



HEPiX IPv6 Working Group

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Outline

Condor jobs analysis

- CERN Monit Kibana
- Dataset structure
- Results ordered by CMS_Type
- Results ordered by CMS_Site
- Status reported by CMS

Xrootd jobs analysis

- CERN Monit Kibana
- Dataset structure
- Results ordered by VO
- Results overview
- Results ordered by Site

FTS jobs analysis

- CERN Monit Kibana
- Dataset structure
- Results ordered by VO
- Results overview
- Results ordered by Site

DDM jobs analysis

- CERN Monit Kibana

Conclusions and Future lines

Condor jobs analysis

CERN Monit Kibana

query `monit_prod_condor_raw_metric*` → > 500 lines per job

```
{
  "_index": "monit_prod_condor_raw_metric-2022-06-24",
  "_type": "_doc",
  "_id": "cmsgwms-submit8.fnal.gov",
  "_version": "1656054330000",
  "_score": null,
  "_source": {
    "data": {
      "RecordTime": "1656054330000",
      "DataCollection": "1656054330",
      "DataCollectionDate": "1656054330000",
      "ScheddName": "cmsgwms-submit8.fnal.gov",
      "CMS_Pool": "Global",
      "Type": "production",
      "ChirpCMSWReadVops": 78,
      "ChirpCMSW_cmsRun1_ReadVops": 0,
      "ChirpCMSW_cmsRun4_LastUpdate": "1656053704",
      "ChirpCMSWMaxLumis": 1,
      "CommittedSlotTime": "172300",
      "PostJobPrio": "-1583",
      "RemoteUserCpu": "161761",
      "GLIDEIN_SiteName": "HTCondor",
      "ChirpCMSW_cmsRun5_MaxFiles": 1,
      "TotalSubmitProcs": 200,
      "ChirpCMSW_cmsRun1_ReadTimeMsecs": 0,
      "ChirpCMSW_cmsRun2_EventRate": "0.220196",
      "OriginalCpus": 4,
      "MaxCores": 4,
      "ExecutableSize": 9,
      "ChirpCMSW_cmsRun1_MaxEvents": "131856",
      "GLIDEIN_Memory": 7900,
      "MachineAttrCMSSubSiteName0": null,
      "ChirpCMSW_cmsRun1_TotalCPU": "158747",
      "ChirpCMSW_CPU_Speed": 3000,
      "ChirpCMSWReadOps": 247189,
      "MachineAttrCUDAComputeUnits0": null,
      "ChirpCMSW_cmsRun2_ReadTimeMsecs": 4678,
      "TerminationPending": true,
      "JobPrio": "85013",
      "LastVacateTime": "1656011241",
      "CommittedSuspensionTime": 0,
      "MemoryUsage": 3663,
      "x509UserProxyEmail": "",
      "ChirpCMSW_cmsRun4_ReadBytes": "396323265",
      "ChirpCMSWLastUpdate": "1656054218000",
      "RequestSlots": 0,
      "MachineAttrCUDA_GlobalMemoryMb0": null,
      "PostJobPrio": "-45",
      "JobStartDate": "1655940822000",
      "JobCurrentStartTransferOutputDate": "1656054329000",
      "CMS_JobType": "Production",
      "ChirpCMSW_cmsRun1_ReadSegments": 1,
      "WMAgent_JobID": "1595826",
      "CMS_JobRetryCount": 0,
      "GLIDEIN_ClusterID": "4754045",
      "ChirpCMSWDone": 4,
      "ChirpCMSW_cmsRun2_Runs": 1,
      "ChirpCMSW_cmsRun1_Lumis": 1,
      "CommittedTime": "43075",
      "GLIDEIN_SiteName_Queue": "ccocondorce02.in2p3.fr",
      "ToE": {
        "Who": "itself",
        "How": "OF ITS OWN ACCORD",
        "HowCode": 0,
        "When": "1656054329"
      },
      "JOB_GLIDEIN_Cpus": "$$(Cpus:0)",
      "DESIRED_CMSDataset": null,
      "ChirpCMSWReadBytes": "8943106896",
      "ChirpCMSW_cmsRun5_TotalCPU": "810.109",
      "StartPrincipal": "execute-side@matchsession/134.158.52.4",
      "AccountingGroup": "",
      "MachineAttrGLIDEIN_Gatekeeper0": "ccocondorce02.in2p3.fr:9619",
      "ChirpCMSW_cmsRun3_EventRate": "0.648928",
      "TransferOutStarted": "1656054329",
      "MachineAttrSlotWeight0": 4,
      "RemoteSysCpu": "1417",
      "GLIDEIN_SiteName_Slot": "slot1_6@ccwcondor0694.in2p3.fr",
      "ScratchDirFileCount": 6262,
      "ChirpCMSW_cmsRun3_Lumis": 1,
      "DesiredSiteCount": 39,
      "DataLocationsCount": 49,
      "CRAB_TaskCreationDate": "1656054330000",
      "CMSPrimaryPrimaryDataset": "Unknown",
      "CMSPrimaryProcessedDataset": "Unknown",
      "CMSPrimaryDataTier": "Unknown",
      "VO": "cms",
      "Site": "T1_FR_CCIN2P3",
      "Tier": "T1",
      "Country": "FR",
      "InputData": "Onsite",
      "CpuEff": "35.944190882337395",
      "Status": "Completed",
      "Universe": "Vanilla",
      "QueueHrs": "40.36666666666667",
      "Badput": "78.24333333333333",
      "CpuBadput": "80.77722222222222",
      "ChirpCMSWEventRate": "4.655476",
      "ChirpCMSW_SiteIO": [
        {
          "SiteName": "T1_UK_RAL",
          "ChirpString": "cmsRun3",
          "ReadBytes": "8624222",
          "ReadTimeMS": 4196
        },
        {
          "SiteName": "cernch",
          "ChirpString": "cmsRun3",
          "ReadBytes": "420292411",
          "ReadTimeMS": 16442
        }
      ],
      "CompletedFiles": 3,
      "MaxFiles": 1,
      "CMSWDone": true,
      "CMSWWallHrs": "11.691666666666666",
      "KEvents": "131.856",
      "MegaEvents": "0.131856",
      "SinceLastCMSWUpdateHrs": "0.031111111111111",
      "StageOutHrs": "0.0311111111111111"
    }
  }
}
```



Dataset structure

Composed of 17813 jobs:

- Stored by endpoints:
 - {Schedd_Name, Startd_Principal} pairs
 - 1st iteration: 6th to 27th of June 2022:
17813 different data exchange events
 - 2nd iteration: 1st to 14th of September:
16072 different data exchange events

Timestamp	Schedd_Name	Dual_Stacked	IPv4	IPv6
1654168479000	vo cms0121.cern.ch	No	137.138.152.48	2001:1458:d00:13::16
1654168477000	vo cms0155.cern.ch	No	137.138.148.11	2001:1458:d00:12::2d
1654168476000	vo cms0155.cern.ch	No	137.138.148.11	2001:1458:d00:12::2d
1654168474000	vo cms0121.cern.ch	No	137.138.152.48	2001:1458:d00:13::16
1654168469000	vo cms0121.cern.ch	No	137.138.152.48	2001:1458:d00:13::16
1654168577000	vo cms0283.cern.ch	Yes	188.184.85.85	2001:1458:201:e3::100:54f
1654168576000	vo cms0283.cern.ch	Yes	188.184.85.85	2001:1458:201:e3::100:54f
1654168576000	vo cms0282.cern.ch	Yes	188.184.87.109	2001:1458:201:e3::100:767
1654168575000	vo cms0283.cern.ch	Yes	188.184.85.85	2001:1458:201:e3::100:54f
1654168575000	vo cms0282.cern.ch	Yes	188.184.87.109	2001:1458:201:e3::100:767

