMA	Diff	Explanation
2020-06-03T12:19:27Z	100	108	551	100.00%	448.34 MiB/s	371.37 MiB/s	1	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-06-03T12:15:09Z	99	97	563	100.00%	442.48 MiB/s	362.82 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T12:10:41Z	97	96	567	100.00%	436.65 MiB/s	353.98 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
2020-06-03T12:06:39Z	95	93	572	100.00%	436.42 MiB/s	344.79 MiB/s	2	Good link efficiency, current average throughput is larger than the preceding average
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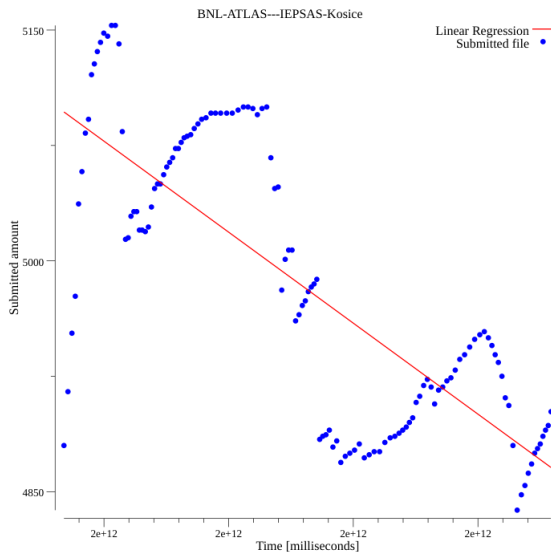


Icons made by Freepik from www.flaticon.com

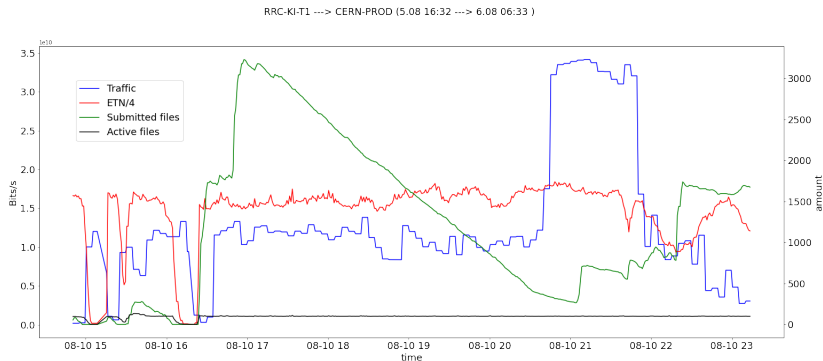
Can we predict finish time?



Can we predict the finish time?



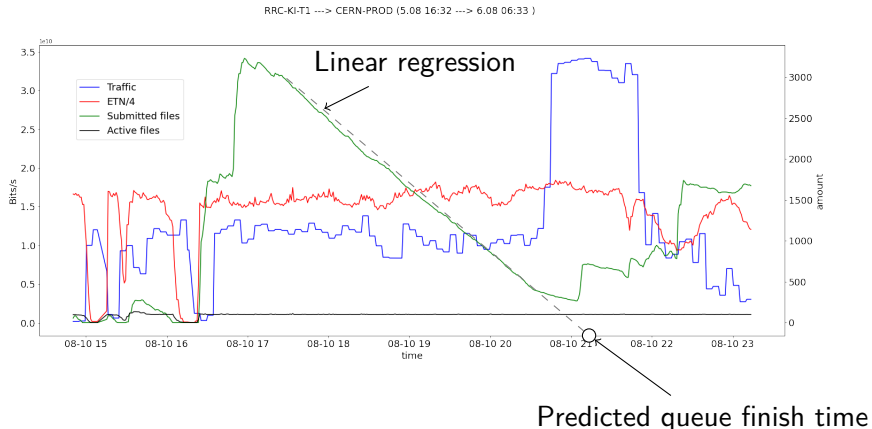
Can we predict the finish time?



