

# Networking and activities in Napoli

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## Summary

- Network Requirement Update
- Test HTTP protocol in DIRAC
- HNSciCloud Project
- New Initiatives
  - HTTPhy PRIN Project

## Network Requirement Update

For for each Country involved in computing activities and for each data flow two value has been estimated:

- Average Throughput per year
- Max Bandwidth per year

# Throughput Estimation

For each class of data, the expected throughput per year has been obtained by dividing the amount of data to move, by the time of data acquisition/data production and with the application of a security factor of 50%.

For data Analysis the estimation has been done by considering a 250Mbit/s per KDB12 extrapolate from the current usage, then by multiply this value for the expected amount of resources for Analysis and Skimming

# Max Bandwidth Estimation

To obtain the Max Bandwidth from the expected throughput, as rule of thumb we can apply a factor 3 or 5 according with data distribution best practices.

In that case the **Max Bandwidth can be considered an estimation of the 95<sup>th</sup> percentile** of Bandwidth usage.

The difference between the expected Max Bandwidth and **the future observed peaks will be a function of the link capacity, link usage and traffic engineering policy eventually implemented in each site.**

In this work the Max Bandwidth has been obtained by **apply a factor 5 to the average throughput for all countries.**

**Red Values** => 1Gbps  
**Green Values** < 1Gbps

# Average Throughput per Country per Year

## THROUGHPUT PER YEAR IN - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
USA	0,32	2,02	3,39	2,11	2,85	3,06	3,02
Italy	0,30	0,38	0,64	1,71	2,34	2,63	2,65
Germany	0,26	0,33	0,55	1,59	2,16	2,40	2,39
KEK	0,48	0,51	0,75	0,93	1,34	2,07	2,38
Russia	0,16	0,20	0,34	0,48	0,70	0,94	1,01
Canada	0,07	0,09	0,14	0,80	1,06	1,04	0,99
France	0,03	0,04	0,07	0,74	0,94	0,99	0,90
China	0,09	0,11	0,19	0,28	0,40	0,54	0,57
Korea	0,08	0,10	0,17	0,24	0,35	0,47	0,50
India	0,06	0,08	0,13	0,19	0,27	0,37	0,40
Australia	0,05	0,06	0,11	0,15	0,22	0,30	0,32
Slovenia	0,05	0,06	0,10	0,14	0,20	0,27	0,29
Taiwan	0,05	0,06	0,10	0,14	0,20	0,27	0,29
Mexico	0,04	0,05	0,08	0,12	0,17	0,24	0,25
Poland	0,04	0,05	0,08	0,12	0,17	0,24	0,25
Austria	0,02	0,03	0,05	0,07	0,10	0,13	0,14
Czech	0,02	0,02	0,04	0,05	0,07	0,10	0,11
Vietnam	0,02	0,02	0,04	0,05	0,07	0,10	0,11
Israel	0,01	0,01	0,02	0,03	0,05	0,07	0,07
Malaysia	0,01	0,01	0,02	0,03	0,05	0,07	0,07
Thailand	0,01	0,01	0,02	0,03	0,05	0,07	0,07
Turkey	0,01	0,01	0,02	0,03	0,05	0,07	0,07
Ukraine	0,01	0,01	0,02	0,03	0,05	0,07	0,07
Saudi Ara	0,01	0,01	0,01	0,02	0,02	0,03	0,04
Spain	0,01	0,01	0,01	0,02	0,02	0,03	0,04
<b>TOTAL</b>	<b>2,22</b>	<b>4,30</b>	<b>7,11</b>	<b>10,11</b>	<b>13,94</b>	<b>16,57</b>	<b>16,99</b>

## THROUGHPUT PER YEAR OUT - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
KEK	0,50	2,39	4,08	6,00	7,90	8,52	8,04
USA	0,31	0,48	0,74	0,77	1,12	1,53	1,68
Italy	0,30	0,31	0,49	0,73	1,08	1,44	1,60
Germany	0,26	0,27	0,43	0,65	0,94	1,27	1,41
Russia	0,16	0,16	0,26	0,35	0,53	0,67	0,76
Canada	0,07	0,07	0,11	0,20	0,29	0,41	0,45
China	0,09	0,09	0,15	0,20	0,30	0,38	0,43
Korea	0,08	0,08	0,13	0,18	0,26	0,34	0,38
India	0,06	0,06	0,10	0,14	0,21	0,26	0,30
France	0,03	0,03	0,06	0,13	0,17	0,27	0,29
Australia	0,05	0,05	0,08	0,11	0,17	0,22	0,24
Slovenia	0,05	0,05	0,07	0,10	0,15	0,19	0,22
Taiwan	0,05	0,05	0,07	0,10	0,15	0,19	0,22
Mexico	0,04	0,04	0,06	0,09	0,13	0,17	0,19
Poland	0,04	0,04	0,06	0,09	0,13	0,17	0,19
Austria	0,02	0,02	0,04	0,05	0,08	0,10	0,11
Czech	0,02	0,02	0,03	0,04	0,06	0,07	0,08
Vietnam	0,02	0,02	0,03	0,04	0,06	0,07	0,08
Israel	0,01	0,01	0,02	0,03	0,04	0,05	0,05
Malaysia	0,01	0,01	0,02	0,03	0,04	0,05	0,05
Thailand	0,01	0,01	0,02	0,03	0,04	0,05	0,05
Turkey	0,01	0,01	0,02	0,03	0,04	0,05	0,05
Ukraine	0,01	0,01	0,02	0,03	0,04	0,05	0,05
Saudi Ara	0,01	0,01	0,01	0,01	0,02	0,02	0,03
Spain	0,01	0,01	0,01	0,01	0,02	0,02	0,03
<b>TOTAL</b>	<b>2,22</b>	<b>4,30</b>	<b>7,11</b>	<b>10,11</b>	<b>13,94</b>	<b>16,57</b>	<b>16,99</b>

**Red Values** => 1Gbps  
**Green Values** < 1Gbps

# Max Bandwidth per Country per Year

## MAX BANDWIDTH IN - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
USA	1,62	10,09	16,96	10,53	14,23	15,29	15,09
Italy	1,52	1,90	3,18	8,54	11,69	13,16	13,23
Germany	1,32	1,65	2,76	7,94	10,82	11,99	11,97
KEK	2,38	2,54	3,76	4,65	6,71	10,37	11,89
Russia	0,80	1,01	1,68	2,41	3,50	4,71	5,03
Canada	0,34	0,43	0,72	4,02	5,30	5,20	4,94
France	0,17	0,22	0,36	3,69	4,72	4,96	4,50
China	0,46	0,57	0,96	1,38	2,00	2,69	2,87
Korea	0,40	0,50	0,84	1,21	1,75	2,36	2,51
India	0,32	0,40	0,66	0,95	1,37	1,85	1,98
Australia	0,26	0,32	0,54	0,77	1,12	1,51	1,62
Slovenia	0,23	0,29	0,48	0,69	1,00	1,35	1,44
Taiwan	0,23	0,29	0,48	0,69	1,00	1,35	1,44
Mexico	0,20	0,25	0,42	0,60	0,87	1,18	1,26
Poland	0,20	0,25	0,42	0,60	0,87	1,18	1,26
Austria	0,11	0,14	0,24	0,34	0,50	0,67	0,72
Czech	0,09	0,11	0,18	0,26	0,37	0,50	0,54
Vietnam	0,09	0,11	0,18	0,26	0,37	0,50	0,54
Israel	0,06	0,07	0,12	0,17	0,25	0,34	0,36
Malaysia	0,06	0,07	0,12	0,17	0,25	0,34	0,36
Thailand	0,06	0,07	0,12	0,17	0,25	0,34	0,36
Turkey	0,06	0,07	0,12	0,17	0,25	0,34	0,36
Ukraine	0,06	0,07	0,12	0,17	0,25	0,34	0,36
Saudi Ara	0,03	0,04	0,06	0,09	0,12	0,17	0,18
Spain	0,03	0,04	0,06	0,09	0,12	0,17	0,18
<b>TOTAL</b>	<b>11,08</b>	<b>21,51</b>	<b>35,55</b>	<b>50,55</b>	<b>69,71</b>	<b>82,84</b>	<b>84,96</b>

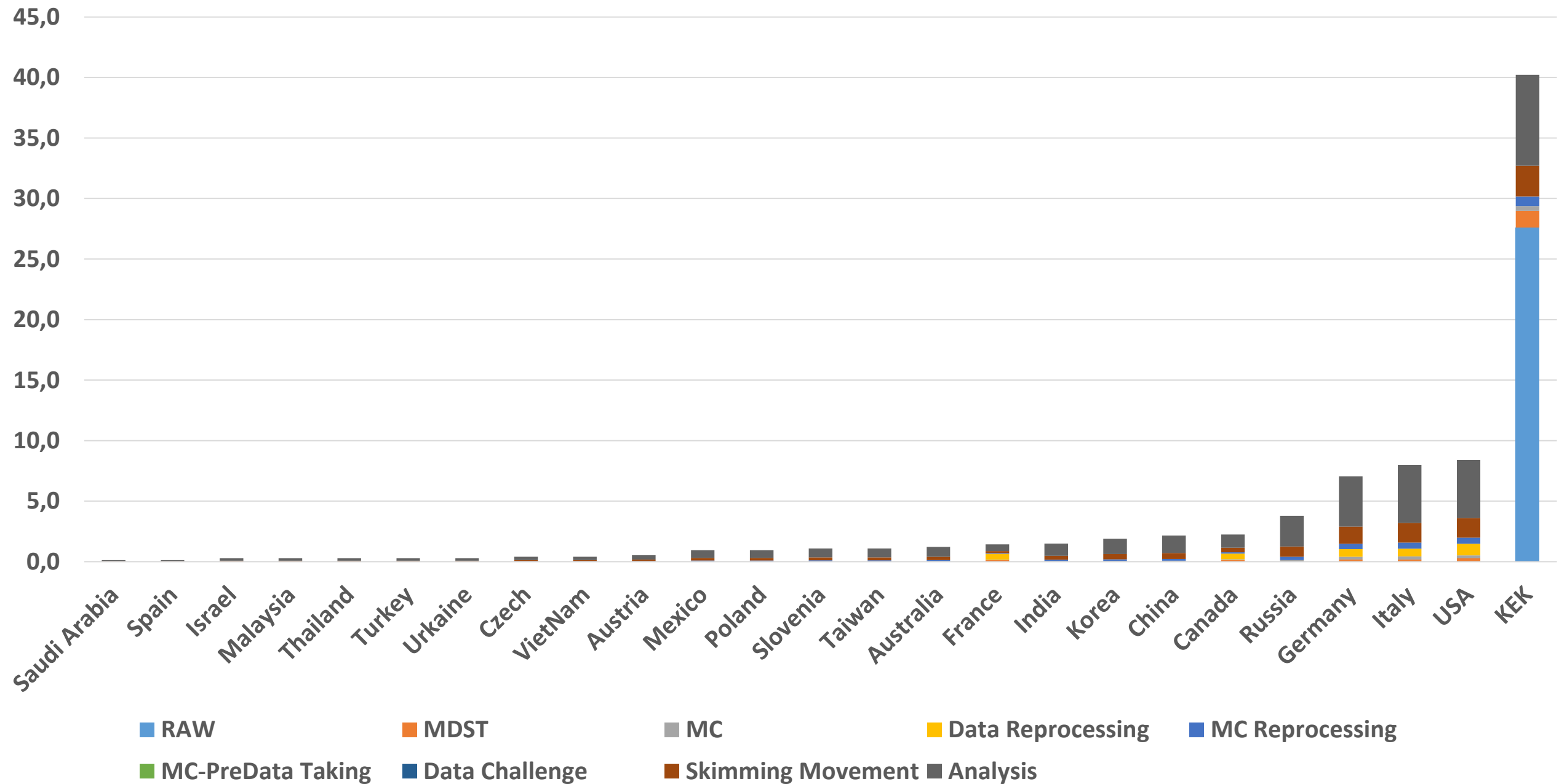
## MAX BANDWIDTH OUT - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
KEK	2,49	11,95	20,42	30,01	39,50	42,61	40,22
USA	1,53	2,42	3,71	3,85	5,58	7,63	8,41
Italy	1,52	1,53	2,45	3,67	5,38	7,21	8,00
Germany	1,32	1,33	2,13	3,23	4,72	6,37	7,05
Russia	0,80	0,81	1,30	1,75	2,63	3,36	3,79
Canada	0,34	0,35	0,56	1,02	1,43	2,07	2,24
China	0,46	0,46	0,74	1,00	1,51	1,92	2,17
Korea	0,40	0,40	0,65	0,88	1,32	1,68	1,90
India	0,31	0,32	0,51	0,69	1,04	1,32	1,49
France	0,17	0,17	0,28	0,64	0,86	1,35	1,43
Australia	0,26	0,26	0,42	0,56	0,85	1,08	1,22
Slovenia	0,23	0,23	0,37	0,50	0,75	0,96	1,08
Taiwan	0,23	0,23	0,37	0,50	0,75	0,96	1,08
Mexico	0,20	0,20	0,32	0,44	0,66	0,84	0,95
Poland	0,20	0,20	0,32	0,44	0,66	0,84	0,95
Austria	0,11	0,12	0,19	0,25	0,38	0,48	0,54
Czech	0,09	0,09	0,14	0,19	0,28	0,36	0,41
Vietnam	0,08	0,09	0,14	0,19	0,28	0,36	0,41
Israel	0,06	0,06	0,09	0,13	0,19	0,24	0,27
Malaysia	0,06	0,06	0,09	0,13	0,19	0,24	0,27
Thailand	0,06	0,06	0,09	0,13	0,19	0,24	0,27
Turkey	0,06	0,06	0,09	0,13	0,19	0,24	0,27
Ukraine	0,06	0,06	0,09	0,13	0,19	0,24	0,27
Saudi Ara	0,03	0,03	0,05	0,06	0,09	0,12	0,14
Spain	0,03	0,03	0,05	0,06	0,09	0,12	0,14
<b>TOTAL</b>	<b>11,08</b>	<b>21,51</b>	<b>35,55</b>	<b>50,55</b>	<b>69,71</b>	<b>82,84</b>	<b>84,96</b>



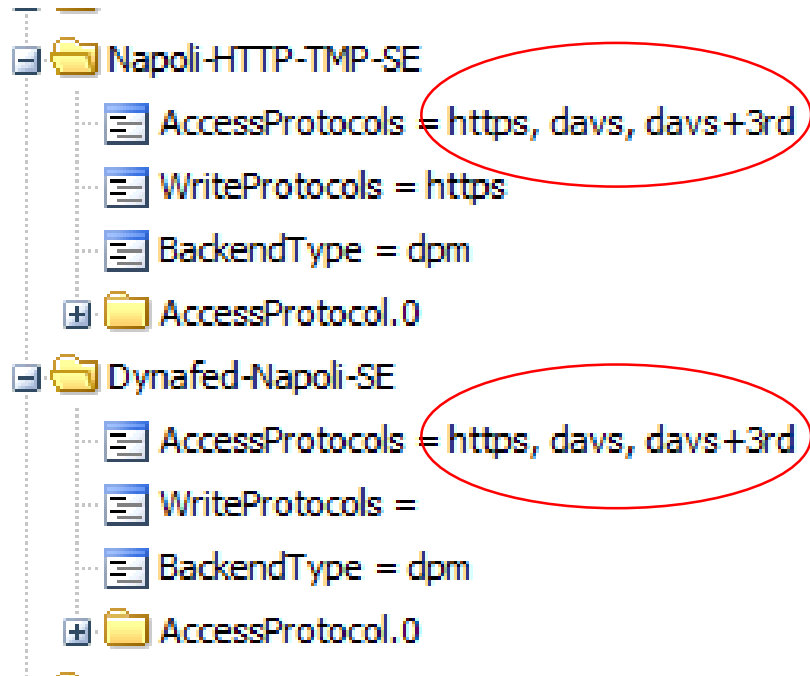


# Max Bandwidth Outbound per Country 2024 (Gbps)





# Test HTTP protocol with DIRAC



Belle II uses the concept of dataset and datablock.