- Virtual organization: CMS

Timestamp	Startd_Principal	Dual_Stacked	Startd_Principal_Name	IPv6
1654168479000	192.84.86.87	Yes	compute-03-273.ultralight.org	2605:d9c0:1:61::3:273
1654168477000	198.32.43.180	Yes	compute-13-153.ultralight.org	2605:d9c0:1:61::13:153
1654168476000	134.158.52.8	No	ccwcondor0698.in2p3.fr	NaN
1654168474000	128.142.57.109	Yes	b7s02p4684.cern.ch	2001:1458:301:7::100:6c
1654168469000	131.225.206.77	Yes	cmswn2254.fnal.gov	2620:6a:0:8420:f0:0:206:77
1654168577000	128.142.192.142	Yes	b7g18p7709.cern.ch	2001:1458:301:56::100:a
1654168576000	128.142.59.93	Yes	b7s04p6184.cern.ch	2001:1458:301:21::100:5c
1654168576000	128.227.78.58	No	host-128-227-78-58.xlate.ufl.edu	NaN
1654168575000	131.154.208.125	No	cn-609-05-03.cr.cnaf.infn.it	NaN
1654168575000	137.138.184.221	No	cms-ucsrv-c2f46-32-14.cern.ch	2001:1458:201:b9::100:19

- For each job:
 - check_if_dual_stacked()
 - get_ipv4_ipv6_addresses()
 - save_ipv4_ipv6_addresses()

- NOTE: dual-stacked means that the DNS answers with both IPv4/IPv6 addresses. It can be the case that the machine has got an IPv6 address but the DNS is not configured to answer with it as, for example, by appending the .ipv6 to the name → hostname.ipv6.cern.ch

Timestamp	Site	Pool	Type	SubmissionTool	JobType	CampaignType
1654168479000	T2_US_Caltech	Global	Analysis	CRAB	Analysis	Analysis
1654168477000	T2_US_Caltech	Global	Analysis	CRAB	Analysis	Analysis
1654168476000	T1_FR_CCSIN2P3	Global	Analysis	CRAB	Analysis	Analysis
1654168474000	T2_CH_CERN	Global	Analysis	CRAB	Analysis	Analysis
1654168469000	T1_US_FNAL	Global	Analysis	CRAB	Analysis	Analysis
1654168577000	T2_CH_CERN	Global	Production	WMAgent	Production	MC Ultralegacy
1654168576000	T2_CH_CERN	Global	Production	WMAgent	Production	MC Ultralegacy
1654168576000	T2_US_Florida	Global	Production	WMAgent	Merge	MC Ultralegacy
1654168575000	T1_IT_CNAP	Global	Production	WMAgent	Production	MC Ultralegacy
1654168575000	T2_CH_CERN	Global	Production	WMAgent	Production	MC Ultralegacy



Results ordered by CMS_Type [1st iteration]

Data distribution (17813 jobs):

- 46.2% (8229) belongs to production
- 21.8% (3890) belongs to analysis
- 25.0% (4450) belongs to tier0

Dual-stacked (3850):

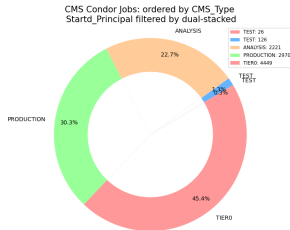
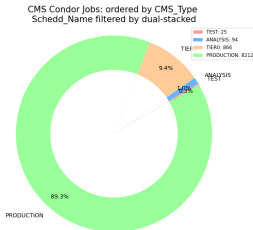
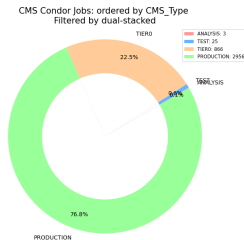
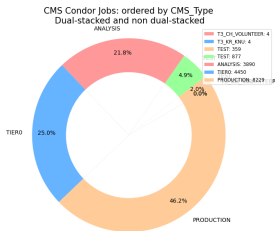
- 76.8% (2956) belongs to production
- 0.1% (3) belongs to analysis
- 22.5% (866) belongs to tier0

Schedd_Name dual-stacked (9197):

- 89.3% (8212) belongs to production
- 1.0% (94) belongs to analysis
- 9.4% (866) belongs to tier0

Startd_Principal dual-stacked (9792)

- 30.3% (2970) belongs to production
- 22.7% (2221) belongs to analysis
- 45.4% (4449) belongs to tier0



Results ordered by CMS_Type [1st iteration]

List of Schedd_Name machines:

Machines {not dual-stacked, analysis jobs} (4159)	Machines {dual-stacked, production jobs} (8212)
vocms0106.cern.ch (347)	vocms0255.cern.ch (2)
vocms0107.cern.ch (205)	vocms0259.cern.ch (7)
vocms0119.cern.ch (265)	vocms0282.cern.ch (2583)
vocms0120.cern.ch (204)	vocms0283.cern.ch (2082)
vocms0121.cern.ch (195)	vocms0290.cern.ch (1)
vocms0122.cern.ch (298)	cmsgwms-submit3.fnal.gov (11)
vocms0137.cern.ch (147)	cmsgwms-submit6.fnal.gov (878)
vocms0144.cern.ch (286)	cmsgwms-submit7.fnal.gov (1467)
vocms0155.cern.ch (304)	cmsgwms-submit8.fnal.gov (1181)
vocms0194.cern.ch (170)	
vocms0195.cern.ch (208)	
vocms0196.cern.ch (204)	
vocms0197.cern.ch (217)	
vocms0198.cern.ch (198)	
vocms0199.cern.ch (180)	
login-el7.uscms.org (731)	

Other machines that are not dual-stacked (4457):

- o vocms013.cern.ch (13) [analysis, test, tier0], vocms015.cern.ch (182) [analysis, test, tier0], vocms047.cern.ch (137) [tier0], vocms0314.cern.ch (3252)[tier0], vocms0258.cern.ch (17) [production], vocms0267.cern.ch (856) [test, T3_CH_Volunteer]

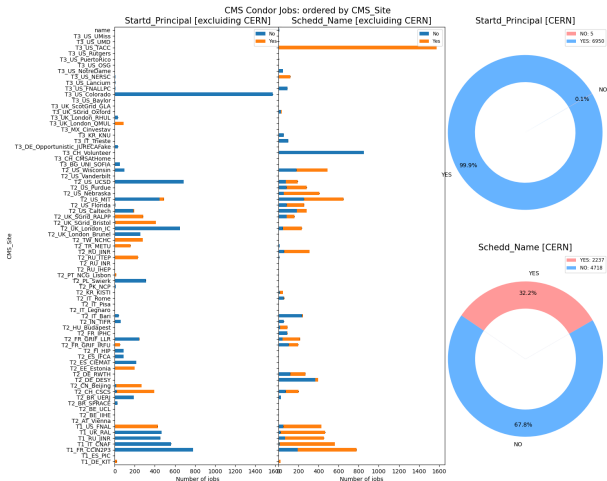
Other machines that are dual-stacked (985):

- o vocms068.cern.ch (94) [analysis], vocms0192.cern.ch (4) [test], vocms0261.cern.ch (2) [test], vocms0262.cern.ch (19) [test], vocms0500.cern.ch (866) [tier0]

Results ordered by CMS_Site [1st iteration]

Pie chart (6955 jobs):

- Schedd_Name_Site = CERN and Startd_Principal_Site = CERN
- Internal data exchange at CERN
- Startd_Principal:
 - 99.9% (6950) are dual-stacked
 - 99.9% of the jobs were able to execute transfers over IPv6
- Schedd_Name:
 - 67.8% (4718) are not dual-stacked
 - 67.8% of the jobs were not able to execute transfers over IPv6



Status reported by CMS

Status reported by CMS on the 5th of October:

- Schedds for analysis jobs (CRAB): 3/4 parts are now configured with IPv6 preference.
- Schedds for production jobs (WMAgent): due to the high workload of these machines the transition is done very carefully and slowly. Also, they mentioned that there is an issue in Fermilab because of a bug in HTCondor regarding the authentication tokens between demons so they moved everything again to IPv4 until this is solved.
- Slots and collectors: 1/3 are now configured with IPv6 preference. Also, they mentioned and reported that for PIC the majority of the work nodes are configured in IPv6 but they still have machines configured for IPv4, KIT and FNAL are 100% configured for IPv6 but IN2P3 is 100% configured in IPv4.

