

Distributed computing infrastructure for the SPD experiment

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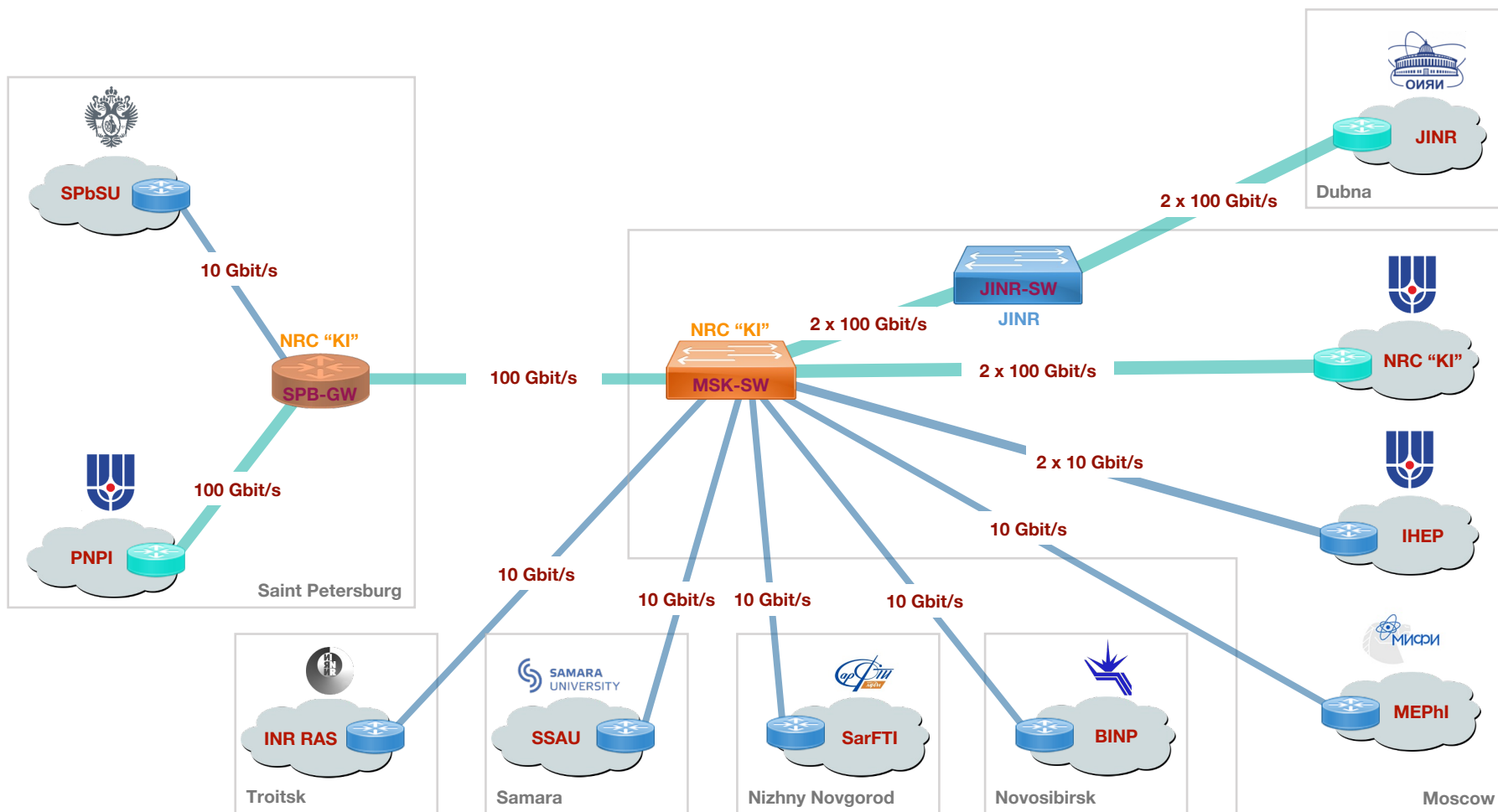
Outline

- Network
- JINR Central Services
- External Sites

Network

- Fast and reliable network is of paramount importance for the distributed computing model adopted by SPD
- It is essential not only for production services but also for everyday work of physicists at participating institutes
- We tend to take network infrastructure for granted, but we should remember that it is expensive and does not come out of nowhere