A datablock is a collection of file, a dataset is a collection of datablock.

User uses the logical name of the datablock as input for analysis jobs.

The framework gbasf2 is responsible to complete file lookup using AMGA as metadata catalog and LFC as file catalog.

The final URL is obtained by concatenating the storage information stored in DIRAC configuration which contain the access protocol as well.

To test the usage of DAVS in the whole chain, two storages has been crated in the DIRAC configuration of the validation server in BNL.

- Napoli-HTTP-TMP-SE
- Dynafed-Napoli-SE

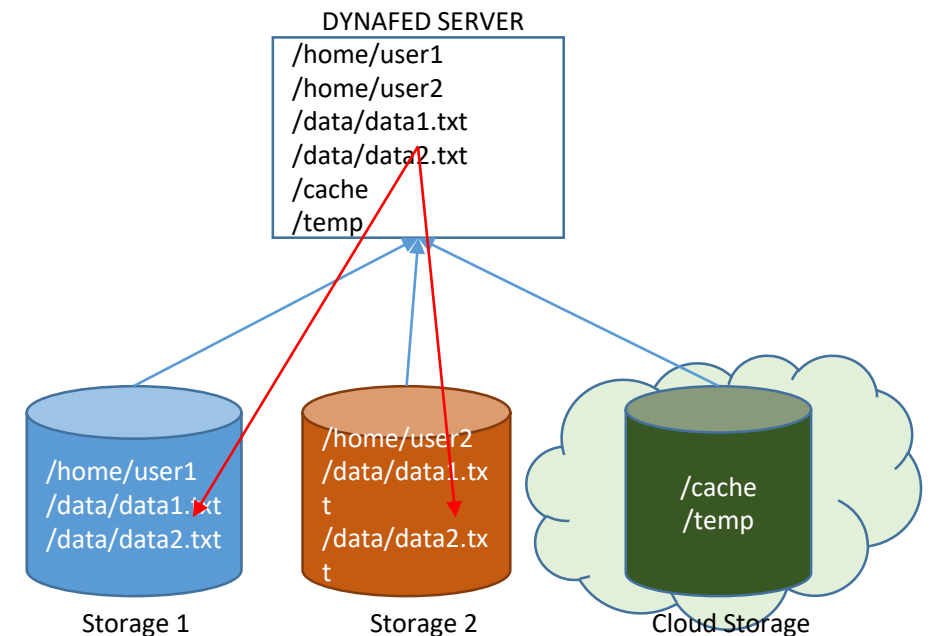
# Dynafed Server for Belle II

#	STORGE NAME	HOSTNAME	TYPE
1	DESY-DE	dcache-belle-webdav.desy.de	DCACHE
2	GRIDKA-SE	f01-075-140-e.gridka.de	DCACHE
3	NTU-SE	bgrid3.phys.ntu.edu.tw	DCACHE
4	SIGNET-SE	dcache.ijs.si	DCACHE
5	UVic-SE	charon01.westgrid.ca	DCACHE
6	BNL-SE	dcbldoor01.sdcc.bnl.gov	DCACHE
7	Adelaide-SE	coepp-dpm-01.ersa.edu.au	DPM
8	CESNET-SE	dpm1.egee.cesnet.cz	DPM
9	CYFRONNET-SE	dpm.cyf-kr.edu.pl	DPM
10	Frascati-SE	atlasse.Inf.infn.it	DPM
11	HEPHY-SE	hephyse.oeaw.ac.at	DPM
12	Melbourne-SE	b2se.mel.coepp.org.au	DPM
13	Napoli-SE	belle-dpm-01.na.infn.it	DPM
14	ULAKBIM-SE	torik1.ulakbim.gov.tr	DPM
15	IPHC-SE	sbgse1.in2p3.fr	DPM
16	CNAF-SE	ds-202-11-01.cr.cnaf.infn.it	STORM
17	ROMA3-SE	storm-01.roma3.infn.it	STORM
18	KEK-SE	Kek-se03.cc.kek.jp	STORM
19	McGill-SE	gridftp02.clumeq.mcgill.ca	STORM

Dynafed is a lightweight federation services able to aggregate multiple Http/WebDav/S3 endpoints showing a single namespace

A Dynafed server is running in Napoli aggregating 19 belle II storage endpoints

<https://dynafed-belle.na.infn.it/myfed>

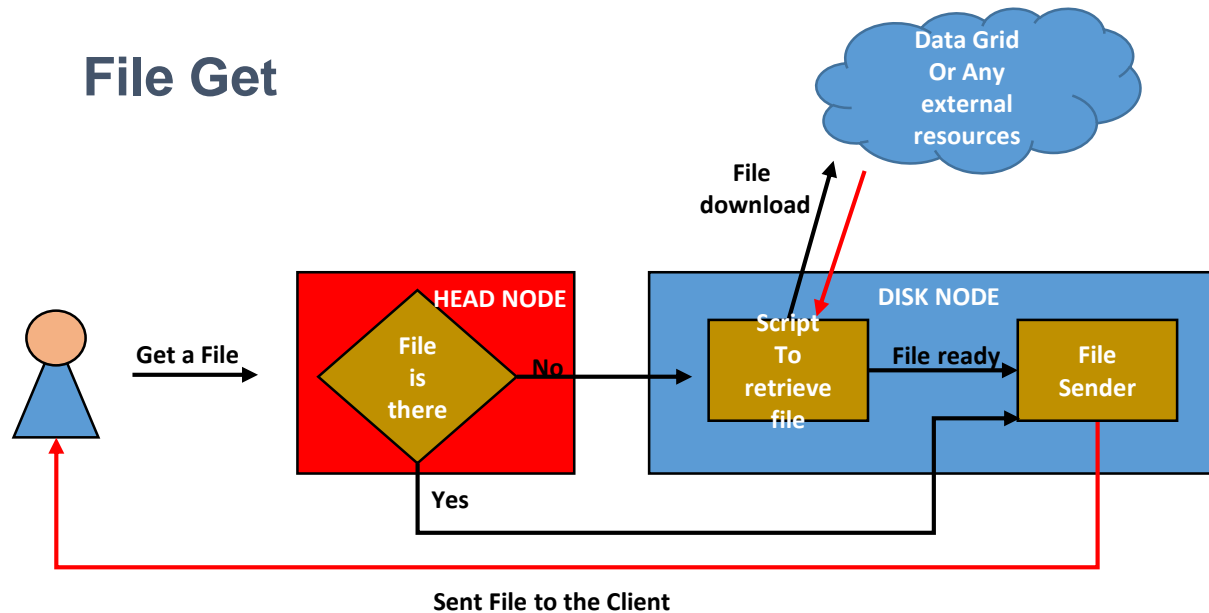


# Concept of Volatile Pool

A Pool in DPM is a collection of File Systems managed as a single storage area.

A **Volatile Pool** is a special pool that can pull files from external sources.

When an **User get a file** from the Volatile pool, the **Disk Node** providing the file system of the pool, send the file to the client if ready, otherwise a script is locally run in order to retrieve the file from some external source.



# Dynafed + Volatile Pool

-rwxrwxrwx	0	0	0	8.4G	Thu, 11 Feb 2016 18:41:21 GMT		<a href="#">10G_DC_097.dat</a>
-rwxrwxrwx	0	0	0	9.8G	Thu, 11 Feb 2016 17:46:55 GMT		<a href="#">10G_DC_098.dat</a>
-rwxrwxrwx	0	0	0	9.8G	Thu, 11 Feb 2016 17:50:56 GMT		<a href="#">10G_DC_099.dat</a>
-rwxrwxrwx	0	0	0	9.8G	Thu, 11 Feb 2016 18:41:47 GMT		<a href="#">10G_DC_100.dat</a>
-rw-rw-r--	0	0	0	10.9M	Sun, 10 Sep 2017 12:47:42 GMT		<a href="#">10MB-MGILL01</a>
-rw-rw-r--	0	0	0	1023.0M	Wed, 13 Apr 2016 16:00:44 GMT		<a href="#">1G</a>
drwxrwxrwx	0	0	0	0	Wed, 20 Jan 2016 22:13:37 GMT		
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 14:06:53 GMT		<a href="#">TEST-10GB-multi01</a>
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 14:01:10 GMT		<a href="#">TEST-10GB-multi02</a>
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 13:57:54 GMT		<a href="#">TEST-10GB-multi03</a>
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 14:05:00 GMT		<a href="#">TEST-10GB-multi04</a>
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 14:00:01 GMT		<a href="#">TEST-10GB-multi05</a>
-rw-rw-r--	0	0	0	11.9G	Mon, 14 Nov 2016 14:05:51 GMT		<a href="#">TEST-10GB-multi06</a>

Il file XML specificato apparentemente non ha un foglio di stile associato. L'albero del documento è mostrato di seguito.

```

--<metalink version="3.0" generator="lcmdm-dav" pubdate="Mon, 14 Nov 2016 14:01:10 GMT">
- <files>
- <file name="/belle-">
  <size>12778995712</size>
  - <resources>
  - <url type="https">
    https://recas-dpm-01.na.infn.it/dpm/na.infn.it/home/belle/cache/TEST-10GB-multi02
  </url>
  - <url type="https">
    https://dpm1.egee.cesnet.cz:443/dpm/cesnet.cz/home/belle/TMP/belle/user/spardi/testhttp/TEST-10GB-multi02
  </url>
  </resources>
  </file>
  </files>
</metalink>

```

Cache

Real File

What happen if we aggregate a Webdav endpoint with a DPM Volatile Pool?

When Dynafed stat files inside the real webdav endpoint, it receive always a reply even from the Volatile Pool.

So that the metalink representing a file in Dynafed, included always the real URL and the corresponding virtual copy in the cache (even if the latter does not exist yet)

Moreover thanks to the GeoPlugin, Dynafed prioritize the cache copy if the Volatile Pool is local to the Client or close to it.

This combination allow to create a cache system

# DAVS protocol in a gbasf2 analysis

Ongoing test are focussed on three possible use-cases:

- DAVS protocol in DIRAC
- DAVS + Dynafed + DIRAC
- DAVS + Dynafed + DPM Volatile Pool (Cache) + DIRAC

All previous use-cases has been tested with success with local jobs using basf2 running in a user-interface.

Next stage is check the possibility to use in DIRAC with gbasf2

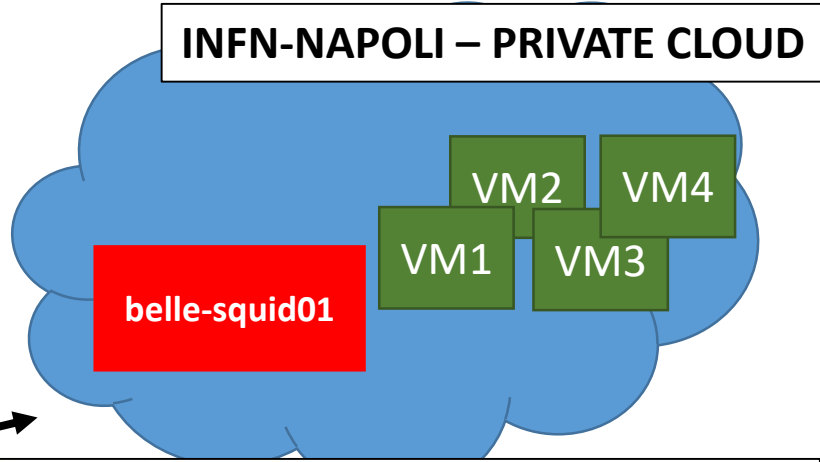
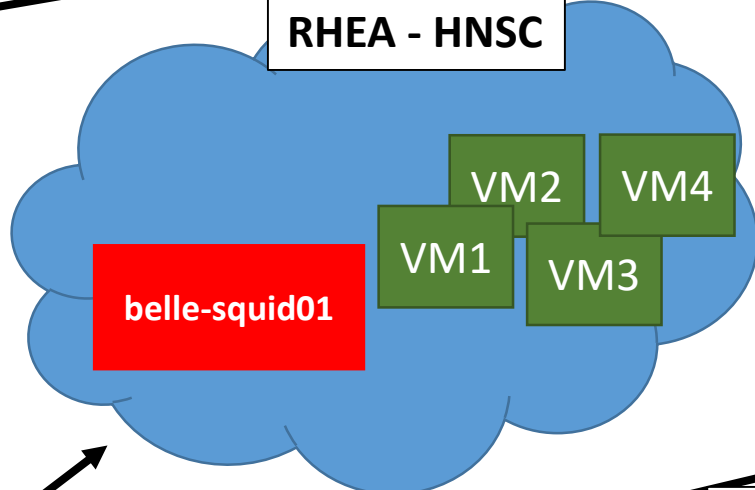
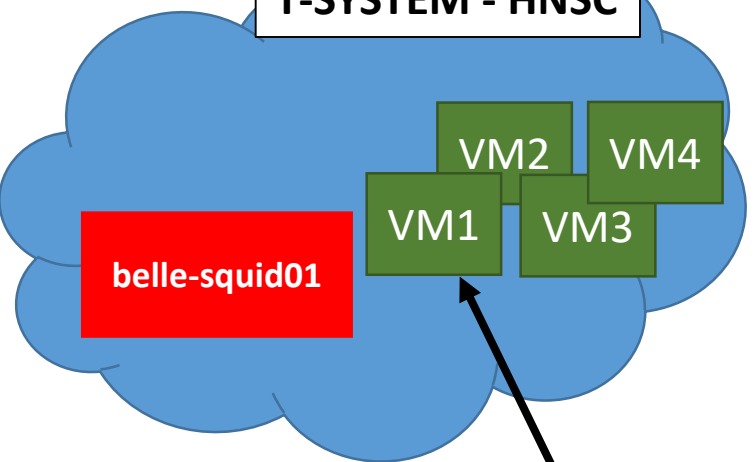
# VCYCLE on HNSciCloud PUBLIC AND PRIVATE CLOUD