→ start 2nd iteration

Results ordered by CMS_Type [2nd iteration]

Data distribution (16072 jobs):

- 58.3% (9368) belongs to production
- 18.6% (2983) belongs to analysis
- 17.9% (2884) belongs to tier0

Dual-stacked (5347):

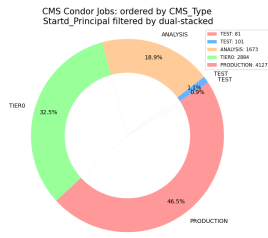
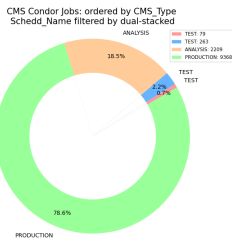
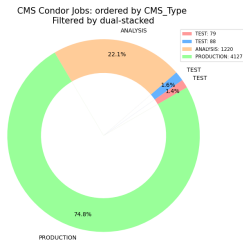
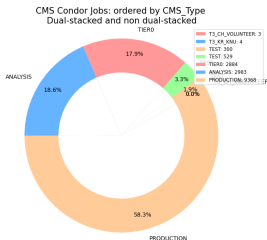
- 74.8% (4127) belongs to production
- 22.1% (1220) belongs to analysis [↑]
- 0% (0) belongs to tier0

Schedd_Name dual-stacked (11577):

- 78.6% (9368) belongs to production
- 18.5% (2209) belongs to analysis [↑]
- 0% (0) belongs to tier0

Startd_Principal dual-stacked (8684)

- 46.5% (4127) belongs to production
- 18.9% (1673) belongs to analysis [~]
- 32.5% (2884) belongs to tier0



Results ordered by CMS_Type [2nd iteration]

List of Schedd_Name machines:

Machines {not dual-stacked, analysis jobs} (815)	Machines {not dual-stacked, production jobs} (0)
vocms0196.cern.ch (196) [Analysis, Test, T3_KR_KNU]	
login-el7.uscms.org (619)	

Other machines that are not dual-stacked (3337):

- o vocms0267.cern.ch (453) [test, T3_CH_Volunteer], vocms0313.cern.ch (1926) [tier0], vocms047.cern.ch (1) [tier0], vocms015.cern.ch (59) [tier0], vocms014.cern.ch (340) [tier0], vocms001.cern.ch (558) [tier0]

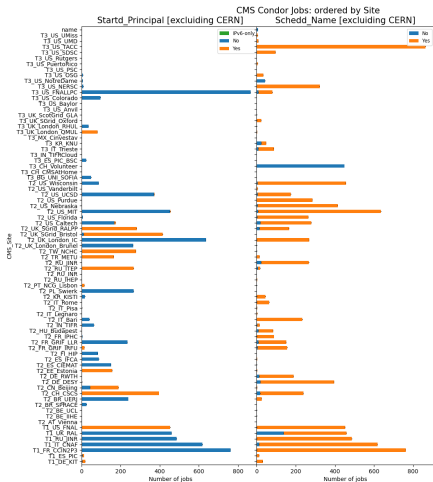
Timestamp 1663102345000, Startd_Principal IPv6-only (1): 2a00:139c:4:8b7:0:1:b:a1

Schedd_Name	Dual_Stacked	IPv4	IPv6
Startd_Principal	Dual_Stacked	IPv4	IPv6
Site	CMS.Pool	CMS_Type	CMS_SubmissionTool
cmsgwms-submit5.fnal.gov	Yes	131.225.204.166	2620:6a:0:8420:f0:0:204:166
2a00:139c:4:8b7:0:1:b:a1	IPv6-only	IPv6-only	2a00:139c:4:8b7:0:1:b:a1
T1_DE_KIT	Global	production	WMAgent

Results ordered by CMS_Site [2nd iteration]

Pie chart (6170 jobs):

- Schedd_Name.Site = CERN and Startd_Principal.Site = CERN
- Internal data exchange at CERN
- Startd_Principal:
 - 99.9% (6168) are dual-stacked
 - 99.9% of the jobs were able to execute transfers over IPv6
- Schedd_Name:
 - 52.8% (3260) are not dual-stacked
 - [tier0, Analysis]
 - vocms001.cern.ch, vocms015.cern.ch, vocms014.cern.ch, vocms047.cern.ch, vocms0196.cern.ch, vocms0313.cern.ch, login-el7.uscms.org
 - 52.8% of the jobs were not able to execute transfers over IPv6



Xrootd jobs analysis

CERN Monit Kibana

query `monit_prod_xrootd_enr.transfer*` → > 100 lines per job

```
{
  "_index": "monit_prod_xrootd_enr_transfer-2022-06-20",
  "_type": "_doc",
  "_id": "722237578-1655737833000",
  "_version": 1655737605926,
  "_score": null,
  "_source": {
    "data": {
      "vo": "cms",
      "src_site": "Purdue-RCAC",
      "dst_site": "CERN",
      "src_domain": "rcac.purdue.edu",
      "dst_domain": "cern.ch",
      "activity": "z",
      "app_info": "",
      "client_domain": "cern.ch",
      "client_host": "b7g3lp1577",
      "end_time": 1655737833000,
      "file_lfn": "/store/9006-AC1F6B34A89A.root",
      "file_size": 10123741,
      "ipv6": false,
      "is_transfer": true,
      "operation": "read",
      "operation_time": 250,
      "read_average": 420058.5625,
      "read_bytes": 13441874,
      "read_bytes_at_close": 10123741,
      "read_max": 2313214,
      "read_min": 104,
      "read_operations": 32,
      "read_sigma": 597482.75,
      "read_single_average": 182708.6875,
      "read_single_bytes": 3471465,
      "read_single_max": 2248513,
      "read_single_min": 104,
      "read_single_operations": 19,
      "read_single_sigma": 541482.75,
      "read_vector_average": 766954.5625,
      "read_vector_bytes": 9970409,
      "read_vector_count_average": 14.076923370361328,
      "read_vector_count_max": 49,
      "read_vector_count_min": 2,
      "read_vector_count_sigma": 17.43321990966797,
      "read_vector_max": 2313214,
      "read_vector_min": 156564,
      "read_vector_operations": 13,
      "read_vector_sigma": 497526.875,
      "remote_access": true,
      "server_domain": "rcac.purdue.edu",
      "server_host": "cms-c005",
      "server_site": "",
      "server_username": "",
      "start_time": 1655737583000,
      "throughput": 40494.964,
      "user": "",
      "user_dn": "",
      "user_fqan": "/cms",
      "user_protocol": "xroot",
      "user_role": "",
      "write_average": 0,
      "write_bytes": 0,
      "write_bytes_at_close": 0,
      "write_max": 0,
      "write_min": 0,
      "write_operations": 0,
      "write_sigma": 0,
      "monit_timestamp": 1655737605926,
      "dst_hostname": "UNKNOWN",
      "dst_experiment_site": "CERN-n/a",
      "dst_tier": -1,
      "dst_country": "Switzerland",
      "dst_country_code": "UNKNOWN",
      "dst_federation": "UNKNOWN",
      "src_hostname": "UNKNOWN",
      "src_experiment_site": "T2_US_Purdue",
      "src_tier": -1,
      "src_country": "USA",
      "src_country_code": "UNKNOWN",
      "src_federation": "UNKNOWN",
      "technology": "xrootd",
      "count": 1
    },
    "metadata": {
      "partition": "22",
      "type_prefix": "enr",
      "kafka_timestamp": 1655737606935,
      "topic": "xrootd_enr_transfer",
      "producer": "xrootd",
      "_id": "722237578-1655737833000",
      "type": "transfer",
      "_version": "1655737605926",
      "timestamp": 1655737833000
    }
  },
  "fields": {
    "metadata.kafka_timestamp": [
      "2022-06-20T15:06:46.935Z"
    ],
    "metadata.timestamp": [
      "2022-06-20T15:10:33.000Z"
    ]
  },
  "highlight": {
    "data.dst_site": [ "" ],
    "data.src_site": [ "" ]
  },
  "sort": [
    1655737833000
  ]
}
```