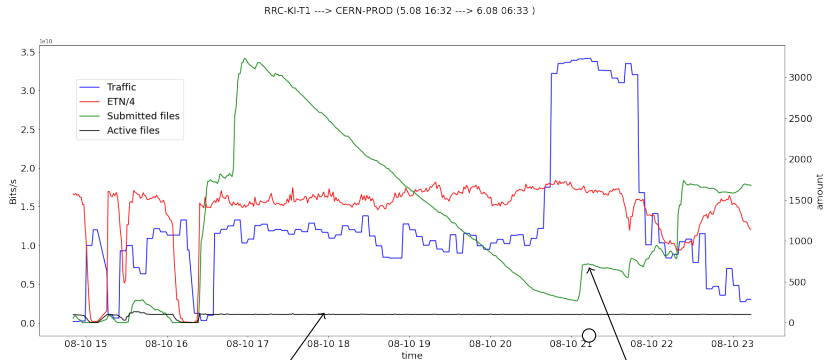
$$\text{ETN (Estimated traffic network)} = \frac{c * \text{Last_AvgFileSize} * \text{Last_ActiveCount}}{\text{time since last report [s]}}, \quad c = \text{const.}$$

We can predict the queue finish time,

but it doesn't mean we can predict when the transfer will finish in this way.



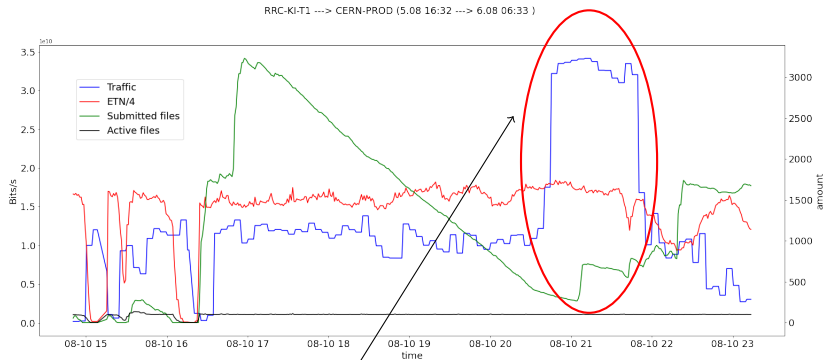
We can predict the queue finish time, but it doesn't mean we can predict when the transfer will finish in this way.



Running transfer associated with 10^{10} [Bits/s] Traffic

New Bulk

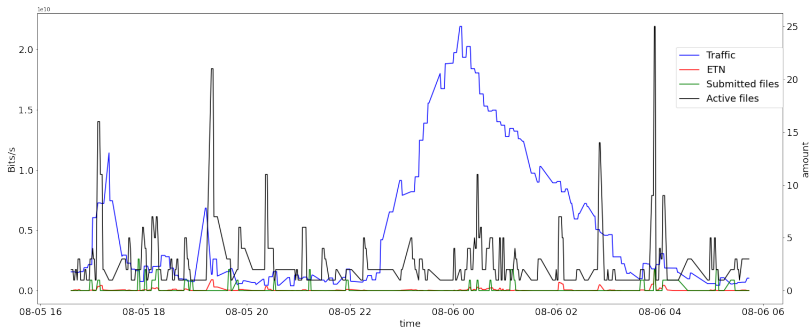
We can predict the queue finish time, but it doesn't mean we can predict when the transfer will finish in this way.



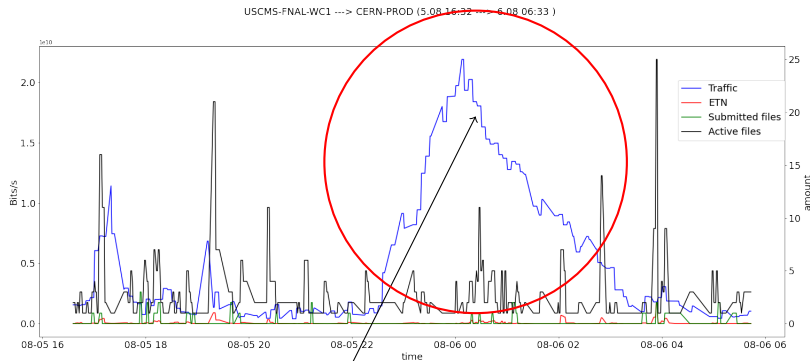
undefined traffic

Sometimes we can not "describe" the traffic

USCMS-FNAL-WC1 ----> CERN-PROD (5.08 16:32 ----> 6.08 06:33)



Sometimes we can not "describe" the traffic



Unidentified traffic

Conclusion (Transfer broker)

- If we add an extra path, we can optimize the transfer time.