RECAS-VCYCLE01.NA.INFN.IT

T-SYSTEM - HNSC

RHEA - HNSC

INFN-NAPOLI – PRIVATE CLOUD



Belle-KEK

Site:VCYCLE.Napoli.it

Site	VM	OS	Kernel	Architecture	Created	Deleted	Updated	Status	Location
VCYCLE01	VM1	Ubuntu	4.15.0-101-generic	x86_64	2017-01-12 10:00:00		2017-01-12 10:00:00	Running	RECAS
VCYCLE01	VM2	Ubuntu	4.15.0-101-generic	x86_64	2017-01-12 10:00:00		2017-01-12 10:00:00	Running	RECAS
VCYCLE01	VM3	Ubuntu	4.15.0-101-generic	x86_64	2017-01-12 10:00:00		2017-01-12 10:00:00	Running	RECAS
VCYCLE01	VM4	Ubuntu	4.15.0-101-generic	x86_64	2017-01-12 10:00:00		2017-01-12 10:00:00	Running	RECAS
VCYCLE01	belle-squid01	Ubuntu	4.15.0-101-generic	x86_64	2017-01-12 10:00:00		2017-01-12 10:00:00	Running	RECAS

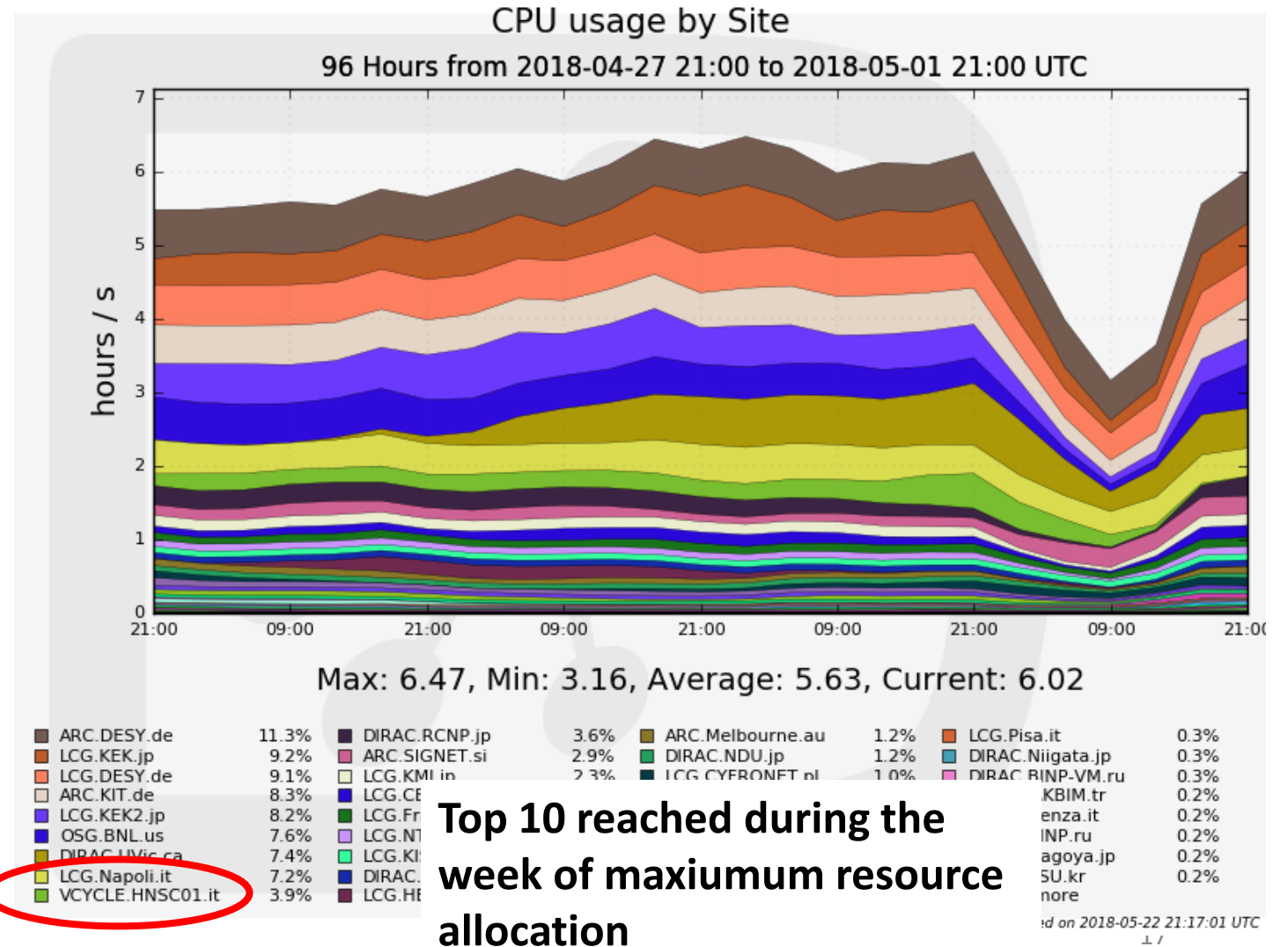
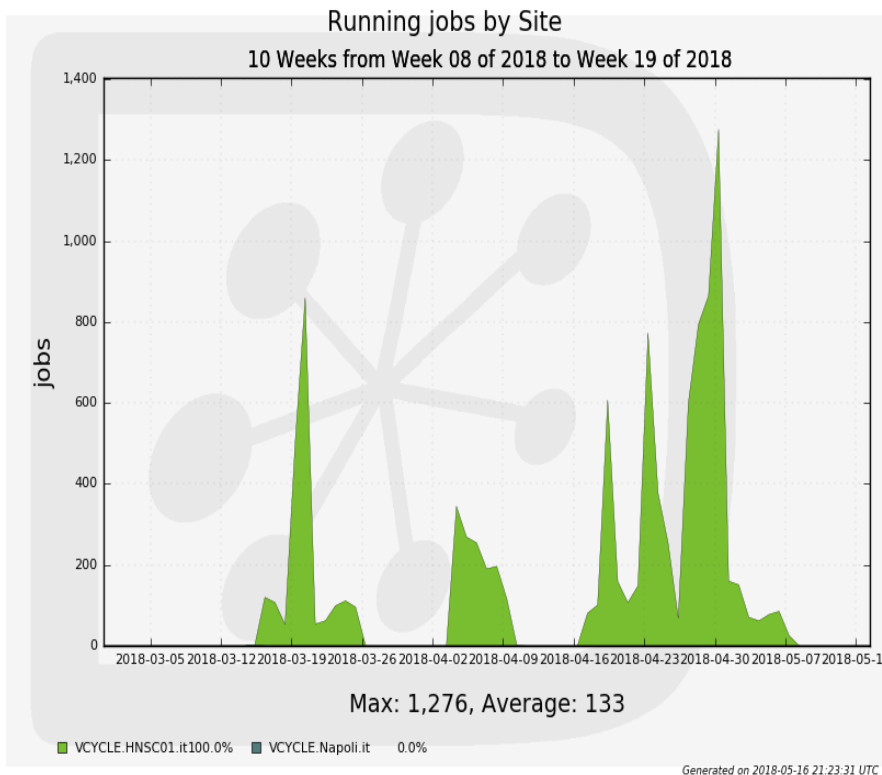
DIRAC Sites  
VCYCLE.Napoli.it  
VCYCLE.HNSC01.it  
VCYCLE.HNSC02.it

**Helix Nebula** @HelixNebulaSC · 1 dic 2017  
 What's the status of the HNSciCloud hybrid cloud platform for the research community? Almost ready to pilot and bring on board adopters [hnscloud.eu](http://hnscloud.eu)  
 Traduci dalla lingua originale: inglese

The screenshot shows a presentation slide titled "Growing the buyers group". It features a diagram of a cloud ecosystem and a list of benefits. A red circle highlights a sub-diagram within the main diagram.



# Running jobs during scalability test (last 2 months)



# PRIN Project HTTPhy

Young line/Linea Giovani

HTTP Ecosystem for Multi-Experiment Analysis in Particle Physics. (HTTPhy)

The HTTPhy project aims at developing an HTTP ecosystem for Particle Physics experiments and obtain excellence scientific results using the new platform. The architecture provides a data federation services and a set of Big-Data tools built on top of a set of distributed storages. (Belle II and Belle the main use-cases)

PE - Physical Sciences and Engineering

Three Unit

INFN - Silvio Pardi (PI) – Elisa Manoni – Umberto Tamponi

UNITO - Stefano Spataro

UNIFI - Giulia Casarosa – Laura Zani.

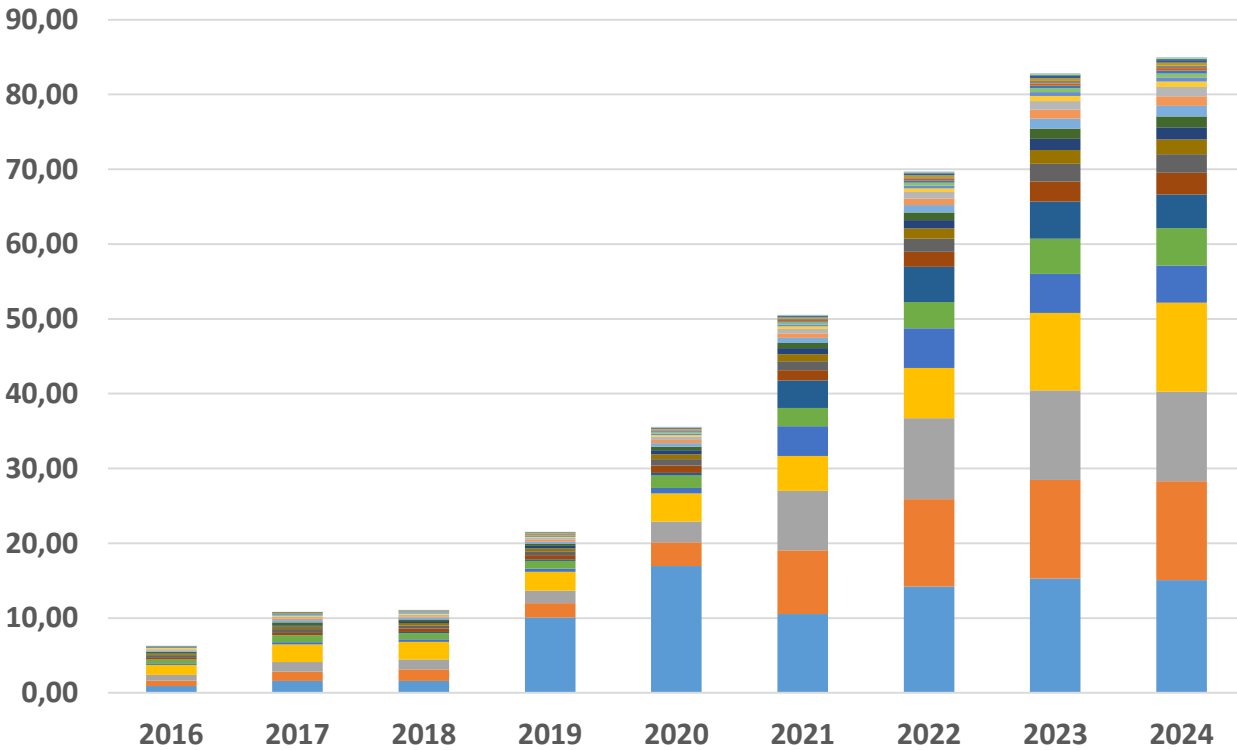
Budget: **799.465,4 (594.259,4 MIUR Funding)**