Dataset structure

Composed of 6660 jobs:

- From 1st to 14th of September 2022

- Stored by endpoints:

- {client_host, server_host} pairs
- 6660 different data exchange events

- Virtual organization:

- CMS
- ATLAS
- LHCb

- For each job:

- check_if_dual_stacked()
- get_ipv4_ipv6_addresses()
- save_ipv4_ipv6_addresses()

- NOTE: dual-stacked means that the DNS answers with both IPv4/IPv6 addresses. It can be the case that the machine has got an IPv6 address but the DNS is not configured to answer with it as, for example, by appending the .ipv6 to the name → hostname.ipv6.cern.ch

Timestamp	vo	src_site	dst_site	client_host	client_dual_stacked
1655969975000	cms	USCMS-FNAL-WC1	CERN	cmswn2336.fnal.gov	Yes
1655970022000	atlas	CERN-PROD	CERN-PROD	st-192-146d914a.cern.ch	Yes
1655970022000	atlas	CERN-PROD	CERN-PROD	b7g50s2252.cern.ch	Yes
1655970016000	cms	Purdue-RCAC	CERN	p06636710c97232.cern.ch	Yes
1655970021000	cms	CERN	CERN	p06636710u09390.cern.ch	Yes
1655970020000	lhcb	CERN	CERN	st-096-hh151c34.cern.ch	Yes
1655969975000	lhcb	FZK-LCG2	CERN	c01-011-161.gridka.de	No
1655970017000	cms	CERN	INFN-T1	cn-313-05-08.cr.cnaf.infn.it	No
1655970020000	lhcb	CERN	CERN	st-096-hh151c34.cern.ch	Yes
1655970016000	lhcb	CERN	NCBJ-CIS	gw1.cis.gov.pl	No

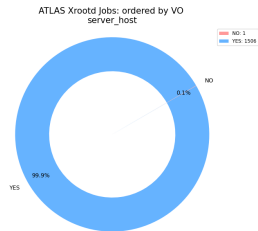
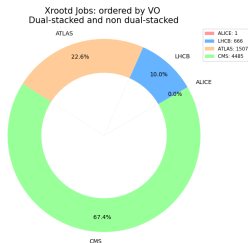
Timestamp	client_ipv4	client_ipv6	server_host	server_dual_stacked
1655969975000	131.225.188.101	2620:6a:0:8421:f0:0:188:101	p06253947b90717.cern.ch	Yes
1655970022000	128.142.165.212	2001:1458:301:ca:100:11	st-192-c8e57e19.cern.ch	Yes
1655970022000	188.185.105.8	2001:1458:d00:3e:100:254	st-096-gg500vk.cern.ch	Yes
1655970016000	128.142.215.100	2001:1458:301:c5:100:4	cms-c001.rcac.purdue.edu	Yes
1655970021000	128.142.214.237	2001:1458:301:a2:100:d	p06636710u09390.cern.ch	Yes
1655970020000	128.142.128.131	2001:1458:301:10:10:100:82	st-096-hh151aa5.cern.ch	Yes
1655969975000	NaN	2a00:139c:4:8b7:0:1:1b:a1	st-096-hh1519db.cern.ch	Yes
1655970017000	131.154.209.48	NaN	st-096-gg5618jy.cern.ch	Yes
1655970020000	128.142.128.131	2001:1458:301:10:10:100:82	st-096-hh151d04.cern.ch	Yes
1655970016000	192.68.51.225	NaN	st-096-dd905ce8.cern.ch	Yes

Timestamp	server_ipv4	server_ipv6	ipv6	operation	remote_access
1655969975000	128.142.162.79	2001:1458:301:ec:100:b	False	write	True
1655970022000	128.142.34.155	2001:1458:301:8e:100:17	False	write	False
1655970022000	128.142.193.119	2001:1458:301:27:100:75	False	read	False
1655970016000	128.211.143.86	2001:18e8:804:7:80d3:8f56	False	read	True
1655970021000	128.142.214.237	2001:1458:301:a2:100:d	False	write	False
1655970020000	128.142.128.118	2001:1458:301:10:10:100:75	False	read	False
1655969975000	128.142.128.124	2001:1458:301:10:10:100:7b	False	write	True
1655970017000	128.142.170.77	2001:1458:301:bf:100:a	False	read	True
1655970020000	128.142.128.138	2001:1458:301:10:10:100:89	False	read	False
1655970016000	128.142.49.138	2001:1458:301:104:100:7	False	read	True

Results ordered by VO [server_host]

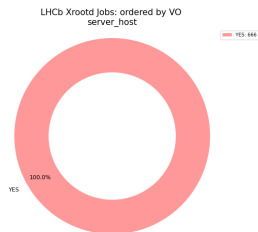
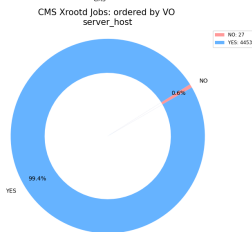
Data distribution (6660 jobs):

- 22.6% (1507) belongs to ATLAS
- 67.4% (4485) belongs to CMS
- 10.0% (666) belongs to LHCb
- 0.01% (1) belongs to ALICE



Dual-stacked (6625):

- 99.9% (1506) belongs to ATLAS
- 99.4% (4453) belongs to CMS
- 100% (666) belongs to LHCb



Results ordered by VO [client_host]

Data distribution (6660 jobs):

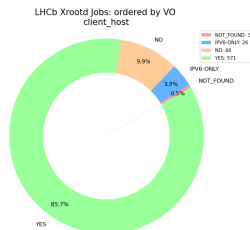
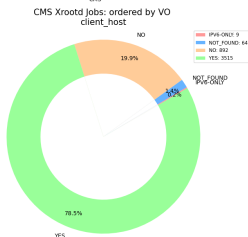
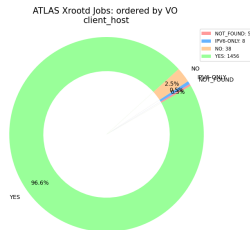
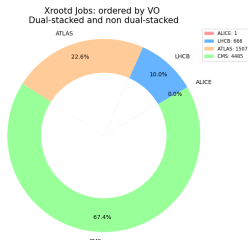
- 22.6% (1507) belongs to ATLAS
- 67.4% (4485) belongs to CMS
- 10.0% (666) belongs to LHCb
- 0.01% (1) belongs to ALICE

Dual-stacked (5418):

- 96.6% (1456) belongs to ATLAS
- 78.5% (3515) belongs to CMS
- 85.7% (571) belongs to LHCb

IPv6-only (43):

- 0.5% (8) belongs to ATLAS
- 1.4% (9) belongs to CMS
- 3.9% (26) belongs to LHCb



Results ordered by VO [client_host]

List of src_site with at least one client_host IPv6-only: FZK-LCG2, CERN, IN2P3, UKI-LT2-Brunel, RU-Protvino-IHEP, BEIJING-LCG2, INFN-T1.