Conclusion (Transfer broker)

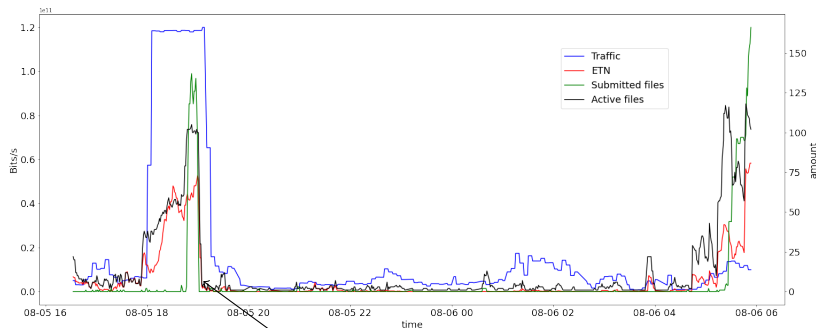
- If we add an extra path, we can optimize the transfer time.
- Using information from FTS we are able to find huge transfers. Transfers can change during observation. Hence, knowing what parameters mean is important to decide how to react.

Conclusion (Transfer broker)

- If we add an extra path, we can optimize the transfer time.
- Using information from FTS we are able to find huge transfers. Transfers can change during observation. Hence, knowing what parameters mean is important to decide how to react.
- We can predict the queue finish time using an easy linear regression model.

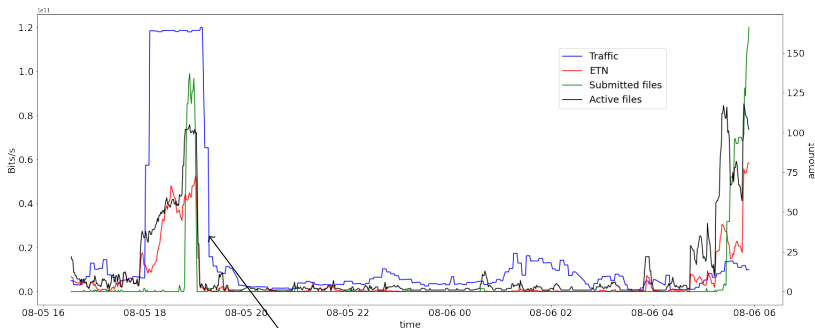
Is it enough to look only at submitted files?

FZK-LCG2 ---> CERN-PROD (5.08 16:32 ---> 6.08 06:33)



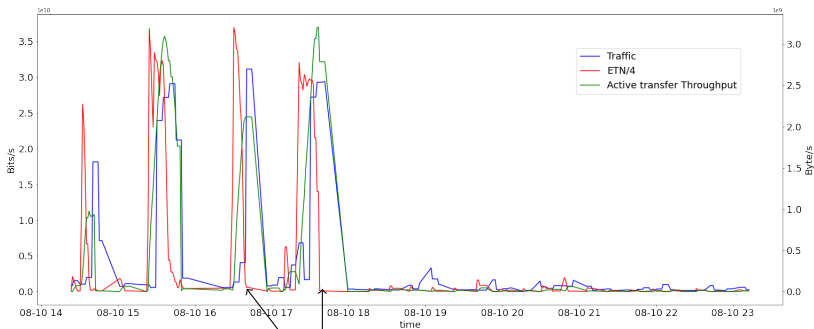
The queue was being observed for only 20 minutes. It started one hour after the transfer which caused increasing traffic. We should consider if we could react faster. Obviously, the queue finished a bit earlier than the transfer. Hence, maybe it is a good idea to focus on the submitted **and** active files (not only on queues).

FZK-LCG2 ---> CERN-PROD (5.08 16:32 ---> 6.08 06:33)



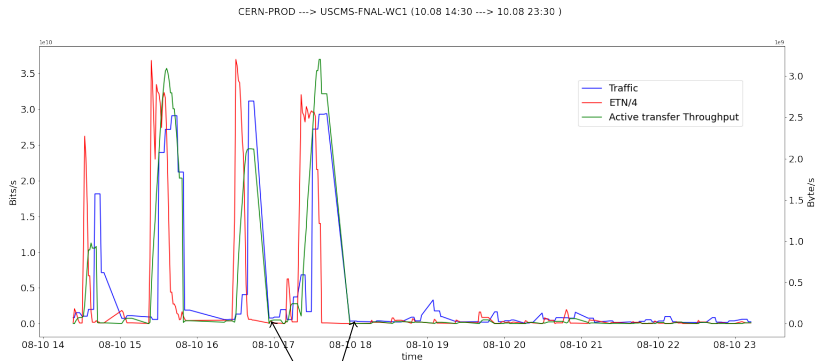
Transfer has finished, and we can observe decreasing traffic