Russian Scientific Backbone



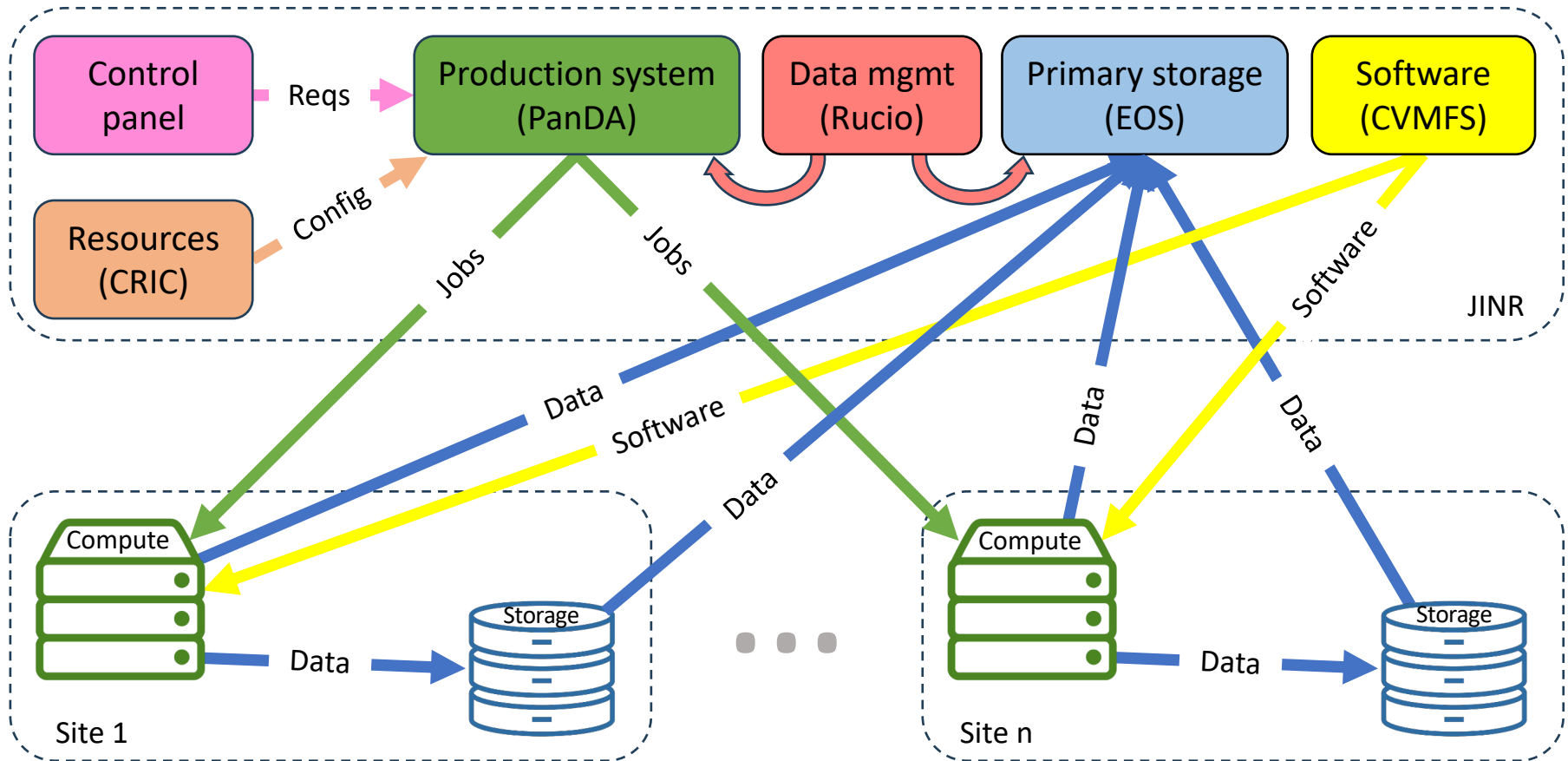
Connection speed

- JINR is connected to backbone with multiple 100Gbps links
 - Storage and Online Filter nodes have 100Gbps network interfaces
 - Most compute nodes have 10Gbps network interfaces
 - At least 100Gbps fault-tolerant fabric is expected inside JINR for all data transfers (Online -> Offline, Offline -> External)
- PNPI is connected to backbone with 100Gbps link
 - Storage nodes have 10Gbps interfaces
 - Compute nodes are connected with 1Gbps links
 - Some improvement is expected, but the hardware is rather old
- SSAU, SPbSU and MEPhI are connected to backbone with 10Gbps links
 - 10Gbps fabric inside