**Status: Submitted.**

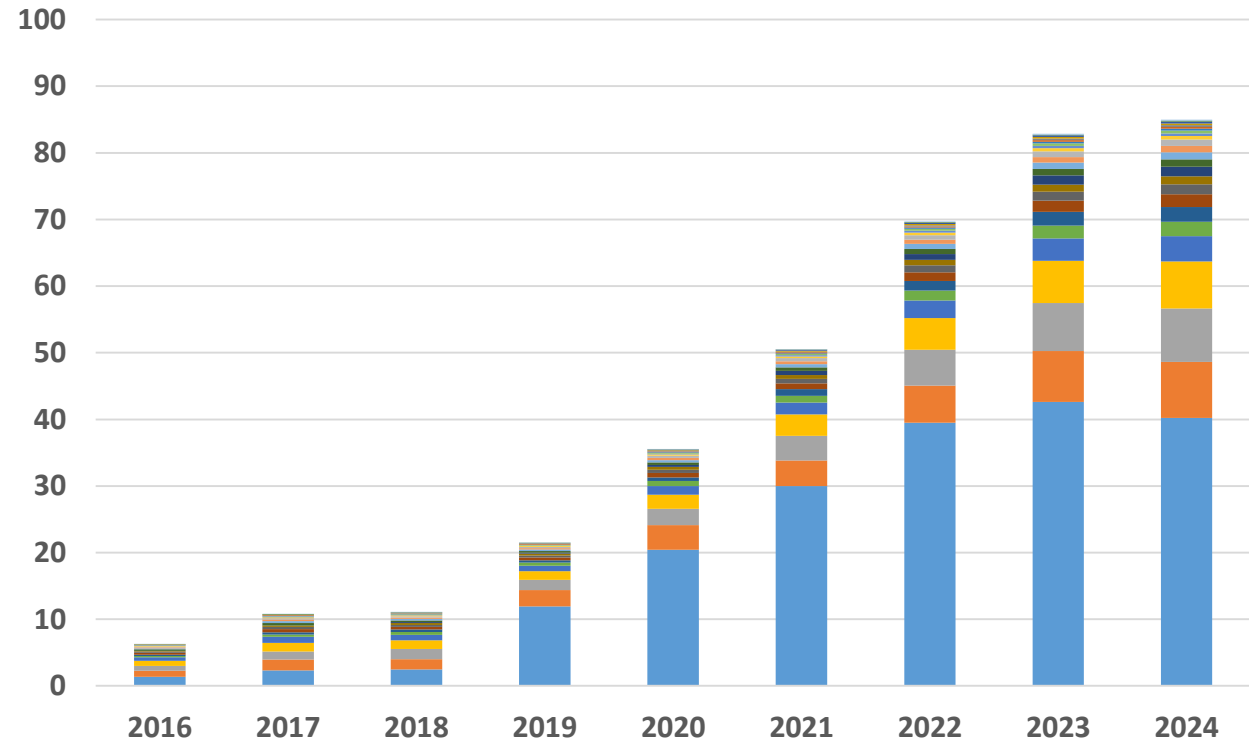
**BACKUP**

# Max Bandwidth per Country per year (In and Out)

Max Bandwidht per year - In (Gbps)



Max Bandwidht per year - Out (Gbps)



- USA
- Russia
- Australia
- Austria
- Thailand
- Italy
- France
- Taiwan
- Czech
- Ukraine
- Germany
- China
- Slovenia
- Mexico
- Vietnam
- KEK
- Canada
- Korea
- India
- Poland
- Malaysia
- Turkey
- Israel
- Saudi Arabia
- Spain

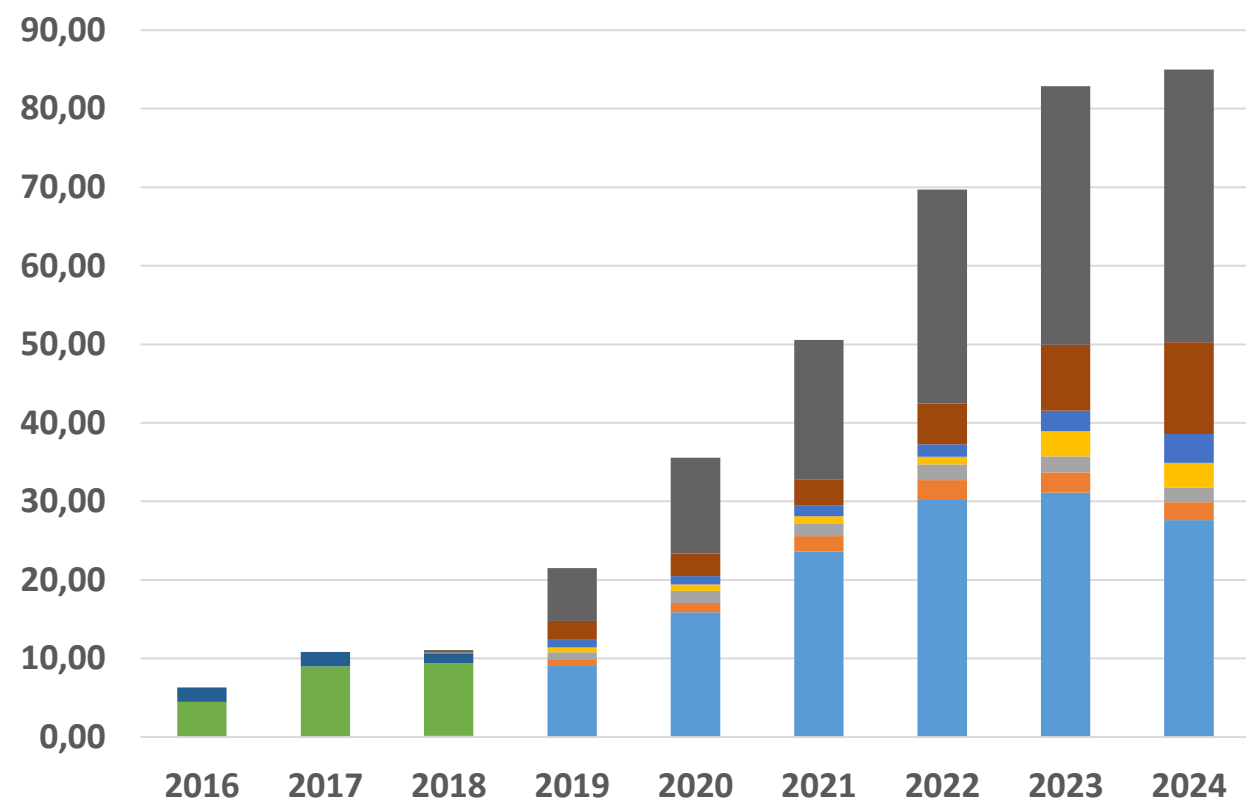
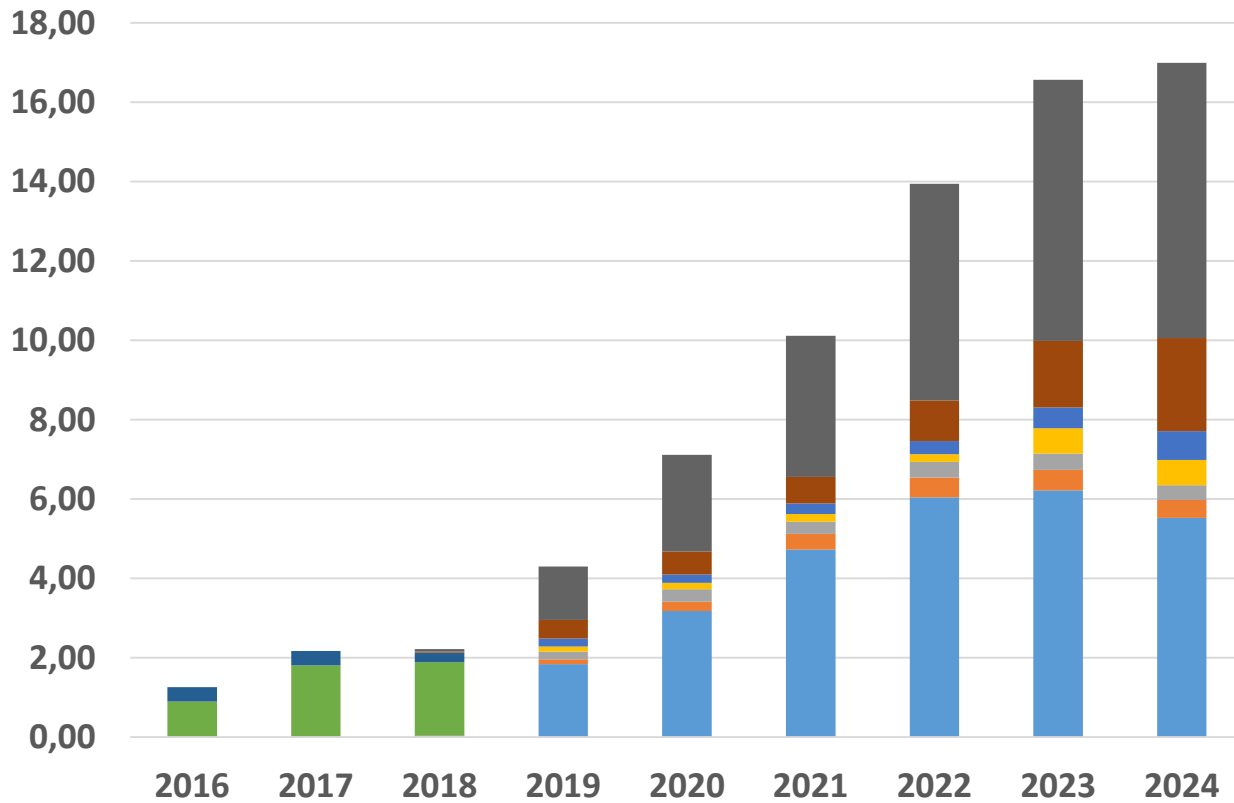
- KEK
- China
- France
- Austria
- Thailand
- USA
- Canada
- Taiwan
- Czech
- Ukraine
- Italy
- Korea
- Slovenia
- Mexico
- Vietnam
- Germany
- Russia
- India
- Australia
- Poland
- Malaysia
- Turkey
- Israel
- Saudi Arabia
- Spain

# Total Throughput and Max Bandwidth per Data Type per year

**ANALYSIS, RAW DATA, AND SKIMMING MOVEMENT ARE THE DOMINANT DATA FLOWS**

Total Throughput IN/OUT per year (Gbps)

Max Bandwidth IN/OUT per year (Gbps)



- RAW
- MDST
- MC
- Data Reprocessing
- MC Reprocessing
- MC-PreData-Taking
- Data Challenge
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# Table of Absolute Maxs

	Thrugput		Max Bandwidth	
	IN	OUT	IN	OUT
KEK	2,38	8,52	11,89	42,61
USA	3,39	1,68	16,96	8,41
Italy	2,65	1,60	13,23	8,00
Germany	2,40	1,41	11,99	7,05
Canada	1,06	0,45	5,30	2,24
Russia	1,01	0,76	5,03	3,79
France	0,99	0,29	4,96	1,43
China	0,57	0,43	2,87	2,17
Korea	0,50	0,38	2,51	1,90
India	0,40	0,30	1,98	1,49
Australia	0,32	0,24	1,62	1,22
Slovenia	0,29	0,22	1,44	1,08
Taiwan	0,29	0,22	1,44	1,08
Mexico	0,25	0,19	1,26	0,95
Poland	0,25	0,19	1,26	0,95
Austria	0,14	0,11	0,72	0,54
Czech	0,11	0,08	0,54	0,41
Vietnam	0,11	0,08	0,54	0,41
Israel	0,07	0,05	0,36	0,27
Malaysia	0,07	0,05	0,36	0,27
Thailand	0,07	0,05	0,36	0,27
Turkey	0,07	0,05	0,36	0,27
Ukraine	0,07	0,05	0,36	0,27
Saudi Arabia	0,04	0,03	0,18	0,14
Spain	0,04	0,03	0,18	0,14

Red Values => 1Gbps  
Green Values < 1Gbps

# 2° RAW Data Copy Replication Strategy

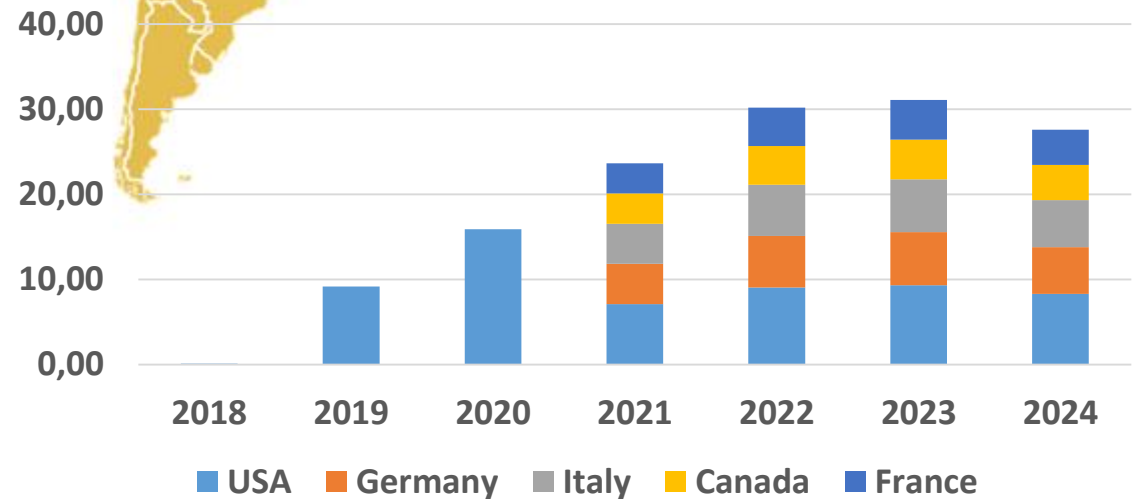
Year	2018- 2020	2021-2024
USA	100%	30%
Italy	0%	20%
Germany	0%	20%
Canada	0%	15%
France	0%	15%

**Max 8.5 Gbps Throughput/year (2023)**

RAW-Data Outbound Max Bandwidth (Gbps)



RAW-Data Inbound Max Bandwidth (Gbps)