CERN-PROD ---> USCMS-FNAL-WC1 (10.08 14:30 ---> 10.08 23:30)



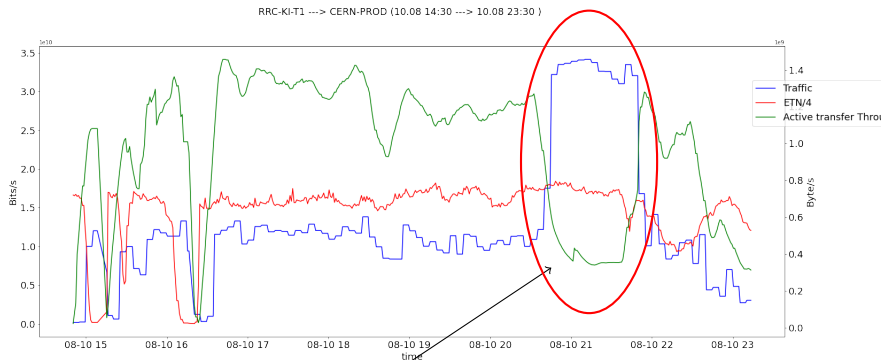
Transfers had finished before traffic decreased.

Coming back to the idea that includes the parameter "throughput"

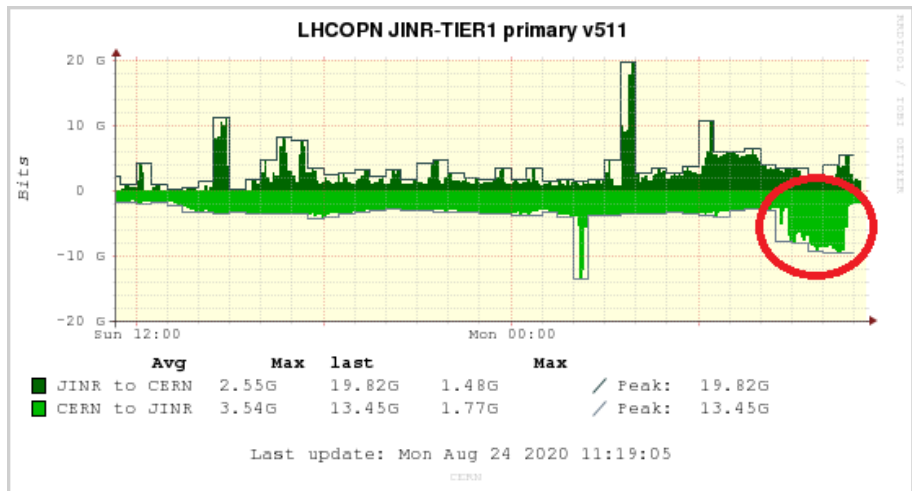


"Throughput" decreased at the same moment as the traffic.

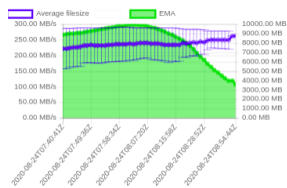
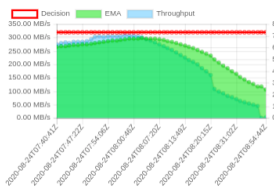
But, if we come back to the previous example...



"Throughput" decreased and remained at a lower level concurrently with traffic unidentified in FTS.

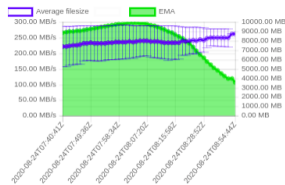
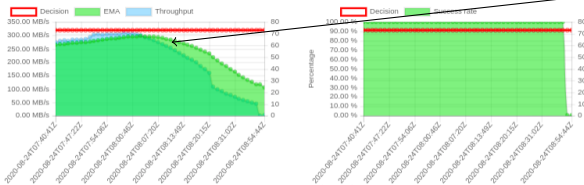


It should be a transfer from CERN to JINR which finished at 10:40 a.m.