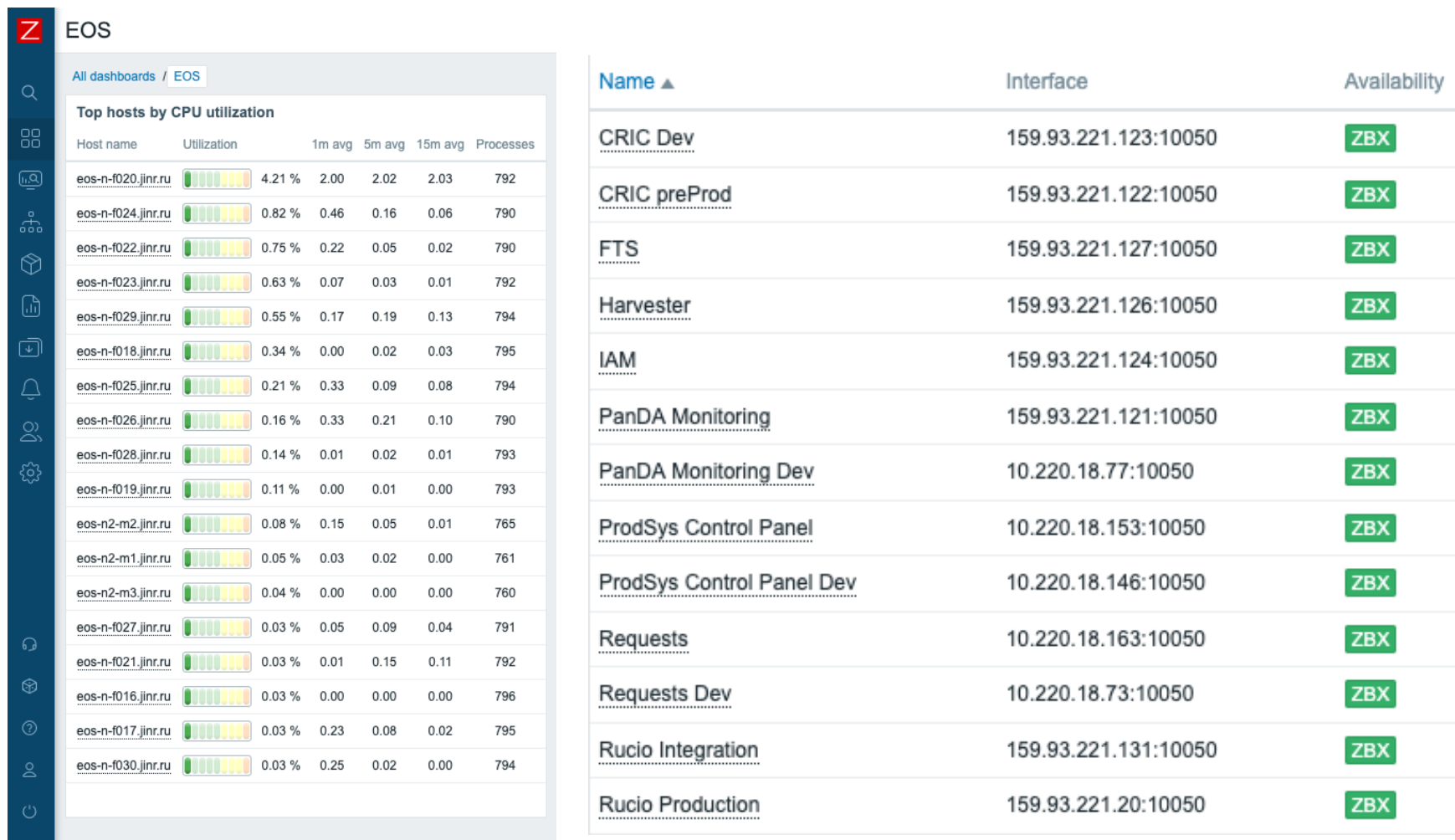
JINR Central Services for SPD

- IAM – the root of trust
- CRIC – resource registry
- CVMFS – software repository
- PanDA/Harvester – job management
- Rucio/FTS – data management
- EOS – primary data storage
- PostgreSQL – database service
- Monitoring for all of the above