**Red Values** => 1Gbps  
**Green Values** < 1Gbps

# USER ANALYSIS MAX BANDWIDTH

## MAX BANDWIDTH IN - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
KEK	0,07	1,46	2,64	3,85	5,91	7,13	7,51
Italy	0,05	0,93	1,68	2,46	3,77	4,55	4,80
USA	0,05	0,93	1,68	2,46	3,77	4,55	4,80
Germany	0,04	0,81	1,46	2,14	3,28	3,95	4,16
Russia	0,02	0,49	0,89	1,30	1,99	2,41	2,53
China	0,01	0,28	0,51	0,74	1,14	1,37	1,45
Korea	0,01	0,25	0,44	0,65	1,00	1,20	1,27
Canada	0,01	0,21	0,38	0,56	0,85	1,03	1,09
India	0,01	0,19	0,35	0,51	0,78	0,95	1,00
Australia	0,01	0,16	0,29	0,42	0,64	0,77	0,81
Slovenia	0,01	0,14	0,25	0,37	0,57	0,69	0,72
Taiwan	0,01	0,14	0,25	0,37	0,57	0,69	0,72
Mexico	0,01	0,12	0,22	0,33	0,50	0,60	0,63
Poland	0,01	0,12	0,22	0,33	0,50	0,60	0,63
France	0,01	0,11	0,19	0,28	0,43	0,52	0,54
Austria	0,00	0,07	0,13	0,19	0,28	0,34	0,36
Czech	0,00	0,05	0,10	0,14	0,21	0,26	0,27
VietNam	0,00	0,05	0,10	0,14	0,21	0,26	0,27
Israel	0,00	0,04	0,06	0,09	0,14	0,17	0,18
Malaysia	0,00	0,04	0,06	0,09	0,14	0,17	0,18
Thailand	0,00	0,04	0,06	0,09	0,14	0,17	0,18
Turkey	0,00	0,04	0,06	0,09	0,14	0,17	0,18
Ukraine	0,00	0,04	0,06	0,09	0,14	0,17	0,18
Saudi Arabia	0,00	0,02	0,03	0,05	0,07	0,09	0,09
Spain	0,00	0,02	0,03	0,05	0,07	0,09	0,09
<b>Totale</b>	<b>0,33</b>	<b>6,73</b>	<b>12,17</b>	<b>17,79</b>	<b>27,27</b>	<b>32,91</b>	<b>34,67</b>

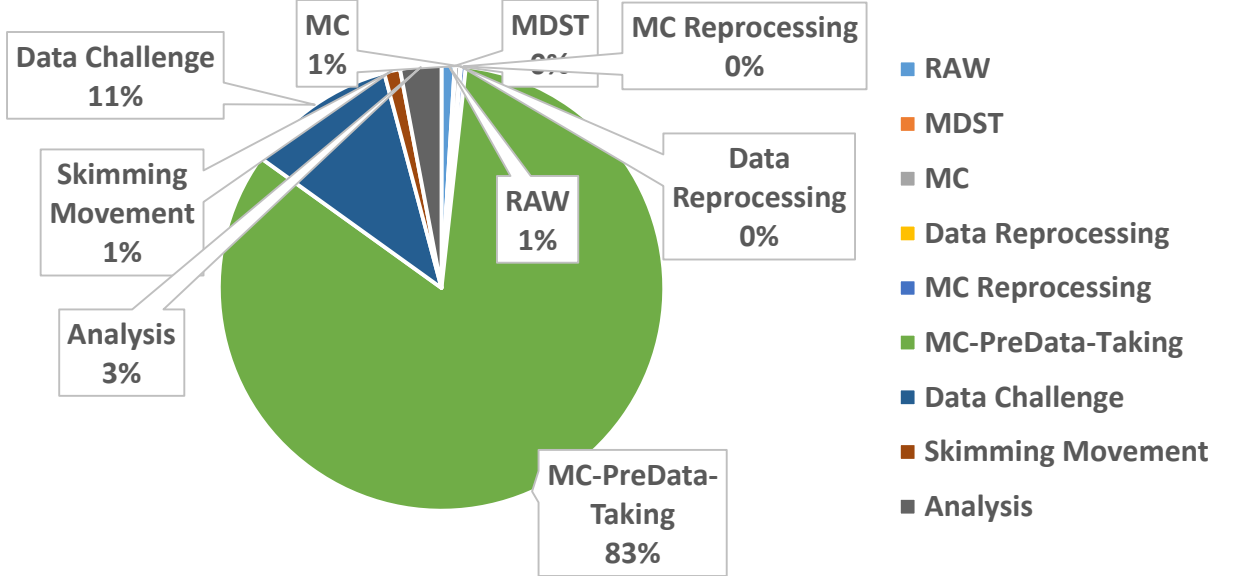
## MAX BANDWIDTH OUT - Gbit/s

	2018	2019	2020	2021	2022	2023	2024
KEK	0,07	1,33	2,13	2,67	4,06	6,29	6,98
Italy	0,05	1,13	2,15	2,55	3,96	4,34	4,57
Germany	0,04	0,98	1,86	2,11	3,31	3,50	3,73
USA	0,04	0,14	0,04	2,17	3,48	3,35	3,66
Russia	0,02	0,60	1,13	1,74	2,60	3,33	3,37
China	0,01	0,34	0,65	1,00	1,49	1,90	1,93
Korea	0,01	0,30	0,57	0,87	1,30	1,67	1,69
India	0,01	0,23	0,45	0,68	1,02	1,31	1,32
Australia	0,01	0,19	0,36	0,56	0,84	1,07	1,08
Slovenia	0,01	0,17	0,32	0,50	0,74	0,95	0,96
Taiwan	0,01	0,17	0,32	0,50	0,74	0,95	0,96
Mexico	0,01	0,15	0,28	0,44	0,65	0,83	0,84
Poland	0,01	0,15	0,28	0,44	0,65	0,83	0,84
Austria	0,00	0,09	0,16	0,25	0,37	0,48	0,48
Czech	0,00	0,06	0,12	0,19	0,28	0,36	0,36
VietNam	0,00	0,06	0,12	0,19	0,28	0,36	0,36
Israel	0,00	0,04	0,08	0,12	0,19	0,24	0,24
Malaysia	0,00	0,04	0,08	0,12	0,19	0,24	0,24
Thailand	0,00	0,04	0,08	0,12	0,19	0,24	0,24
Turkey	0,00	0,04	0,08	0,12	0,19	0,24	0,24
Ukraine	0,00	0,04	0,08	0,12	0,19	0,24	0,24
Saudi Arabia	0,00	0,02	0,04	0,06	0,09	0,12	0,12
Spain	0,00	0,02	0,04	0,06	0,09	0,12	0,12
Canada	0,01	0,26	0,49	0,18	0,39	0,00	0,09
France	0,01	0,13	0,24	0,00	0,00	0,00	0,00
<b>Totale</b>	<b>0,33</b>	<b>6,73</b>	<b>12,17</b>	<b>17,79</b>	<b>27,27</b>	<b>32,96</b>	<b>34,67</b>

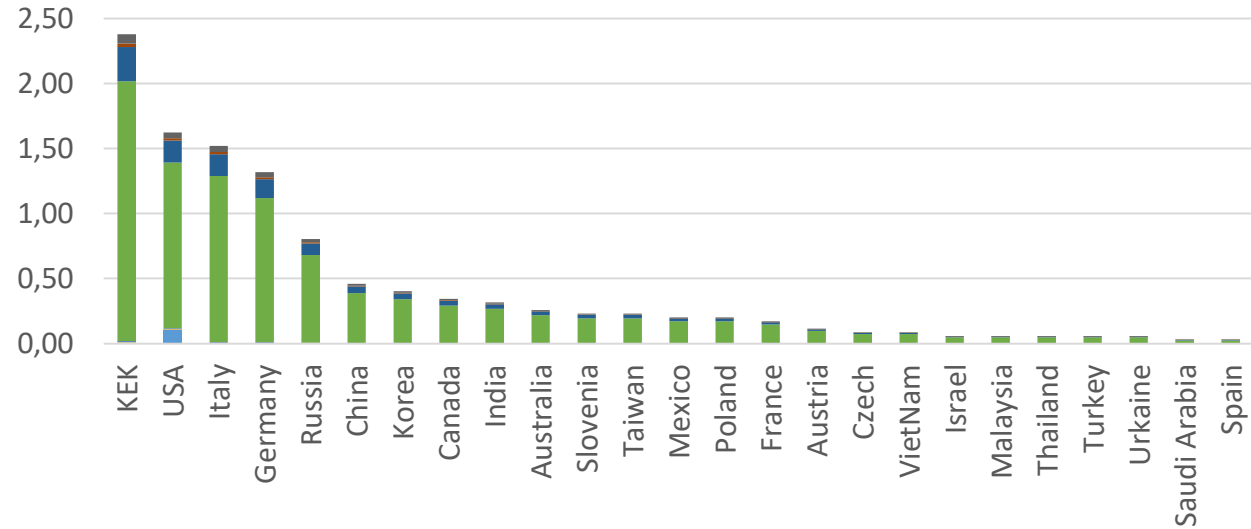




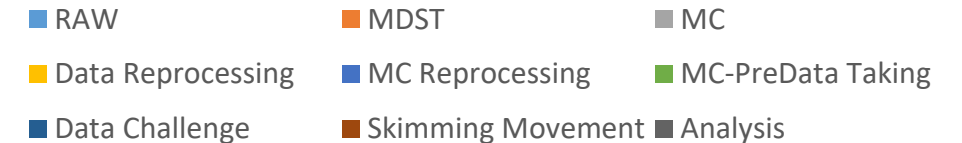
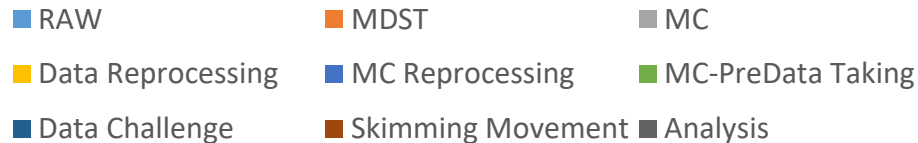
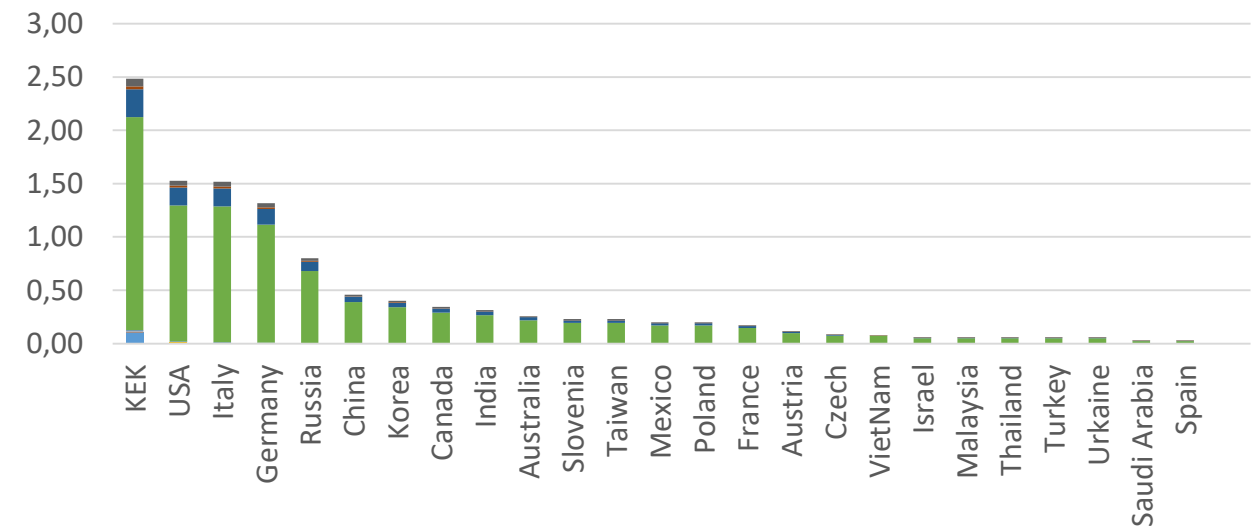
# Max Bandwidth - 2018