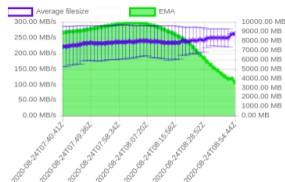
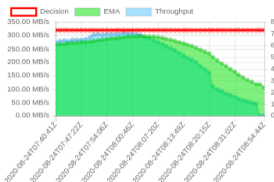
Details for `gsiftp://eoscmsftp.cern.ch → srm://srm-cms-mss.jinr-t1.ru`


2020-08-24T08:36:26Z	73	1	0	100.00%	44.99 MiB/s	118.43 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T08:35:22Z	73	1	0	100.00%	48.94 MiB/s	126.59 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T07:51:51Z	73	68	0	100.00%	384.49 MiB/s	282.08 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T07:50:42Z	73	68	0	100.00%	302.50 MiB/s	279.59 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T07:49:36Z	73	73	1	100.00%	294.06 MiB/s	277.04 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T07:48:29Z	73	73	4	100.00%	285.95 MiB/s	275.15 MiB/s	0 Queue emptying. Hold on.. Too many streams
2020-08-24T07:47:22Z	73	73	6	100.00%	285.06 MiB/s	273.95 MiB/s	0 Queue emptying. Hold on.
2020-08-24T07:46:16Z	73	73	11	100.00%	283.81 MiB/s	272.72 MiB/s	0 Queue emptying. Hold on.
2020-08-24T07:45:08Z	73	74	15	100.00%	283.87 MiB/s	271.48 MiB/s	0 Queue emptying. Hold on.

Details for `gsiftp://eoscmsftp.cern.ch → srm://srm-cms-mss.jinr-t1.ru` ^α "Throughput" was decreasing.

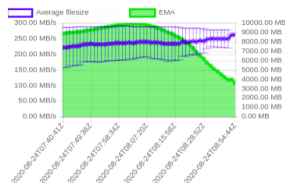
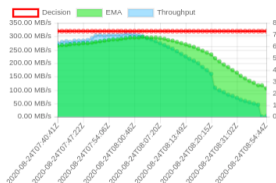


Timestamp	Decision	Running	Queue	Success rate (Last 1min)	Throughput	EMA	Diff	Explanation
2020-08-24T08:36:26Z	73	1	0	100.00%	44.99 MiB/s	118.43 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T08:35:22Z	73	1	0	100.00%	48.94 MiB/s	126.59 MiB/s	0	Queue emptying. Hold on.. Too many streams
		•						
		•						
2020-08-24T07:51:51Z	73	68	0	100.00%	304.49 MiB/s	282.08 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:50:42Z	73	68	0	100.00%	302.50 MiB/s	279.59 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:49:36Z	73	73	1	100.00%	294.06 MiB/s	277.04 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:48:29Z	73	73	4	100.00%	285.95 MiB/s	275.15 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:47:22Z	73	73	6	100.00%	285.06 MiB/s	273.95 MiB/s	0	Queue emptying. Hold on.
2020-08-24T07:46:16Z	73	73	11	100.00%	283.81 MiB/s	272.72 MiB/s	0	Queue emptying. Hold on.
2020-08-24T07:45:08Z	73	74	15	100.00%	283.87 MiB/s	271.48 MiB/s	0	Queue emptying. Hold on.

Details for `gsiftp://eoscmsftp.cern.ch` → `srm://srm-cms-mss.jinr-t1.ru` ^Q


Timestamp	Decision	Running	Queue	Success rate (Last 1min)	Throughput	EMA	Diff	Explanation
2020-08-24T07:40:41Z	73	1	0	100.00%	44.99 MiB/s	118.43 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T08:36:26Z	73	1	0	100.00%	48.94 MiB/s	126.59 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:51:51Z	73	68	0	100.00%	304.49 MiB/s	282.08 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:50:42Z	73	68	0	100.00%	302.50 MiB/s	279.59 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:49:36Z	73	73	1	100.00%	294.06 MiB/s	277.04 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:48:29Z	73	73	4	100.00%	285.95 MiB/s	275.15 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:47:22Z	73	73	6	100.00%	285.06 MiB/s	273.95 MiB/s	0	Queue emptying. Hold on.
2020-08-24T07:46:16Z	73	73	11	100.00%	283.81 MiB/s	272.72 MiB/s	0	Queue emptying. Hold on.
2020-08-24T07:45:08Z	73	74	15	100.00%	283.87 MiB/s	271.48 MiB/s	0	Queue emptying. Hold on.