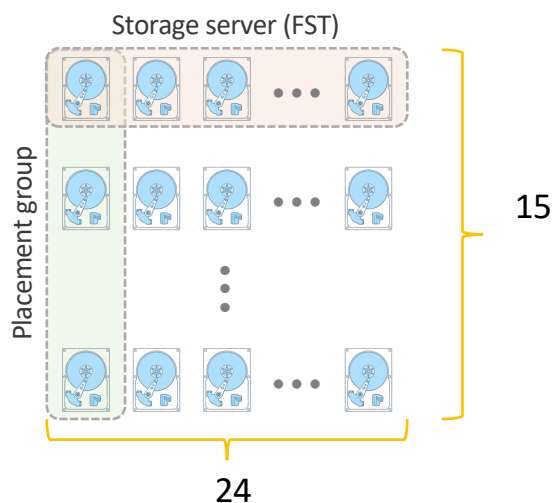
Distributed computing in SPD



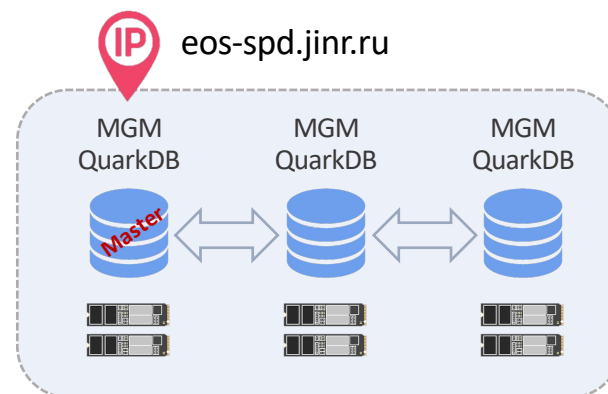
Zabbix monitoring at JINR



EOS deployment at JINR



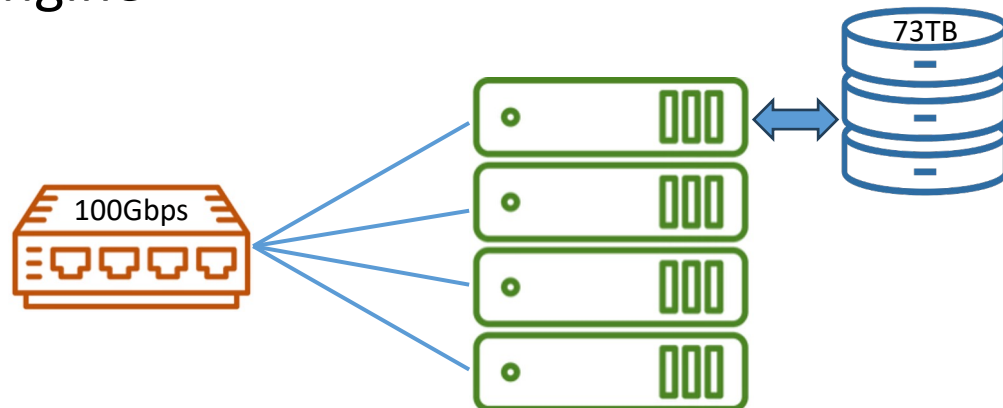
7.2 PB of raw disk storage
 24 placement groups
 15 stripes per group
 11+4 QRAIN layout (27% overhead)
 5.3 PB of usable space