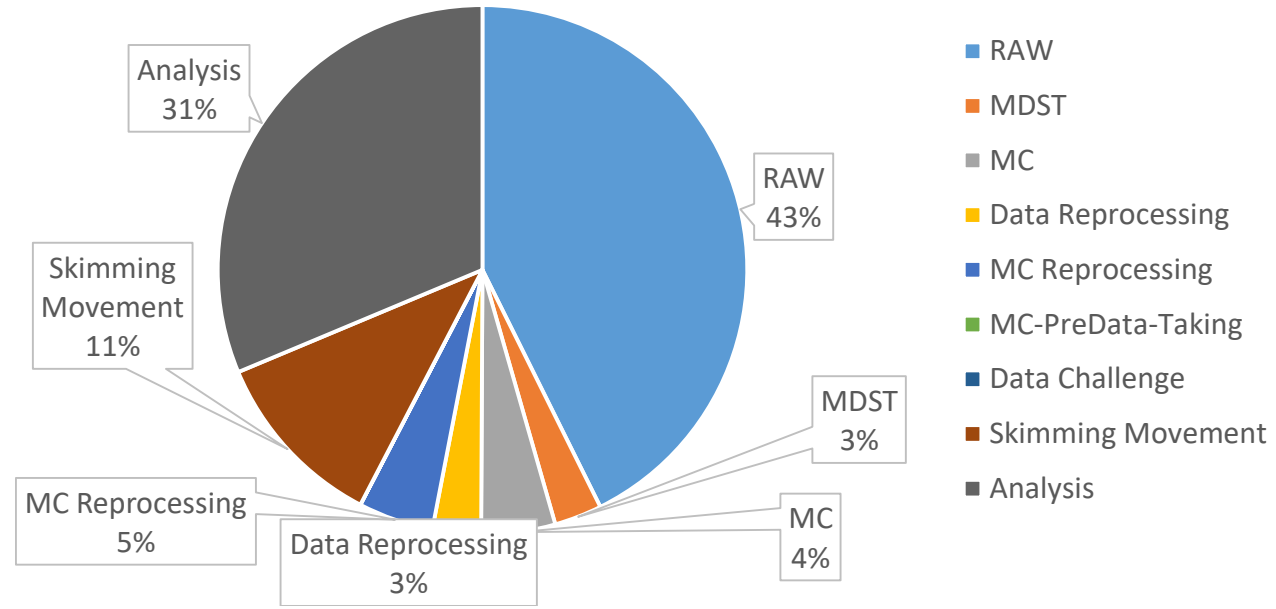
Max Bandwidth 2018 - IN



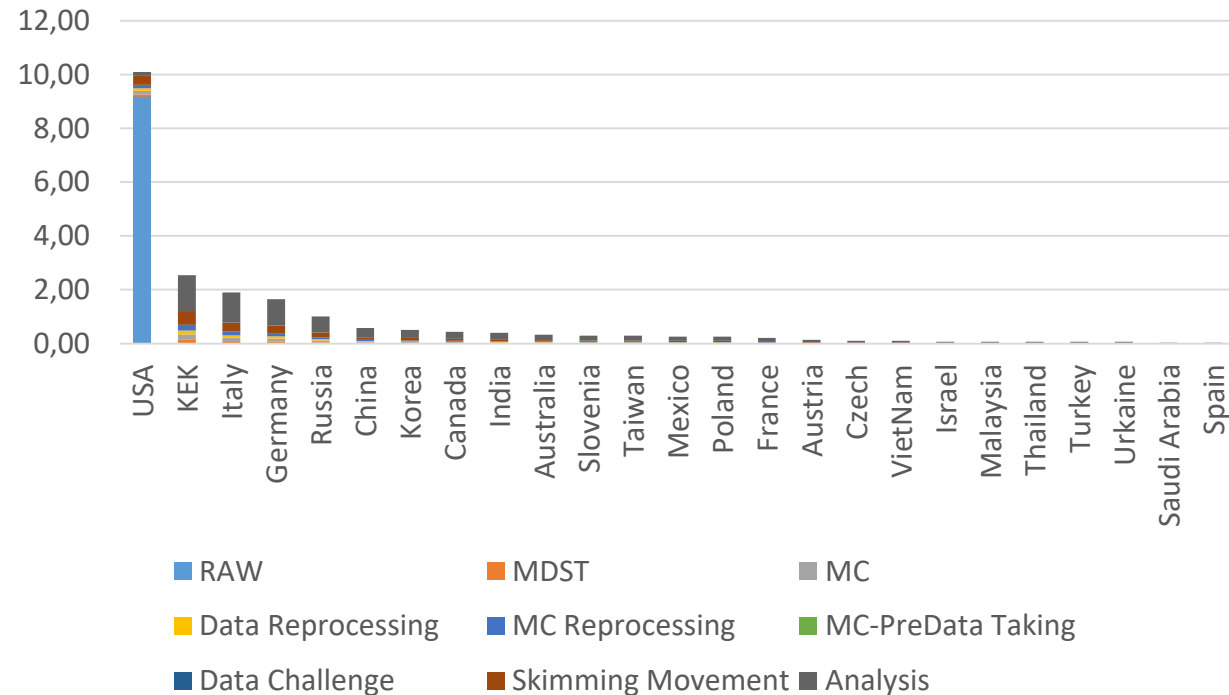
Max Bandwidth 2018 - Out



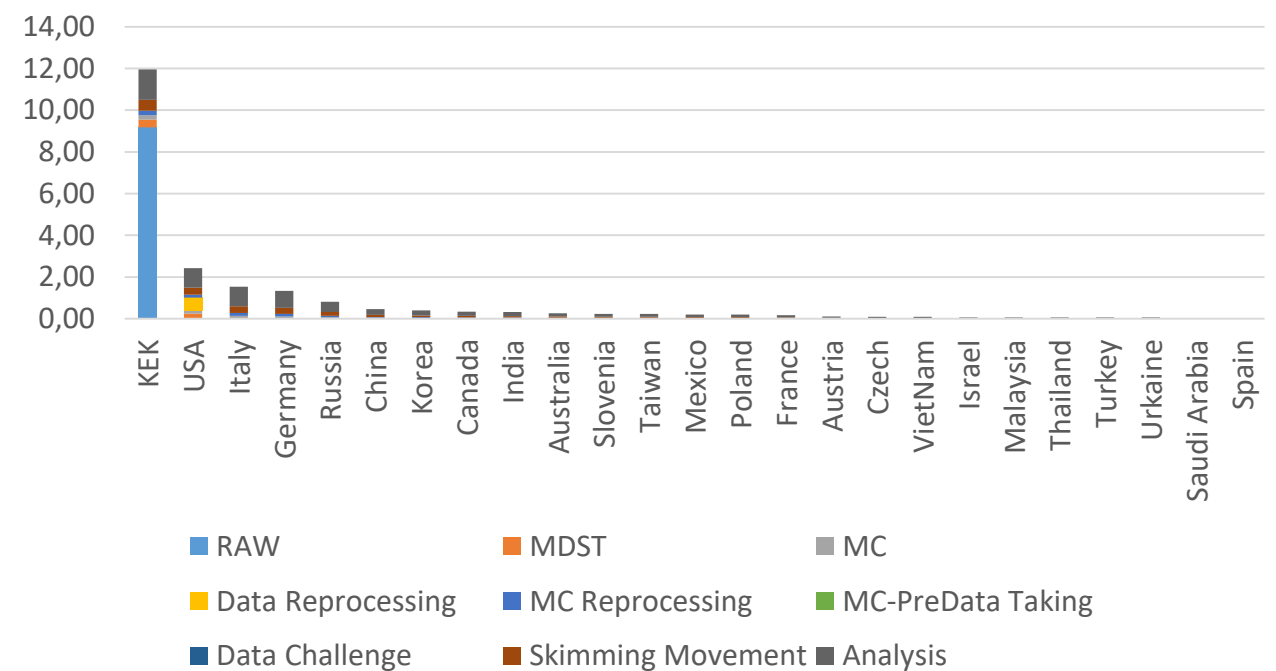
# Max Bandwidth - 2019



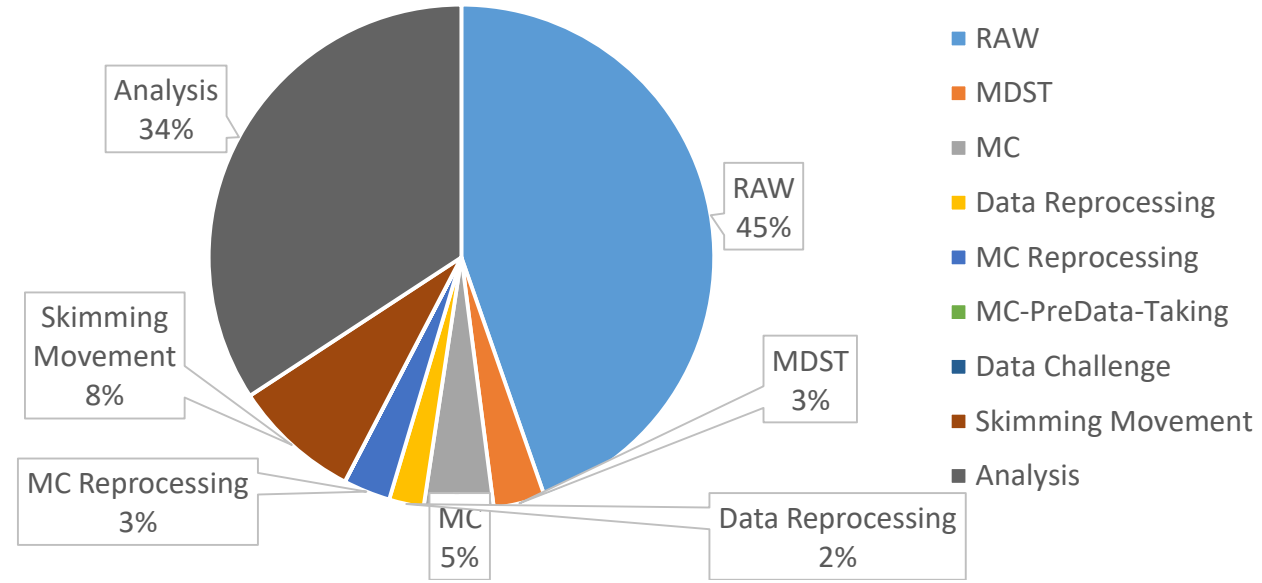
Max Bandwidth 2019 - In



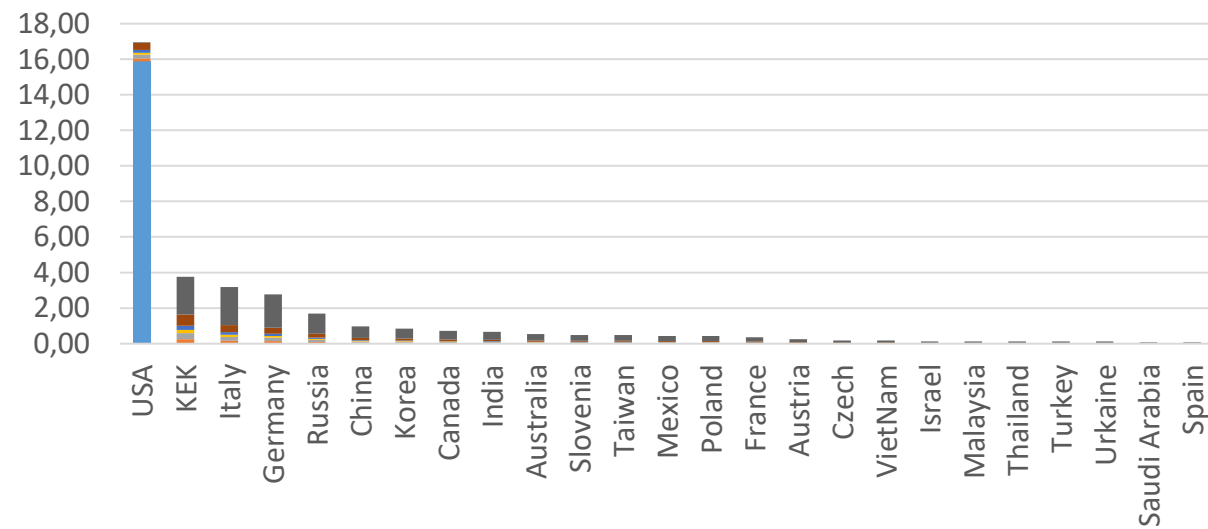
Max Bandwidth 2019 - Out



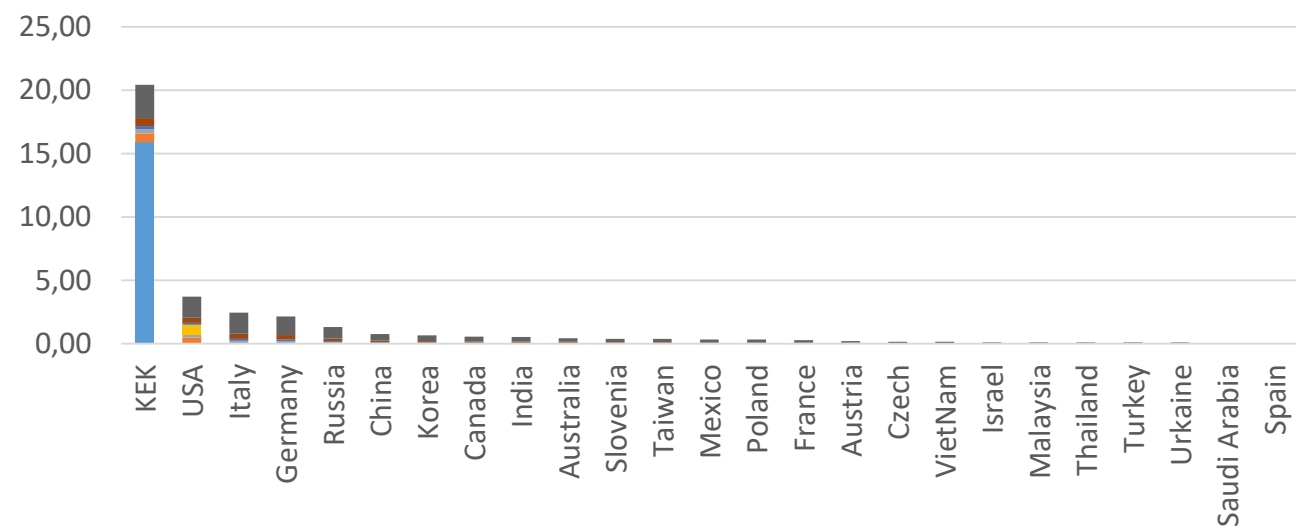
# Max Bandwidth - 2020



Max Bandwidth 2020 - In



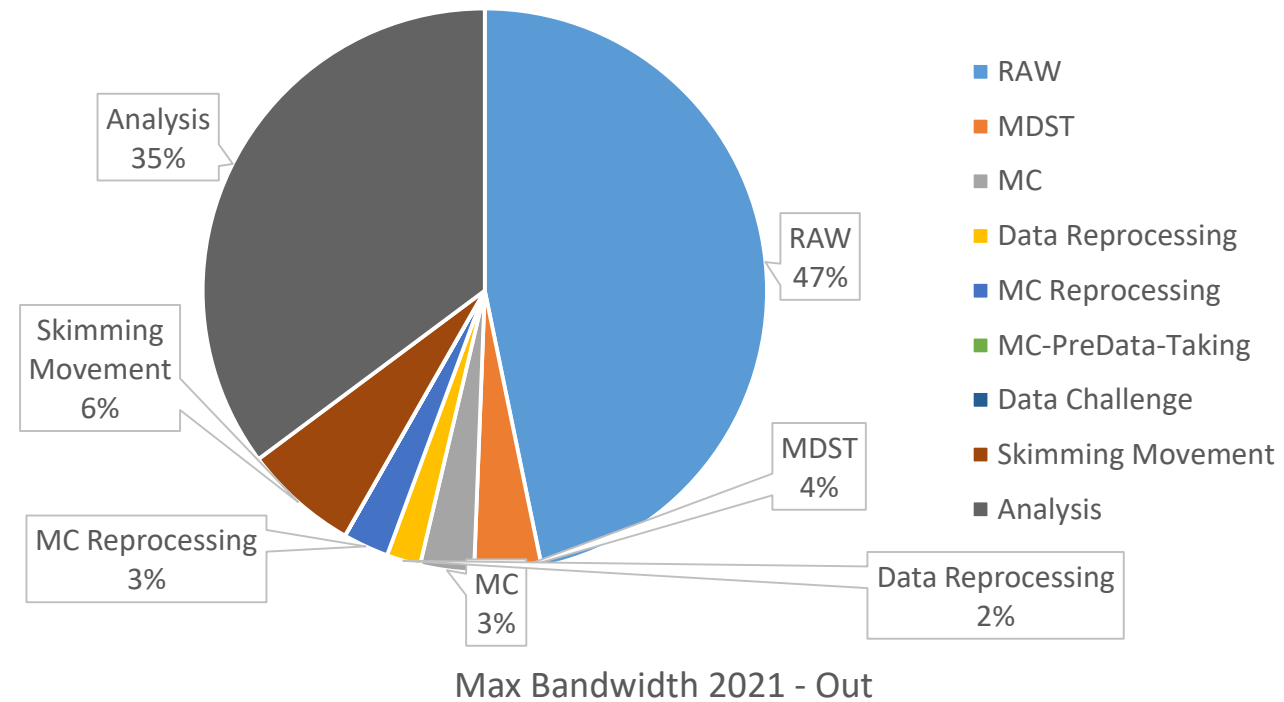
Max Bandwidth 2020 - Out