Timestamp: 1661952952000, client_host IPv6-only (1): 2a00:139c:4:8b7:0:1:b:74

client_hostname	Dual_Stacked	IPv4	IPv6
server_host	Dual_Stacked	IPv4	IPv6
src_site	dst_site	Operation	VO
c01-011-116.gridka.de	IPv6-only	IPv6-only	2a00:139c:4:8b7:0:1:b:74
st-096-gg500wzr.cern.ch	Yes	128.142.193.121	2001:1458:301:27::100:77
FZK-LCG2	CERN	write	LHCb

Timestamp: 1661954007000, client_host IPv6-only (1): 2001:1458:201:e5::100:44

client_hostname	Dual_Stacked	IPv4	IPv6
server_host	Dual_Stacked	IPv4	IPv6
src_site	dst_site	Operation	VO
etf-08.cern.ch	IPv6-only	IPv6-only	2001:1458:201:e5::100:44
ds-102-10-08.cr.cnaf.infn.it	Yes	131.154.130.99	2001:760:4205:128::130:99
INFN-T1	CERN-PROD	read	ATLAS

Results ordered by VO [client_host]

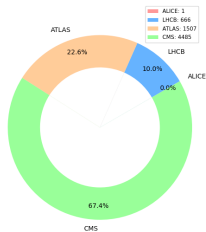
Number of client_host that are **not dual-stacked**: 248.

Number of client_host that are **not dual-stacked** and belongs to CERN: 79

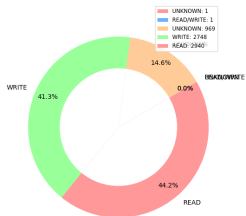
client_host	client_host	client_host
aiatlas053.cern.ch (7)	fu-c2d31-34-01-daq2fus8v0-cms.cern.ch (7)	fu-c2d43-32-01-daq2fus18v0-cms.cern.ch (2)
aiatlas056.cern.ch (5)	fu-c2d32-14-01-daq2fus9v0-cms.cern.ch (3)	fu-c2d44-10-03-daq2fus19v0-cms.cern.ch (4)
aipanda204.cern.ch (1)	fu-c2d32-40-03-daq2fus9v0-cms.cern.ch (2)	fu-c2d44-26-04-daq2fus19v0-cms.cern.ch (4)
atlas-rucio-prod-02-cik2mbmwulxj-node-5.cern.ch (2)	fu-c2d33-14-01-daq2fus10v0-cms.cern.ch (1)	fu-c2d44-30-04-daq2fus19v0-cms.cern.ch (12)
atlas-rucio-prod-03-uzukus7njqn3y-node-4.cern.ch (2)	fu-c2d33-34-03-daq2fus10v0-cms.cern.ch (2)	fu-c2d45-20-02-daq2fus20v0-cms.cern.ch (10)
cmsbuild01.cern.ch (3)	fu-c2d34-10-01-daq2fus11v0-cms.cern.ch (6)	fu-c2d45-20-03-daq2fus20v0-cms.cern.ch (7)
cmsbuild03.cern.ch (4)	fu-c2d34-12-01-daq2fus11v0-cms.cern.ch (2)	fu-c2d45-36-02-daq2fus20v0-cms.cern.ch (2)
cmsbuild10.cern.ch (19)	fu-c2d34-14-01-daq2fus11v0-cms.cern.ch (5)	fu-c2d46-26-01-daq2fus21v0-cms.cern.ch (5)
cmsbuild14.cern.ch (2)	fu-c2d34-14-04-daq2fus11v0-cms.cern.ch (1)	fu-c2d46-34-01-daq2fus21v0-cms.cern.ch (14)
cmsbuild20.cern.ch (2)	fu-c2d34-26-02-daq2fus11v0-cms.cern.ch (5)	fu-c2d47-24-04-daq2fus22v0-cms.cern.ch (1)
cmsbuild72.cern.ch (9)	fu-c2d35-14-03-daq2fus12v0-cms.cern.ch (3)	fu-c2d47-36-02-daq2fus22v0-cms.cern.ch (3)
cmsbuild75.cern.ch (1)	fu-c2d35-16-02-daq2fus12v0-cms.cern.ch (1)	ibmminsky-2.cern.ch (18)
cmsbuild76.cern.ch (8)	fu-c2d35-32-02-daq2fus12v0-cms.cern.ch (4)	lbcsv01.cern.ch (3)
cmsbuild77.cern.ch (3)	fu-c2d35-36-01-daq2fus12v0-cms.cern.ch (2)	lxatutb489.cern.ch (4)
cmsbuild80.cern.ch (8)	fu-c2d36-16-04-daq2fus13v0-cms.cern.ch (4)	lxatutb567.cern.ch (1)
cmsbuild90-rh8.cern.ch (8)	fu-c2d37-12-01-daq2fus14v0-cms.cern.ch (14)	mrg-c2f12-18-01-cdrs0v0-cms.cern.ch (16)
default-runner-786745c7b4-8mt6v.cern.ch (1)	fu-c2d37-16-02-daq2fus14v0-cms.cern.ch (1)	olarm-102.cern.ch (2)
eosctafst0124.cern.ch (1)	fu-c2d38-22-03-daq2fus15v0-cms.cern.ch (2)	paas-standard-avz-a-76rsg.cern.ch (3)
etf-01.cern.ch (1)	fu-c2d38-32-04-daq2fus15v0-cms.cern.ch (5)	pc-tdq-mon-30-mon0.cern.ch (11)
etf-02.cern.ch (1)	fu-c2d38-34-02-daq2fus15v0-cms.cern.ch (3)	pcatiltb03.cern.ch (1)
etf-03.cern.ch (1)	fu-c2d41-14-04-daq2fus16v0-cms.cern.ch (2)	vm-sp1-cn-10025.cern.ch (1)
etf-27.cern.ch (1)	fu-c2d41-22-04-daq2fus16v0-cms.cern.ch (19)	vm-sp1-cn-76016.cern.ch (1)
etf-28.cern.ch (1)	fu-c2d41-34-03-daq2fus16v0-cms.cern.ch (5)	vocms0268.cern.ch (125)
fu-c2a03-13-02-daq2fus39v0-cms.cern.ch (2)	fu-c2d41-36-01-daq2fus16v0-cms.cern.ch (2)	vocms0269.cern.ch (18)
fu-c2a03-13-04-daq2fus39v0-cms.cern.ch (16)	fu-c2d42-20-02-daq2fus17v0-cms.cern.ch (4)	vocms0275.cern.ch (124)
fu-c2a03-35-04-daq2fus40v0-cms.cern.ch (2)	fu-c2d42-24-03-daq2fus17v0-cms.cern.ch (4)	
fu-c2a03-41-04-daq2fus40v0-cms.cern.ch (6)	fu-c2d43-24-04-daq2fus18v0-cms.cern.ch (7)	