Queue finished at 9:50 a.m. CEST (08:40 a.m. UTC)

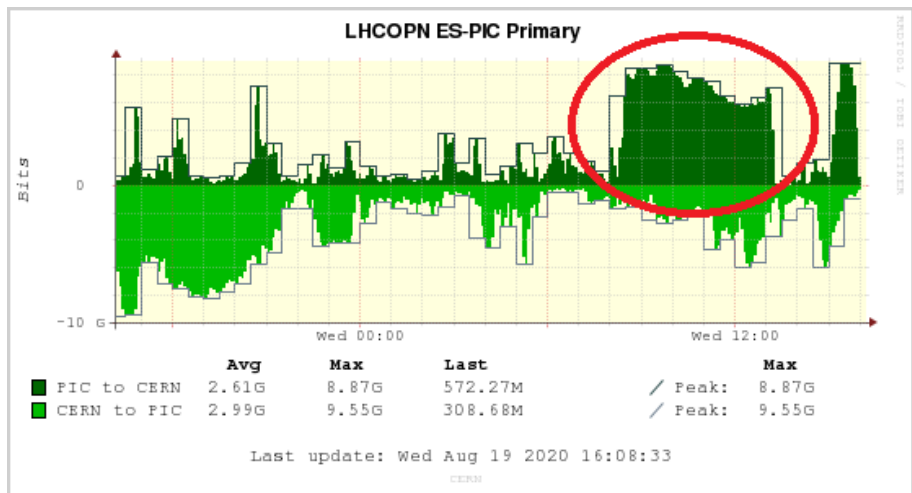
Details for gsiftp://eoscmsftp.cern.ch → srm://srm-cms-mss.jinr-t1.ru ^Q


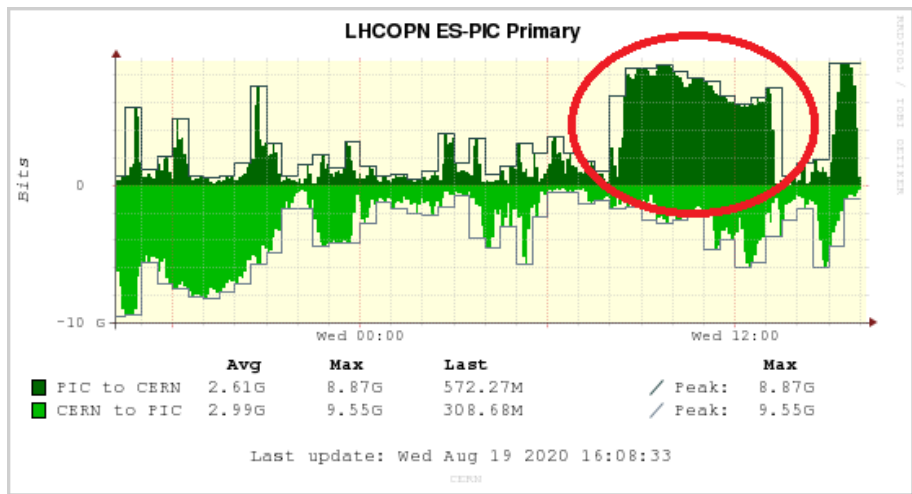
Timestamp	Decision	Running	Queue	Success rate (last 1min)	Throughput	EMA	Diff	Explanation
2020-08-24T07:36:26Z	73	1	0	100.00%	44.99 MiB/s	118.43 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T08:35:22Z	73	1	0	100.00%	48.94 MiB/s	126.59 MiB/s	0	Queue emptying. Hold on.. Too many streams

⋮

Transfer finished around 10:40 a.m.

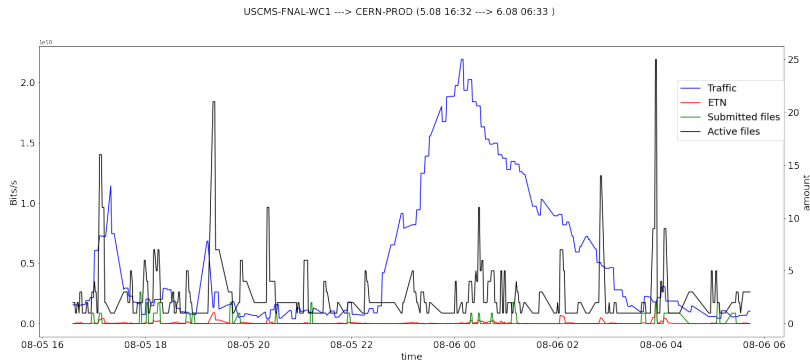
2020-08-24T07:51:51Z	73	68	0	100.00%	304.49 MiB/s	282.08 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:50:42Z	73	68	0	100.00%	302.50 MiB/s	279.59 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:49:36Z	73	73	1	100.00%	294.06 MiB/s	277.04 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:48:29Z	73	73	4	100.00%	285.95 MiB/s	275.15 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-24T07:47:22Z	73	73	6	100.00%	285.06 MiB/s	273.95 MiB/s	0	Queue emptying. Hold on.
2020-08-24T07:46:16Z	73	73	11	100.00%	283.81 MiB/s	272.72 MiB/s	0	Queue emptying. Hold on.
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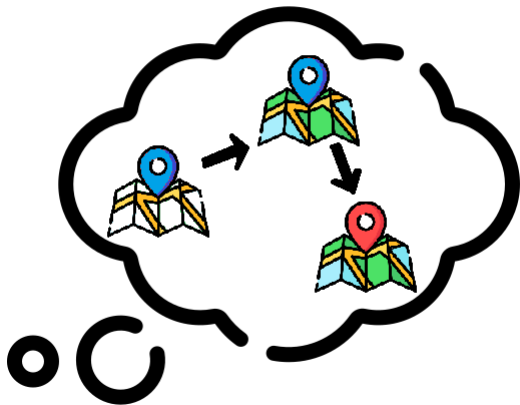