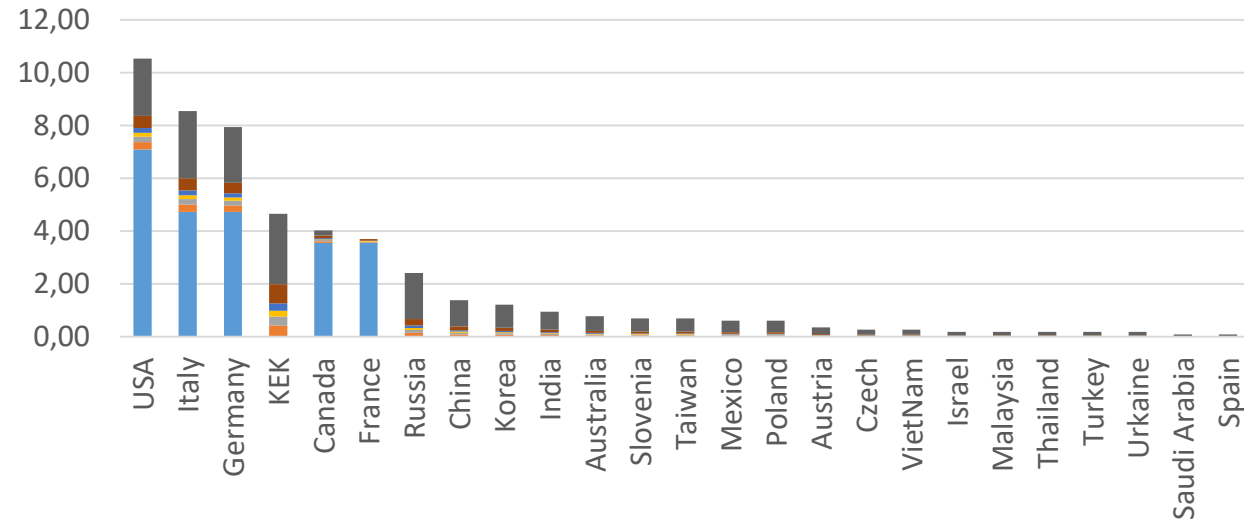
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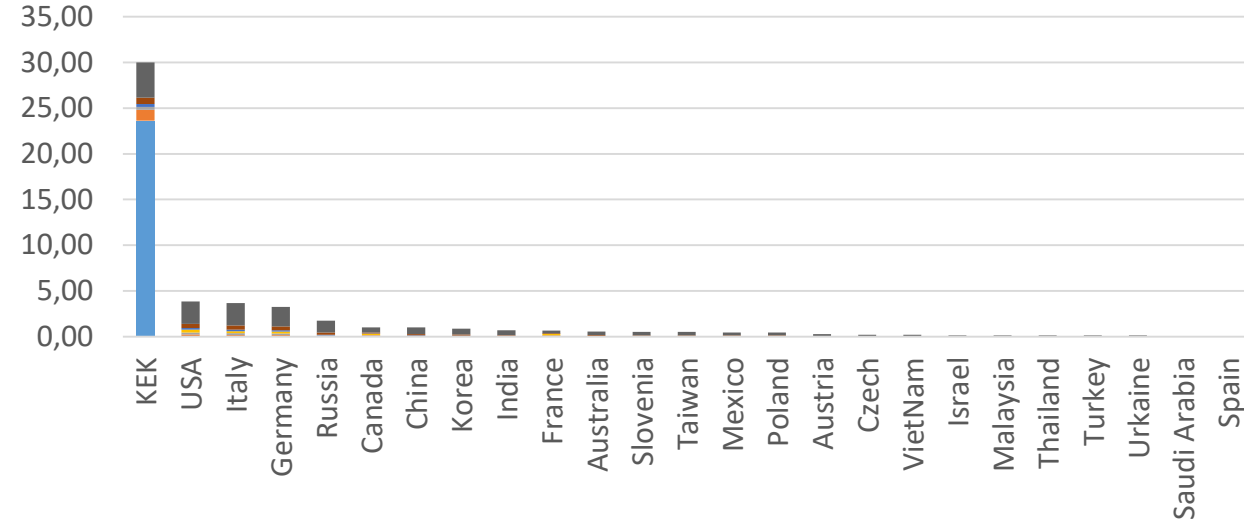
# Max Bandwidth - 2021



Max Bandwidth 2021 - In



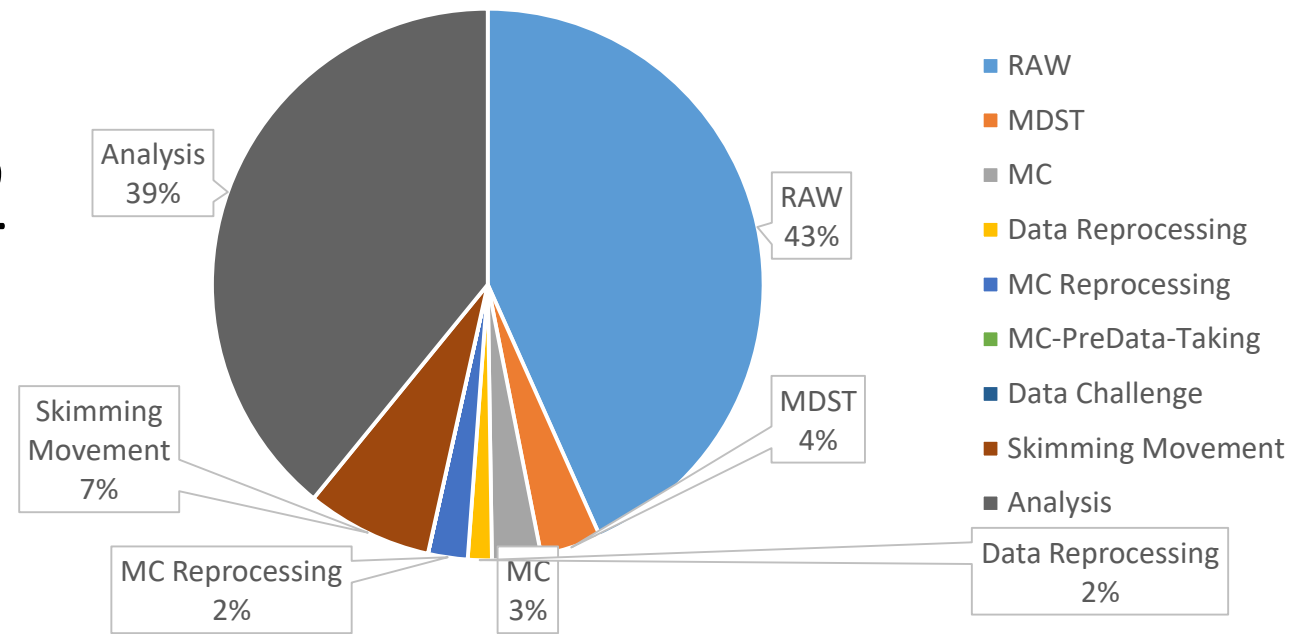
Max Bandwidth 2021 - Out



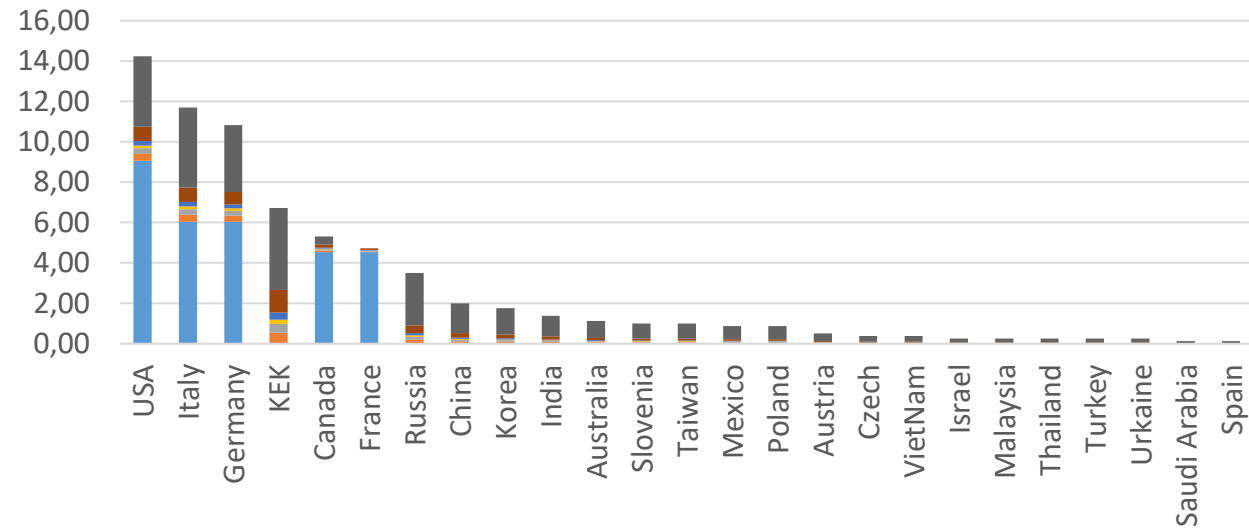
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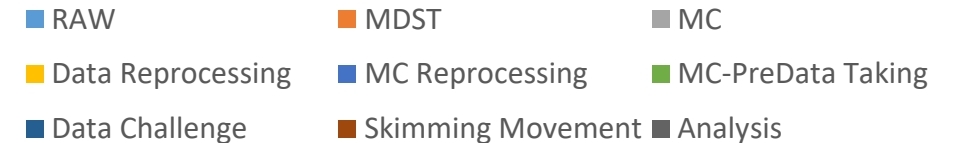
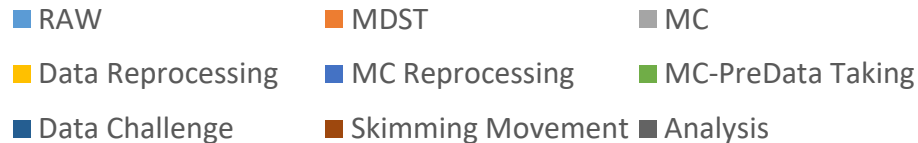
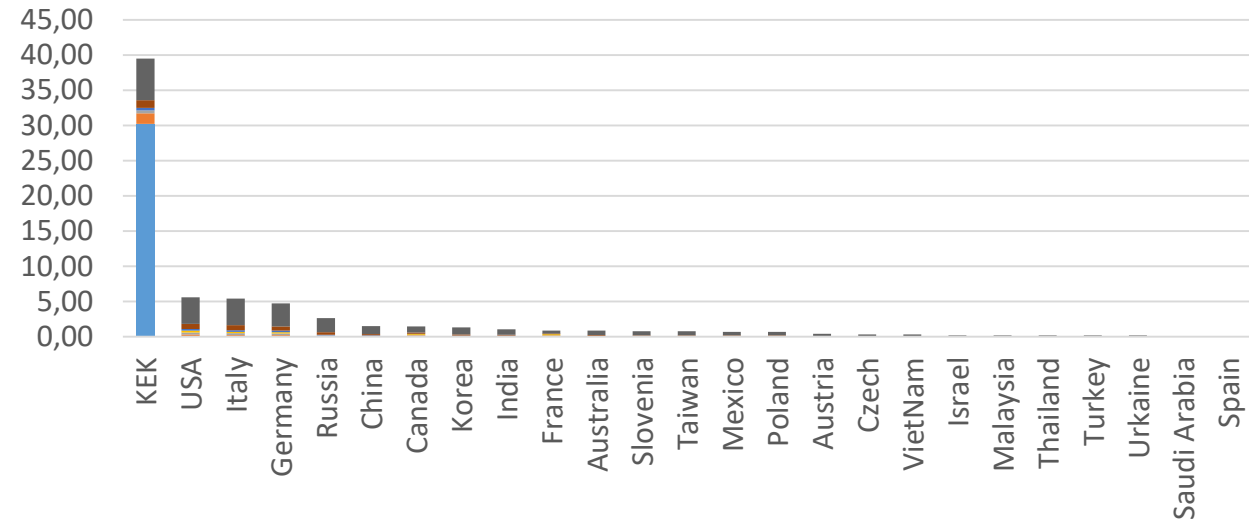
# Max Bandwidth - 2022