HA MGM/QuarkDB on 3 nodes
 1.5 TB of namespace
 Floating IP alias

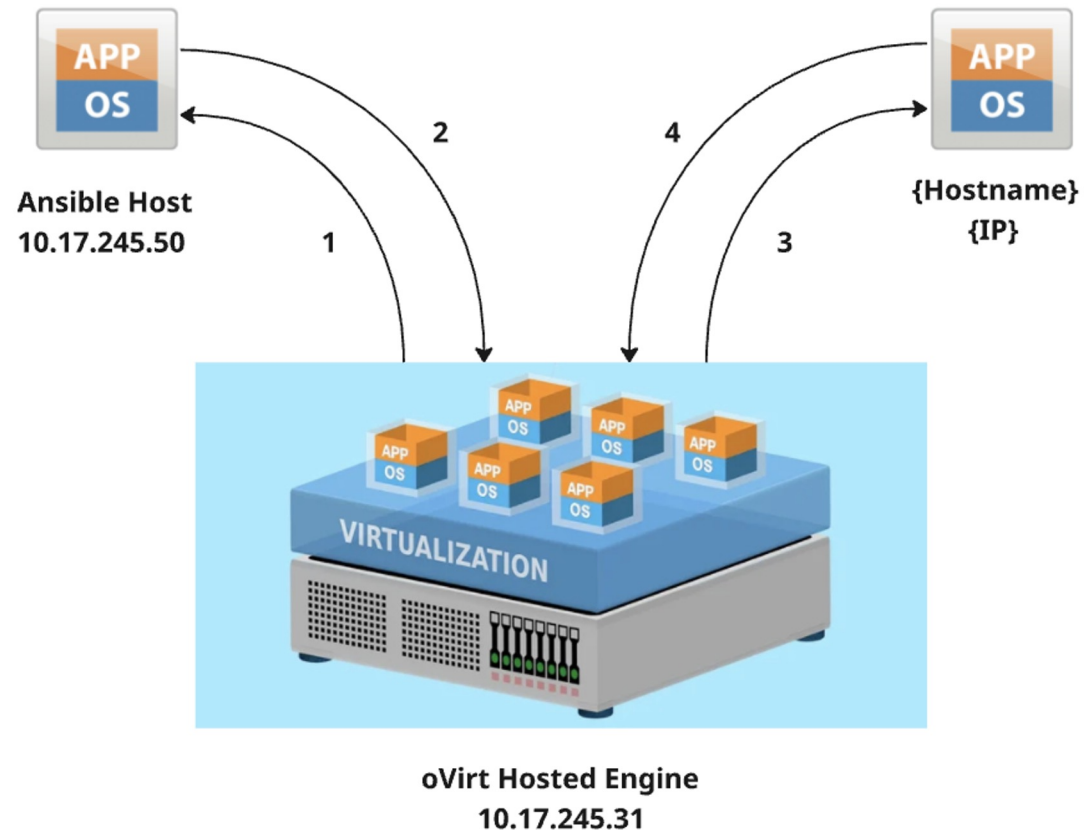
On-line Filter prototype at JINR

- 4 nodes, 128 cores / 256 GB each
 - 73 TB of storage on 1 node
 - 100 Gbps network interfaces
- oVirt for easy VM deployment
 - oVirt Hosted Engine
 - Ansible Host



Deployment of middleware via Ansible

- Ansible talks to the oVirt API to instantly clone VMs from existing template, using Cloud-Init (ConfigDrive) to configure IP address, DNS, and SSH keys on first boot
- Connects via SSH to configure OS-level dependencies and persistently mount the necessary NFS directories
- Extracts the Pilot software from NFS, dynamically assigns a unique pilot ID and registers a user-level daemon