It **should** be a transfer from PIC to CERN which finished at 1:15 p.m.

Sometimes we can not "describe" the traffic. Is it true?

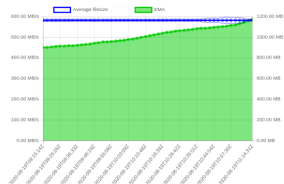
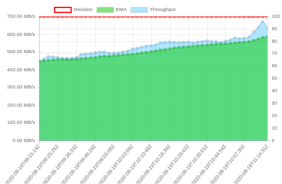


Transfer PIC → DE-KIT,
 could be PIC → CERN → DE-KIT



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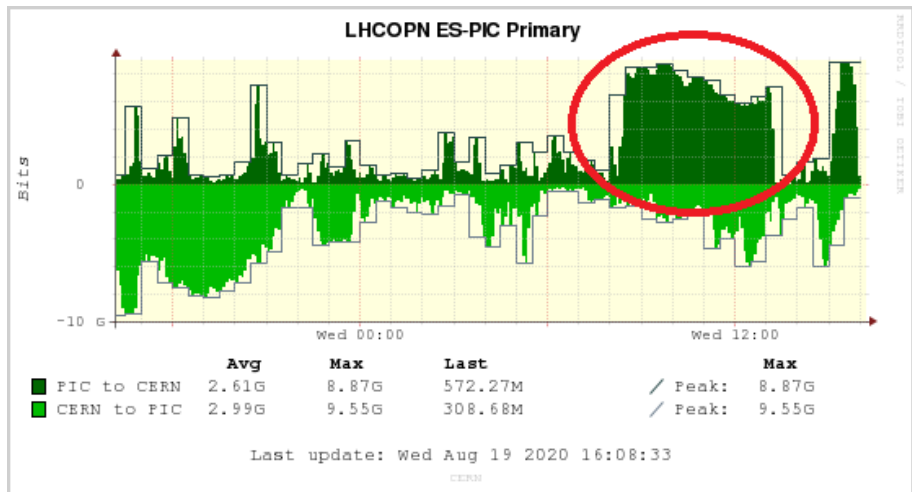
Details for srm://srmatlas.pic.es -- srm://atlassrm-kit.gridka.de



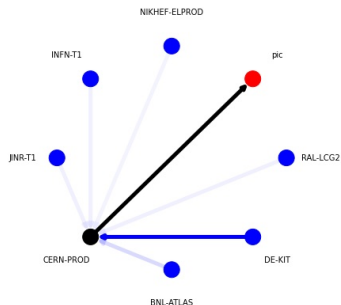
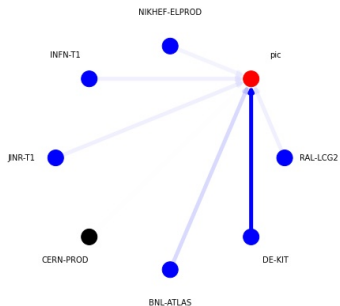
First Previous 2 Next Last