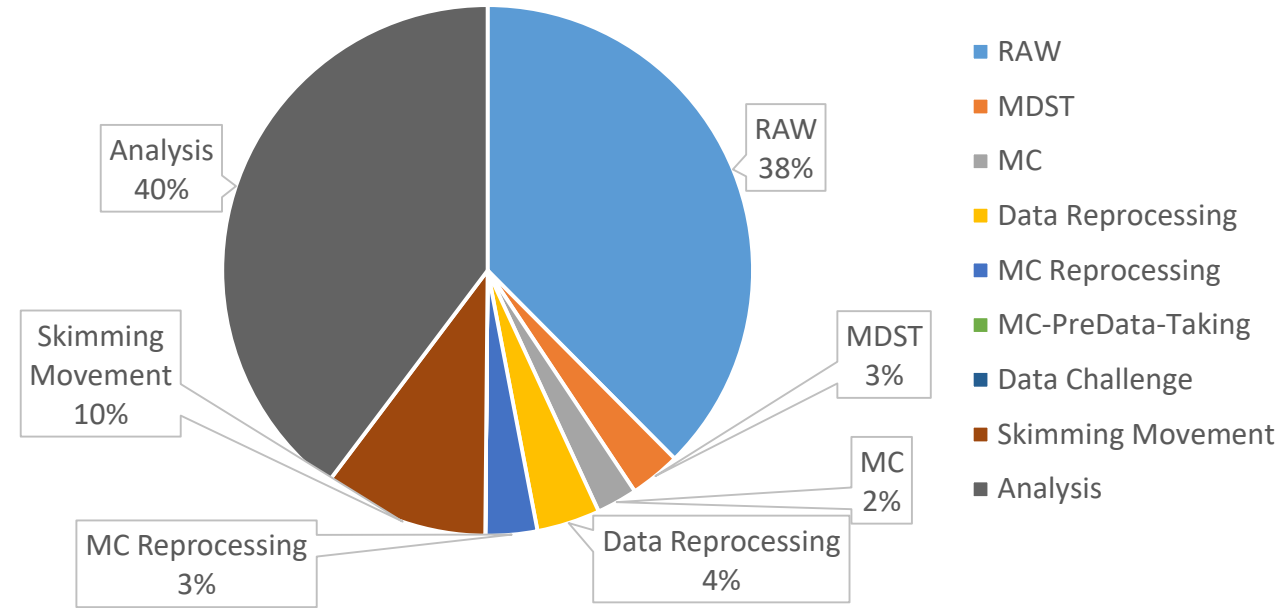
Max Bandwidth 2022 - In



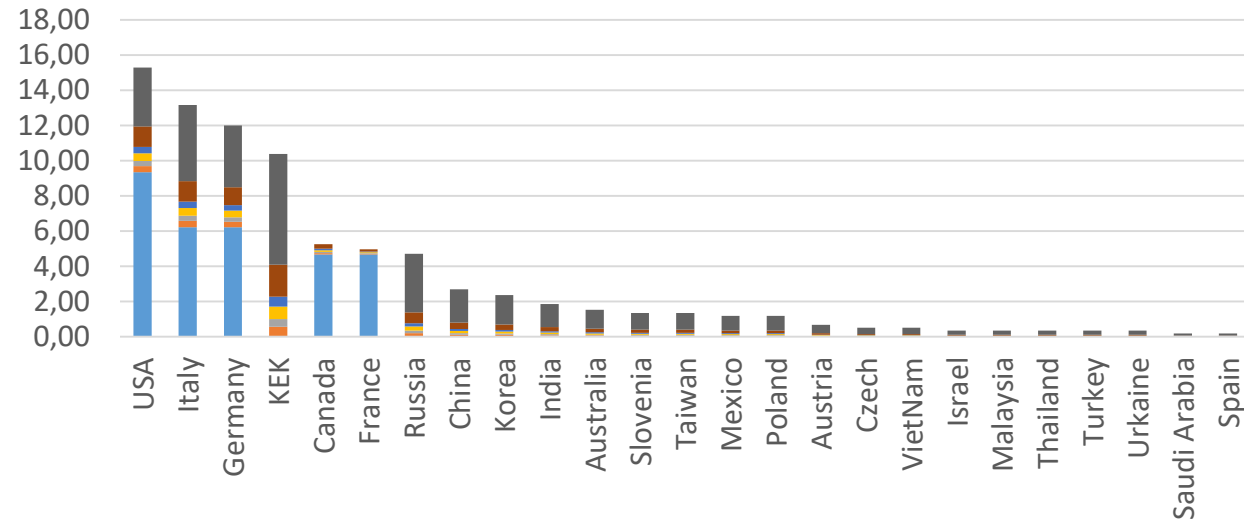
Max Bandwidth 2022 - Out



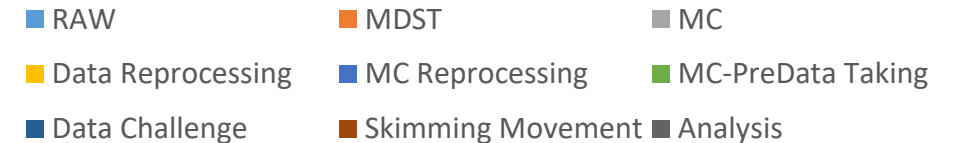
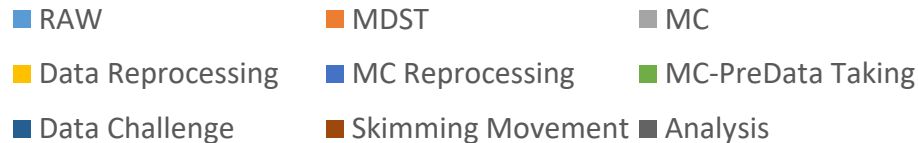
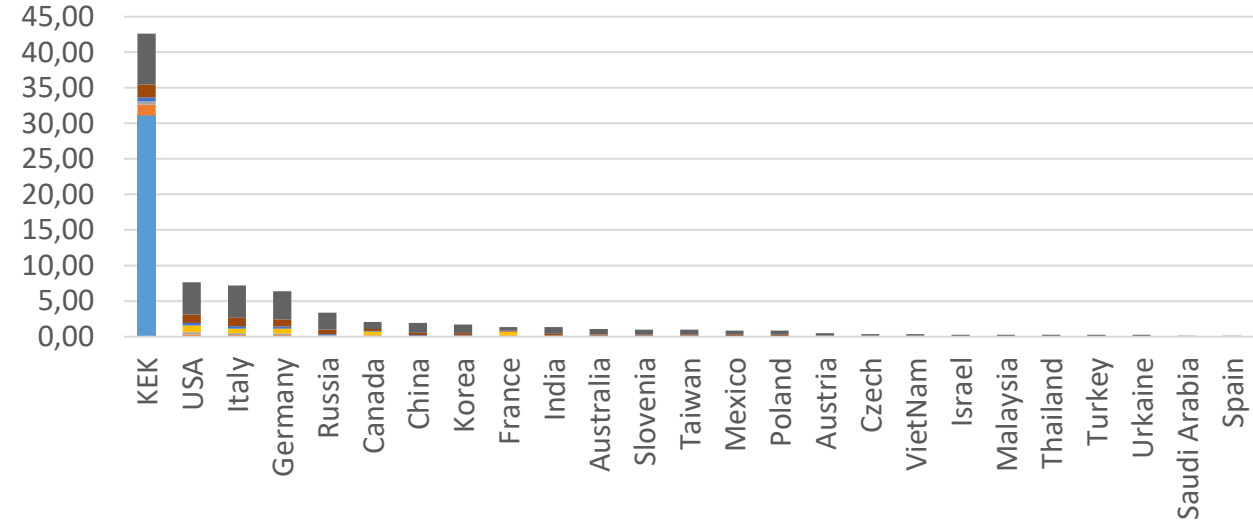
# Max Bandwidth - 2023



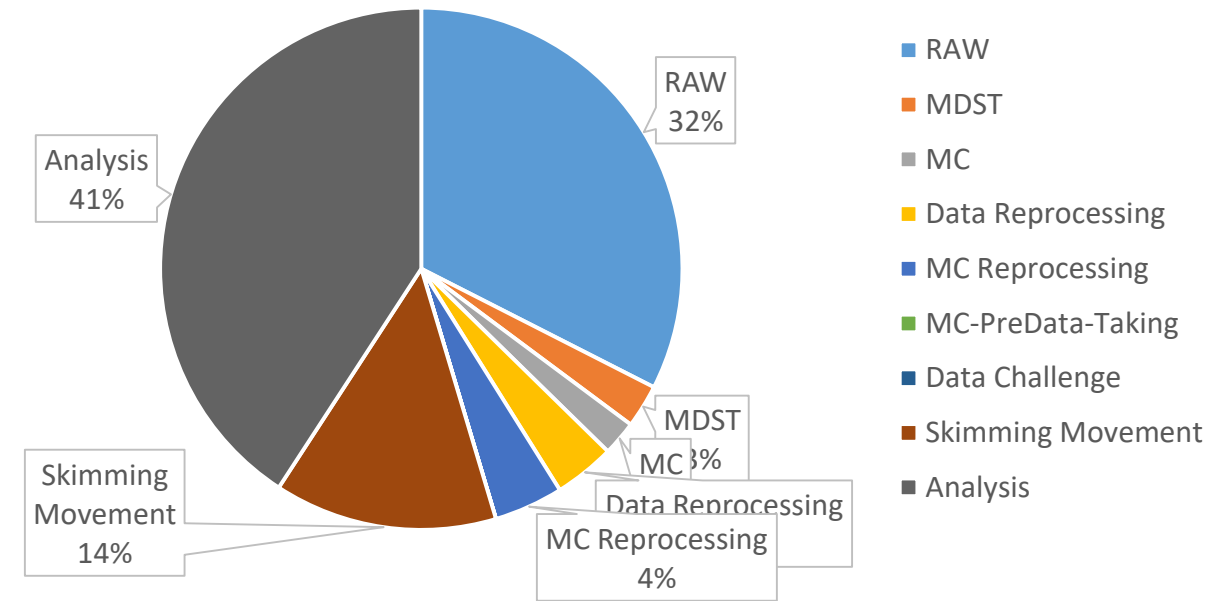
Max Bandwidth 2023 - In



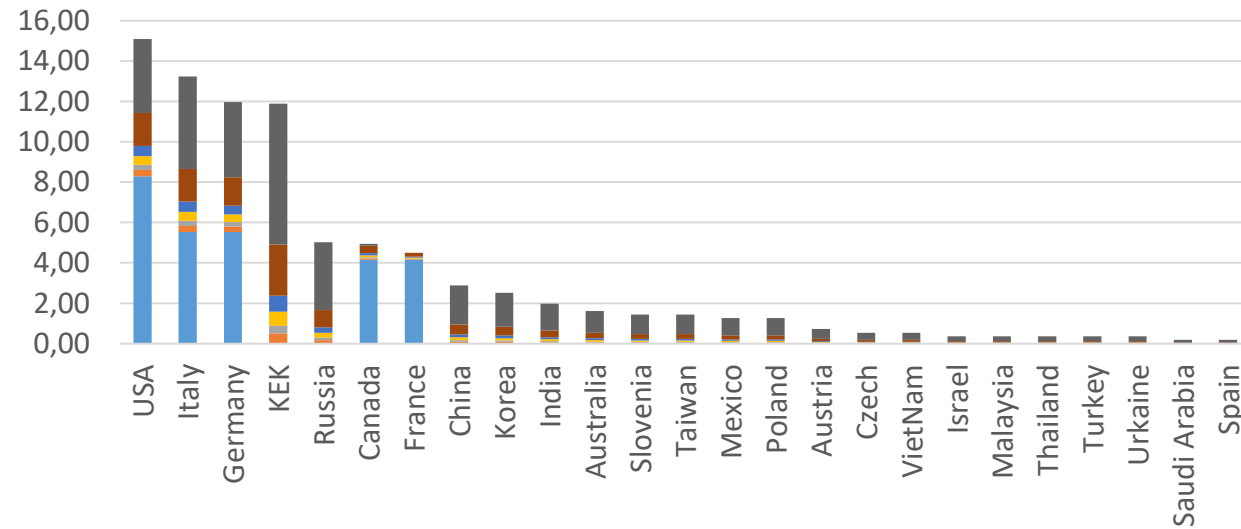
Max Bandwidth 2023 - Out



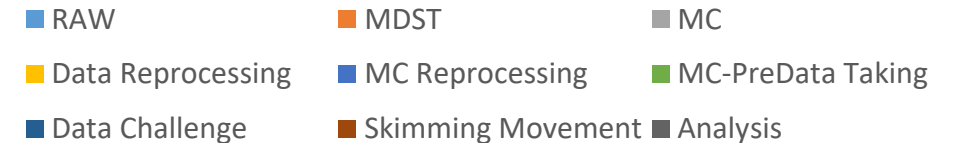
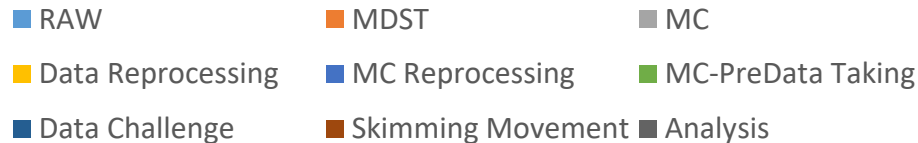
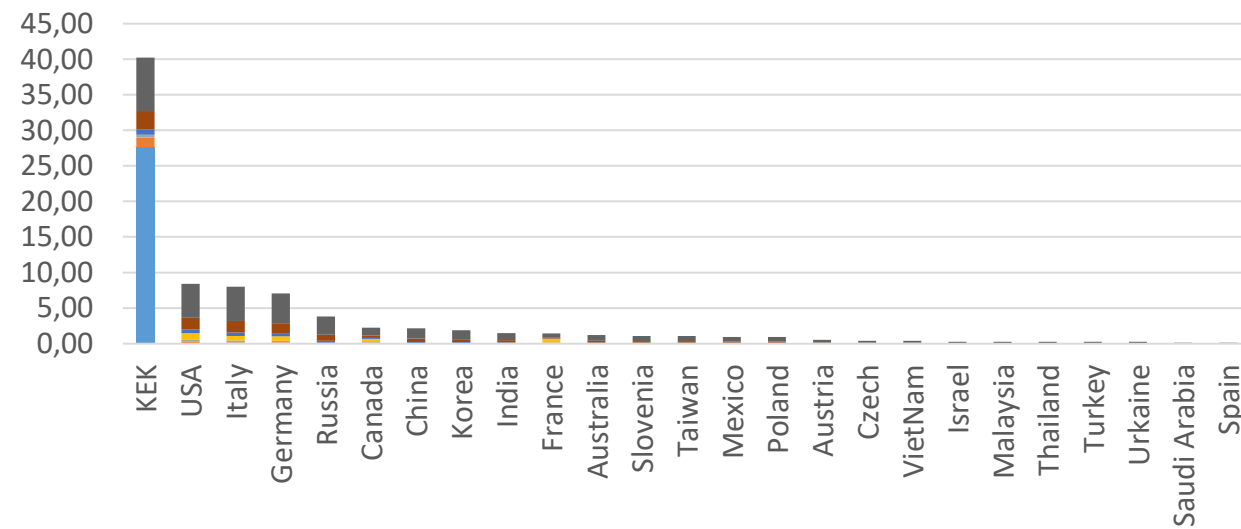
# Max Bandwidth - 2024



Max Bandwidth 2024 - In



Max Bandwidth 2024 - Out





- [https://www.juniper.net/documentation/en\\_US/junos/topics/concept/policer-mx-m120-m320-burstersize-determining.html](https://www.juniper.net/documentation/en_US/junos/topics/concept/policer-mx-m120-m320-burstersize-determining.html)