Results overview

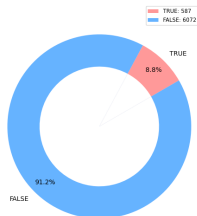
Xroot Jobs: ordered by VO
Dual-stacked and non dual-stacked



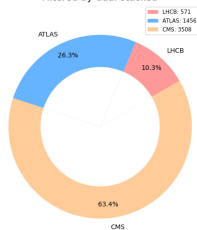
Xroot Jobs: ordered by Operation
Dual-stacked and non dual-stacked



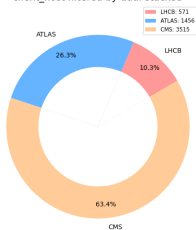
Xroot Jobs: ordered by Remote_Access
Dual-stacked and non dual-stacked



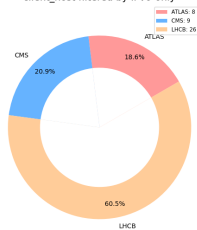
Xroot Jobs: ordered by VO
Filtered by dual-stacked



Xroot Jobs: ordered by VO
client_host filtered by dual-stacked



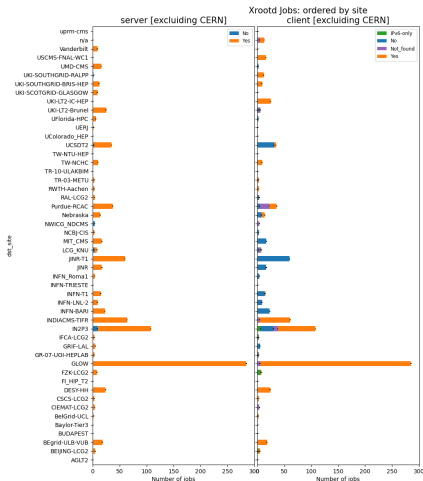
Xroot Jobs: ordered by VO
client_host filtered by IPv6-only



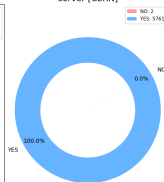
Results ordered by Site

Pie chart (5763 jobs):

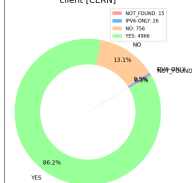
- Server_Site = CERN and Client_Site = CERN
- Internal data exchange at CERN
- Server:
 - 99.9% (5761) are dual-stacked
 - 99.9% of the jobs were able to execute transfers over IPv6
- Client:
 - 13.1% (756) are not dual-stacked
 - 13.1% of the jobs were not able to execute transfers over IPv6



server [CERN]



client [CERN]



FTS jobs analysis

CERN Monit Kibana

query `monit_prod_fts_enr_complete*` → > 150 lines per job

```
{
  "_index": "monit_prod_fts_enr_complete-2022-09-14",
  "_type": "_doc",
  "_id": "-941590230-1663159983634",
  "_version": 1663159985,
  "_score": null,
  "_source": {
    "data": {
      "vo": "atlas",
      "src_hostname": "dav.ndgf.org",
      "dst_hostname": "webdav.echo.stfc.ac.uk",
      "activity": "Production Output",
      "block_size": 0,
      "buf_size": 0,
      "channel_type": "urlicopy",
      "chk_timeout": 0,
      "dest_srm_v": "",
      "dst_rse": "RAL-LCG2-ECHO_DATADISK",
      "dst_se": "davs://webdav.echo.stfc.ac.uk",
      "dst_site_name": "",
      "dst_url": "davs://webdav.echo.stfc.ac.uk:1094",
      "endpnt": "fts3-atlas.cern.ch",
      "f_size": 115152118,
      "file_id": "4409043644",
      "file_size": 115152118,
      "final_destination": "",
      "ipv6": true,
      "is_recoverable": false,
      "job_id": "2262c89a-342c-11ed-805a-fa163e261b09",
      "job_n_replica": false,
      "job_state": "UNKNOWN",
      "latency": 2602,
      "log_link": "https://fts3-atlas.cern.ch:8449",
      "nstreams": 0,
      "operation_time": 10840,
      "protocol": "davs",
      "remote_access": true,
      "retry": 0,
      "retry_max": 0,
      "src_rse": "NDGF-T1_DATADISK",
      "src_se": "davs://dav.ndgf.org",
      "src_site_name": "",
      "src_srm_v": "",
      "src_url": "davs://dav.ndgf.org:443",
      "srm_space_token_dst": "",
      "srm_space_token_src": "",
      "t_error_message": "",
      "t_channel": "dav.ndgf.org_webdav.echo.stfc.ac.uk",
      "t_error_code": 0,
      "t_failure_phase": "",
      "t_final_transfer_state": "Ok",
      "t_final_transfer_state_flag": 1,
      "t_timeout": 820,
      "tcp_buf_size": 0,
      "time_srm_fin_end": 0,
      "time_srm_fin_st": 0,
      "time_srm_prep_end": 0,
      "time_srm_prep_st": 0,
      "timestamp_checksum_dst_ended": 1663159983578,
      "timestamp_checksum_dst_st": 1663159981371,
      "timestamp_checksum_dst_diff": 2207,
      "timestamp_checksum_src_diff": 46,
      "timestamp_chk_src_ended": 1663159973128,
      "timestamp_chk_src_st": 1663159973082,
      "timestamp_tr_comp": 1663159981371,
      "timestamp_tr_st": 1663159973850,
      "tr_bt_transferred": 83897480,
      "tr_error_category": "",
      "tr_error_scope": "",
      "tr_id": "dav.ndgf.org_webdav.echo.stfc.ac.uk",
      "tr_timestamp_complete": 1663159983634,
      "tr_timestamp_start": 1663159972794,
      "transfer_time": 7521,
      "transfer_type": "3rd pull",
      "user": "",
      "user_dn": "",
      "monit_id": "dba0b4da8ce40602b2c",
      "dst_experiment_site": "RAL-LCG2",
      "dst_site": "RAL-LCG2",
      "dst_tier": 1,
      "dst_country": "UK",
      "dst_federation": "UK-T1-RAL",
      "src_experiment_site": "NDGF-T1",
      "src_site": "NDGF-T1",
      "src_tier": 1,
      "src_country": "Nordic",
      "src_federation": "NDGF",
      "technology": "fts"
    },
    "metadata": {
      "partition": "0",
      "type_prefix": "enr",
      "kafka_timestamp": 1663159985869,
      "topic": "fts_enr_complete",
      "producer": "fts",
      "id": "-941590230-1663159983634",
      "type": "complete",
      "event_timestamp": 1663159983634,
      "version": "1663159985",
      "timestamp": 1663159983634
    }
  },
  "fields": {
    "data.timestamp_chk_src_st": [
      "2022-09-14T12:52:53.082Z"
    ],
    "data.timestamp_chk_src_ended": [
      "2022-09-14T12:52:53.128Z"
    ]
  },
  "sort": [
    1663159983634
  ]
}
```



Dataset structure

Composed of 1291 jobs:

- From 1st to 14th of September 2022

- Stored by endpoints:

- {src_hostname, dst_hostname} pairs
- 1291 different data exchange events

- Virtual organization:

- CMS
- ATLAS
- LHCb

- For each job:

- check_if_dual_stacked()
- get_ipv4_ipv6_addresses()
- save_ipv4_ipv6_addresses()