Timestamp	Decision	Running	Queue	Success rate (Last Size)	Throughput	EMA	Diff	Explanation
2020-08-19T11:14:31Z	100	0	0	100.00%	634.02 MiB/s	587.52 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-19T11:15:17Z	100	93	0	100.00%	671.13 MiB/s	582.36 MiB/s	0	Queue emptying. Hold on.. Too many streams
2020-08-19T11:16:43Z	100	103	130	100.00%	639.03 MiB/s	572.49 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T11:18:36Z	100	101	250	100.00%	613.69 MiB/s	565.10 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T11:18:31Z	100	106	400	100.00%	585.57 MiB/s	559.70 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:57:30Z	100	103	509	100.00%	578.07 MiB/s	556.83 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:54:25Z	100	113	594	100.00%	576.26 MiB/s	554.46 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:51:18Z	100	107	697	100.00%	589.50 MiB/s	552.04 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:48:13Z	100	101	804	100.00%	567.73 MiB/s	548.88 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:44:54Z	100	104	906	100.00%	560.33 MiB/s	546.79 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit
2020-08-19T10:42:03Z	100	104	996	100.00%	554.13 MiB/s	545.20 MiB/s	0	Good link efficiency, current average throughput is larger than the preceding average. Hit upper range limit

Transfer finished around 1:15 p.m.



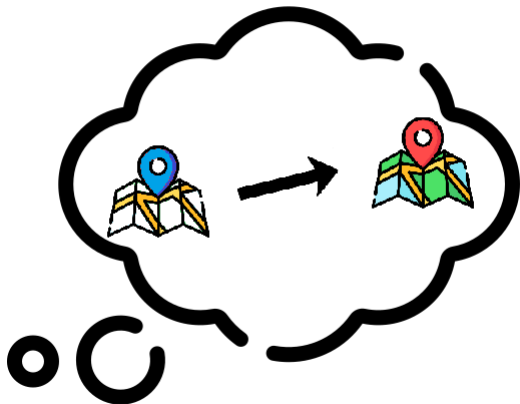
Network controller has to know network topology



Information about transfers from
FTS.

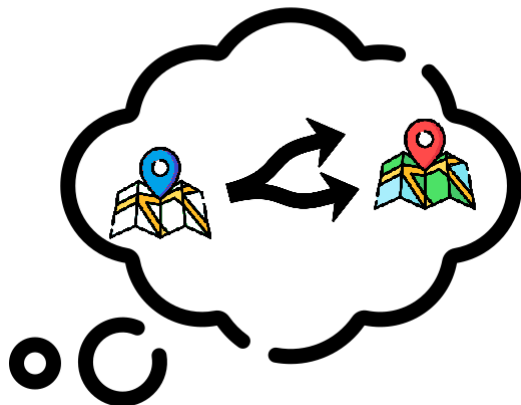
Real transfers.

Previous idea



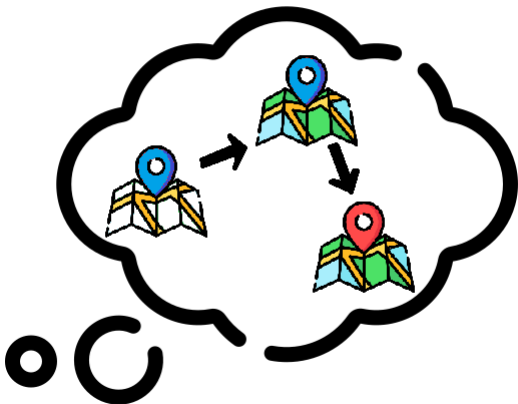
Icons made by Freepik from www.flaticon.com

Previous idea



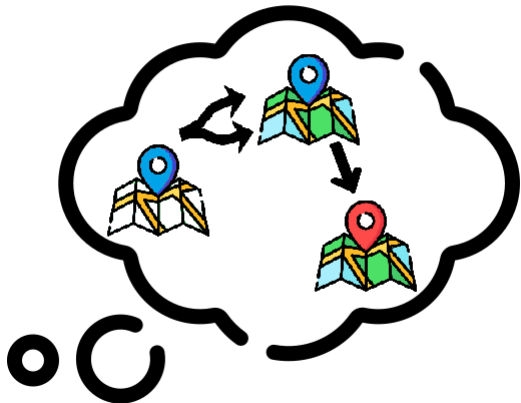
Icons made by Freepik from www.flaticon.com

To develop an idea, let's look at the bigger picture



Icons made by Freepik from www.flaticon.com

To develop an idea, let's look at the bigger picture



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Conclusion (network controller)

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Conclusion (network controller)

- If we add an extra path, we can optimize the transfer time. But the network controller has to know where the path is overloaded.
- We have to look at all points in our network topology not only for interesting us Source and destination. It is because we may not have a direct path.
- If we want to optimize the network, looking at all parameters (not only queues) could be more effective.

Questions

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