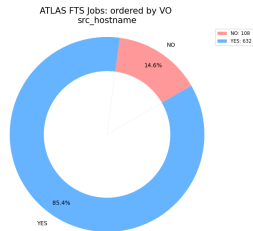
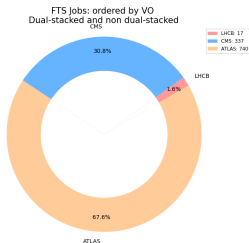
- NOTE: dual-stacked means that the DNS answers with both IPv4/IPv6 addresses. It can be the case that the machine has got an IPv6 address but the DNS is not configured to answer with it as, for example, by appending the .ipv6 to the name → hostname.ipv6.cern.ch

Timestamp	vo	ipv6	protocol	remote_access	src_hostname	src_dual_stacked	src_ipv4
1661848850490	atlas	False	gclouds	True	t2-dpm-01.na.infn.it	Yes	90.147.67.10
1661848850032	cms	False	davs	True	cmsio7.rc.ufl.edu	Yes	128.227.221.224
1661848849736	lhcb	False	srm	True	webdav.echo.stfc.ac.uk	Yes	130.246.177.248
1661848849594	atlas	False	davs	True	lcg-se01.icepp.jp	Yes	157.82.116.96
1661848848653	cms	True	davs	True	cmsxrootd.hep.wisc.edu	Yes	144.92.181.17
1661848847819	cms	True	davs	True	eymir.grid.metu.edu.tr	Yes	161.9.255.60
1661848847633	atlas	False	davs	True	gollias100.farm.particle.cz	Yes	147.231.25.100
1661848846445	atlas	False	davs	True	se-iep-grid.saske.sk	Yes	147.213.204.5
1661848846364	cms	False	davs	True	cmsio7.rc.ufl.edu	Yes	128.227.221.224
1661848846288	atlas	False	davs	True	gollias100.farm.particle.cz	Yes	147.231.25.100
src_ipv6	dst_hostname	dst_dual_stacked	dst_ipv4				
2001:760:422a:137::101:10	atlas-google-cloud.cern.ch	No	130.211.27.187				
2620:104:1f:1000:92e2:baff:fe7c:2ddc	cms-t2-se01.sdfarm.kr	Yes	134.75.124.252				
2001:630:58:1820::82f6:b1f7	storm-fe-lhcb.cr.cmaf.infn.it	Yes	131.154.128.74				
2404:d540:1:589:2:1:2:1	lcg-sel.sfu.computecanada.ca	No	206.12.127.41				
2607:f388:101c:1000:400	sbgsel.in2p3.fr	Yes	134.158.150.11				
2001:a98:1e:ff::60	eoscms.cern.ch	Yes	128.142.160.140				
2001:718:401:6017:2::1000	bohr3226.tier2.hep.manchester.ac.uk	Yes	195.194.105.167				
2001:4118:900:cc00::5	webdav-at2.pic.es	Yes	193.109.172.141				
2620:104:1f:1000:92e2:baff:fe7c:2ddc	cluster142.knu.ac.kr	No	155.230.20.172				
2001:718:401:6017:2::1000	se03.esc.qmul.ac.uk	Yes	194.36.11.44				
dst_ipv6	endpnt	src_site	dst_site				
NaN	fts3-pilot.cern.ch	INFN-NAFOLI-ATLAS	GOOGLE				
2001:320:15:124:c2:da:dc:1001	fts3-cms.cern.ch	UFlorida-HPC	KR-KISTI-GSDC-02				
2001:760:4205:128::128:74	fts3-lhcb.cern.ch	RAL-LCG2	INFN-T1				
NaN	bnl	TOKYO-LCG2	CA-SFU-T2				
2001:660:4705:d002:134:158:150:11	fts3-cms.cern.ch	GLW	IN2P3-IRES				
2001:1458:301:17::100:9	fts3-cms.cern.ch	TR-03-METU	CERN-FROD				
2001:630:22:d0ff:5054:ff:feaa:8042	fts3-atlas.cern.ch	praguelog2	UKI-NORTHGRID-MAN-HEP				
2001:67c:1148:201::15	fts3-atlas.cern.ch	IEFSAS-Kosice	ifae				
NaN	fts3-cms.cern.ch	UFlorida-HPC	KR-KNU-T3				
2a01:56c1:10:1000::c224:b2c	fts3-atlas.cern.ch	praguelog2	UKI-LT2-QMUL				

Results ordered by VO [src_hostname]

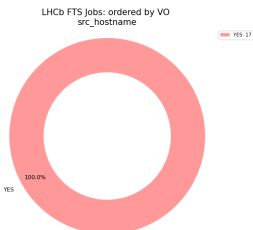
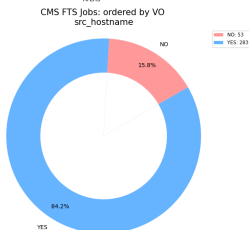
Data distribution (1094 jobs):

- 67.6% (740) belongs to ATLAS
- 30.8% (337) belongs to CMS
- 1.6% (17) belongs to LHCb



Dual-stacked (932):

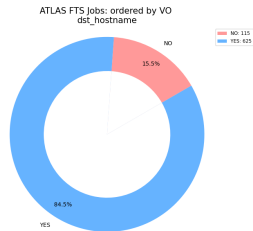
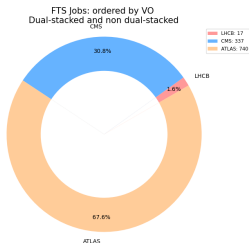
- 85.4% (632) belongs to ATLAS
- 84.2% (283) belongs to CMS
- 100% (17) belongs to LHCb



Results ordered by VO [dst_hostname]

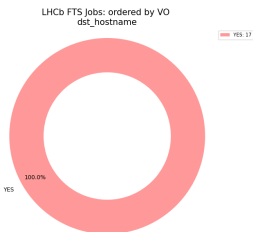
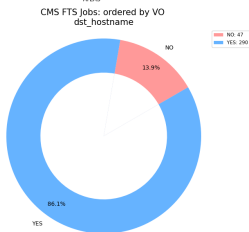
Data distribution (1094 jobs):

- 67.6% (740) belongs to ATLAS
- 30.8% (337) belongs to CMS
- 1.6% (17) belongs to LHCb



Dual-stacked (932):

- 84.5% (625) belongs to ATLAS
- 86.1% (290) belongs to CMS
- 100% (17) belongs to LHCb



Results ordered by VO [src, dst]

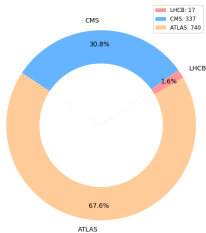
Number of {src_hostname, dst_hostname} **not dual-stacked**: {41, 42}.

Number of {src_hostname, dst_hostname} **not dual-stacked** CERN: {3, 4}.

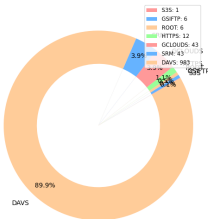
src_hostname	dst_hostname
atlas-google-cloud.cern.ch (11)	atlas-google-cloud.cern.ch (43)
atlas-seal-cloud.cern.ch (1)	atlas-seal-cloud.cern.ch (1)
eoscta atlas.cern.ch (1)	eosctacms.cern.ch (1)
	eosuser.cern.ch (2)

Results overview

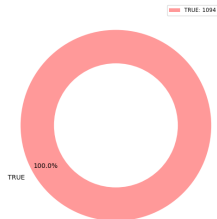
FTS Jobs: ordered by VO
Dual-stacked and non dual-stacked



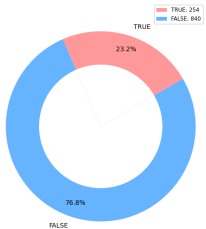
FTS Jobs: ordered by Protocol
Dual-stacked and non dual-stacked



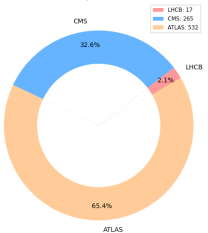
FTS Jobs: ordered by Remote_Access
Dual-stacked and non dual-stacked



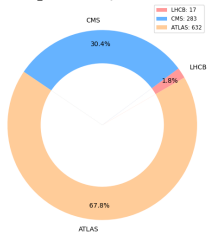
FTS Jobs: ordered by IPv6
Dual-stacked and non dual-stacked



FTS Jobs: ordered by VO
Filtered by dual-stacked



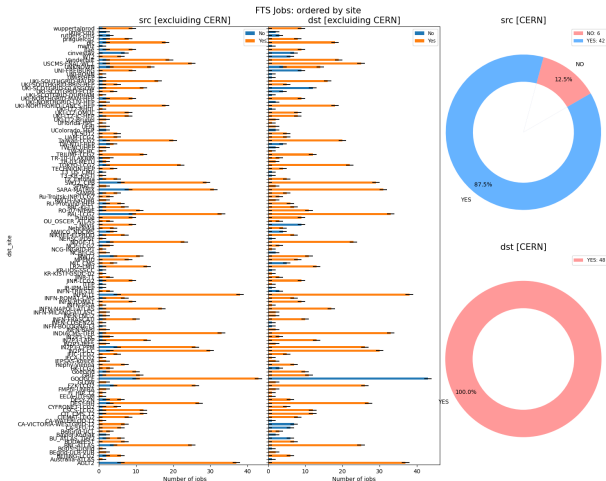
FTS Jobs: ordered by VO
src_host filtered by dual-stacked



Results ordered by Site

Pie chart (48 jobs):

- src_Site = CERN and dst_Site = CERN
- Internal data exchange at CERN
- Source:
 - 87.5% (42) are dual-stacked
 - 87.5% of the jobs were able to execute transfers over IPv6
- Destination:
 - 100% (48) are dual-stacked
 - 100% of the jobs were able to execute transfers over IPv6



DDM jobs analysis

CERN Monit Kibana

query `monit_prod_ddm_enr_transfer*` → > 120 lines per job

```
{
  "_index": "monit_prod_ddm_enr_transfer-2022-09-14",
  "_type": "_doc",
  "_id": "282609661-1663161158000",
  "_version": 1663161159,
  "_score": null,
  "_source": {
    "data": {
      "dst_experiment_site": "CERN-PROD",
      "dst_endpoint": "CERN-PROD_SCRATCHDISK",
      "src_experiment_site": "CERN-PROD",
      "src_endpoint": "CERN-PROD_SCRATCHDISK",
      "account": "UNKNOWN",
      "appid": "5594903112",
      "catStart": 1663161157.3276072,
      "clientState": "DONE",
      "dataset": "user.akelly.hiddenVar.mc16a_Sherpa",
      "datasetName": "UNKNOWN",
      "datasetScope": "UNKNOWN",
      "duid": "UNKNOWN",
      "eventType": "put_sm_a",
      "tool_id": "3.3.3 (l)+i.28.4",
      "name": "user.akelly.30387380",
      "file_size": 61643613,
      "guid": "5DE3764a2F8D4C9D88C6C2F6C78E6E01",
      "hostname": "b7g1ip5711.cern.ch",
      "ip": "128.142.195.104",
      "localSite": "CERN-PROD_SCRATCHDISK",
      "pq": "CERN",
      "protocol": "root",
      "purged reason": "OK",
      "relativeStart": 1663161157.1548414,
      "remoteSite": "CERN-PROD_SCRATCHDISK",
      "scope": "user.akelly",
      "reason": "OK",
      "suspicious": 0,
      "taskId": "30387380",
      "timeEnd": 1663161158.0890229,
      "timeStart": 1663161157.1525512,
      "traceId": "58bbe2b31d9409981f90906a86ecf3f",
      "traceIp": "2001:1458:301:26:100:68",
      "traceTimeEntry": "2022-09-14T13:12:38.284350",
      "created_at": 1663161158.28435,
      "transferStart": 1663161157.154842,
      "url": "/pool/condor/dir_20219/tmp/",
      "usr": "871350eaad9fbee596b63b278b087a",
      "uuid": "5860b2491fed410e7a55503861df71ef",
      "version": "UNKNOWN",
      "vo": "atlas",
      "started_at": 1663161157.3276072,
      "time_end": 1663161158.0890229,
      "duration": 0.7614157199859619,
      "event_type": "transfer-done",
      "activity": "Analysis Upload",
      "src_url": "",
      "dst_url": "/pool/condor/dir_20219/tmp/",
      "src_rse": "CERN-PROD_SCRATCHDISK",
      "dst_rse": "CERN-PROD_SCRATCHDISK",
      "rse": "",
      "src_type": "",
      "force_non_staging": true,
      "transferred_at": 1663161158.0890229,
      "transfer_endpoint": "UNKNOWN",
      "code": 2,
      "state": "transfer",
      "is_staging": false,
      "fts_host": "UNKNOWN",
      "throughput": 80959207.14788567,
      "event_timestamp": 1663161158000,
      "src_token": "ATLASSCRATCHDISK",
      "src_cloud": "CERN",
      "src_site": "CERN-PROD",
      "src_tier": 0,
      "src_federation": "CH-CERN",
      "src_country": "Switzerland",
      "dst_token": "ATLASSCRATCHDISK",
      "dst_cloud": "CERN",
      "dst_site": "CERN-PROD",
      "dst_tier": 0,
      "dst_federation": "CH-CERN",
      "dst_country": "Switzerland",
      "reason_text": "OK",
      "remote_access": false,
      "_id": "282609661-1663161158000",
      "_version": 1663161159
    },
    "metadata": {
      "partition": "14",
      "type_prefix": "enr",
      "kafka_timestamp": 1663161161120,
      "topic": "ddm_enr_transfer",
      "producer": "ddm",
      "_id": "282609661-1663161158000",
      "type": "transfer",
      "event_timestamp": 1663161158000,
      "version": "001",
      "_version": "1663161159",
      "timestamp": 1663161158000
    }
  },
  "fields": {
    "data.traceTimeEntry": {
      "2022-09-14T13:12:38.284Z"
    },
    "metadata.event_timestamp": {
      "2022-09-14T13:12:38.000Z"
    }
  },
  "sort": [
    1663161158000
  ]
}
```



Conclusions and Future lines

- Condor jobs: 2nd iteration
 - Dual-stacked by CMS_Type: 74.8% production, 22.1% analysis.
 - Fewer machines that are not dual-stacked compared to the previous analysis.
 - There is 1 pair where the Startd_Principal is IPv6-only → T1_DE_KIT.
- Xrootd jobs:
 - Server: almost 100% of the machines are dual-stacked.
 - Client: 96.7% for ATLAS, 79.1% for CMS and 86.1% for LHCb of the machines are dual-stacked.
 - There are 43 pairs where the client is IPv6-only: 8 for ATLAS, 9 for CMS and 26 for LHCb → FZK-LCG2, CERN, IN2P3, UKI-LT2-Brunel, RU-Protvino-IHEP, BEIJING-LCG2, INFN-T1.
- FTS jobs:
 - Destination: 84.5% for ATLAS, 86.1% for CMS and 100% for LHCb of the machines are dual-stacked.
 - Source: 85.4% for ATLAS, 84.2% for CMS and 100% for LHCb of the machines are dual-stacked.
- On-going: DDM transfers
- Future: TopTalkers LHCOPN/LHCONE

Thanks for your attention!

HEPiX IPv6 Working Group

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