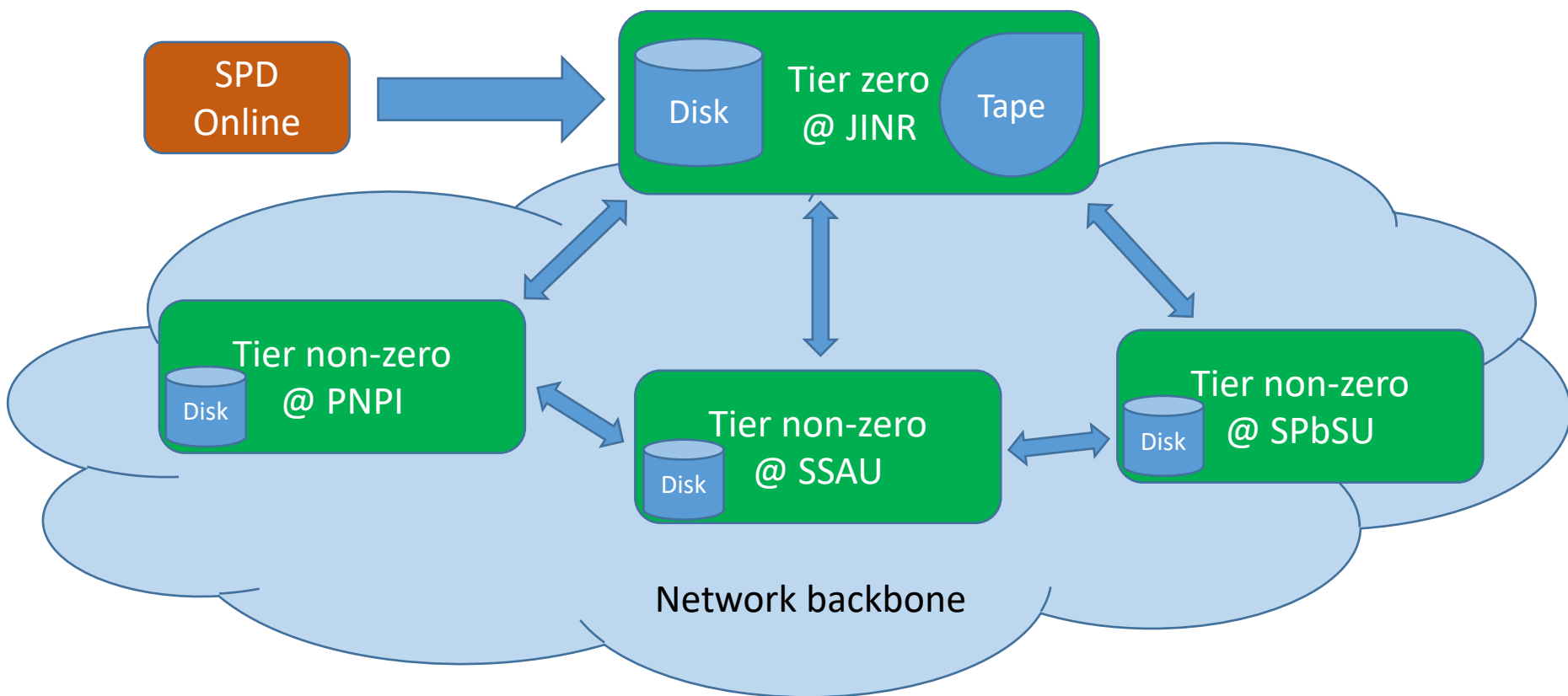
oVirt dashboard

		▲ Name	Com	Host	IP Addresses	FQDN	Cluster	Data C	Memory	CPU
		test-vm-02		sof-srv3.jinr.ru	10.17.245.62 fe80::546f:e0ff:fe38:24		SOF	JINR	 12%	 4%
		test-vm-03		sof-srv1.jinr.ru	10.17.245.63 fe80::546f:e0ff:fe38:25		SOF	JINR	 12%	 3%
		test-vm-04		sof-srv2.jinr.ru	10.17.245.64 fe80::546f:e0ff:fe38:26		SOF	JINR	 12%	 4%
		test-vm-05		sof-srv3.jinr.ru	10.17.245.65 fe80::546f:e0ff:fe38:27		SOF	JINR	 10%	 0%
		test-vm-06		sof-srv1.jinr.ru	10.17.245.66 fe80::546f:e0ff:fe38:28		SOF	JINR	 10%	 0%
		test-vm-07		sof-srv2.jinr.ru	10.17.245.67 fe80::546f:e0ff:fe38:29		SOF	JINR	 10%	 0%
		test-vm-08		sof-srv3.jinr.ru	10.17.245.68 fe80::546f:e0ff:fe38:2a		SOF	JINR	 10%	 0%
		test-vm-09		sof-srv4.jinr.ru	10.17.245.69 fe80::546f:e0ff:fe38:2b		SOF	JINR	 10%	 0%
		test-vm-10		sof-srv1.jinr.ru	10.17.245.70 fe80::546f:e0ff:fe38:2c		SOF	JINR	 10%	 0%
		test-vm-11		sof-srv2.jinr.ru	10.17.245.71 fe80::546f:e0ff:fe38:2d		SOF	JINR	 10%	 0%
		test-vm-12		sof-srv3.jinr.ru	10.17.245.72 fe80::546f:e0ff:fe38:2e		SOF	JINR	 10%	 0%
		test-vm-13		sof-srv4.jinr.ru	10.17.245.73 fe80::546f:e0ff:fe38:2f		SOF	JINR	 9%	 0%
		test-vm-14		sof-srv1.jinr.ru	10.17.245.74 fe80::546f:e0ff:fe38:30		SOF	JINR	 10%	 0%
		test-vm-15		sof-srv4.jinr.ru	10.17.245.75 fe80::546f:e0ff:fe38:31		SOF	JINR	 10%	 0%
		test-vm-16		sof-srv2.jinr.ru	10.17.245.76 fe80::546f:e0ff:fe38:32		SOF	JINR	 10%	 0%

External sites

- Three sites have successfully passed production tests:
 - PNPI
 - SSAU
 - SPbSU
- Negotiation is still ongoing with
 - MEPhI
- Computing resources are managed via ARC CE
 - Migration to ARC CE 7 with token support
- Disk storages at remote sites will be managed as Federated Storage
 - Configuration is expected to start this year
 - Based on EOS 5

SPD Computing Cloud

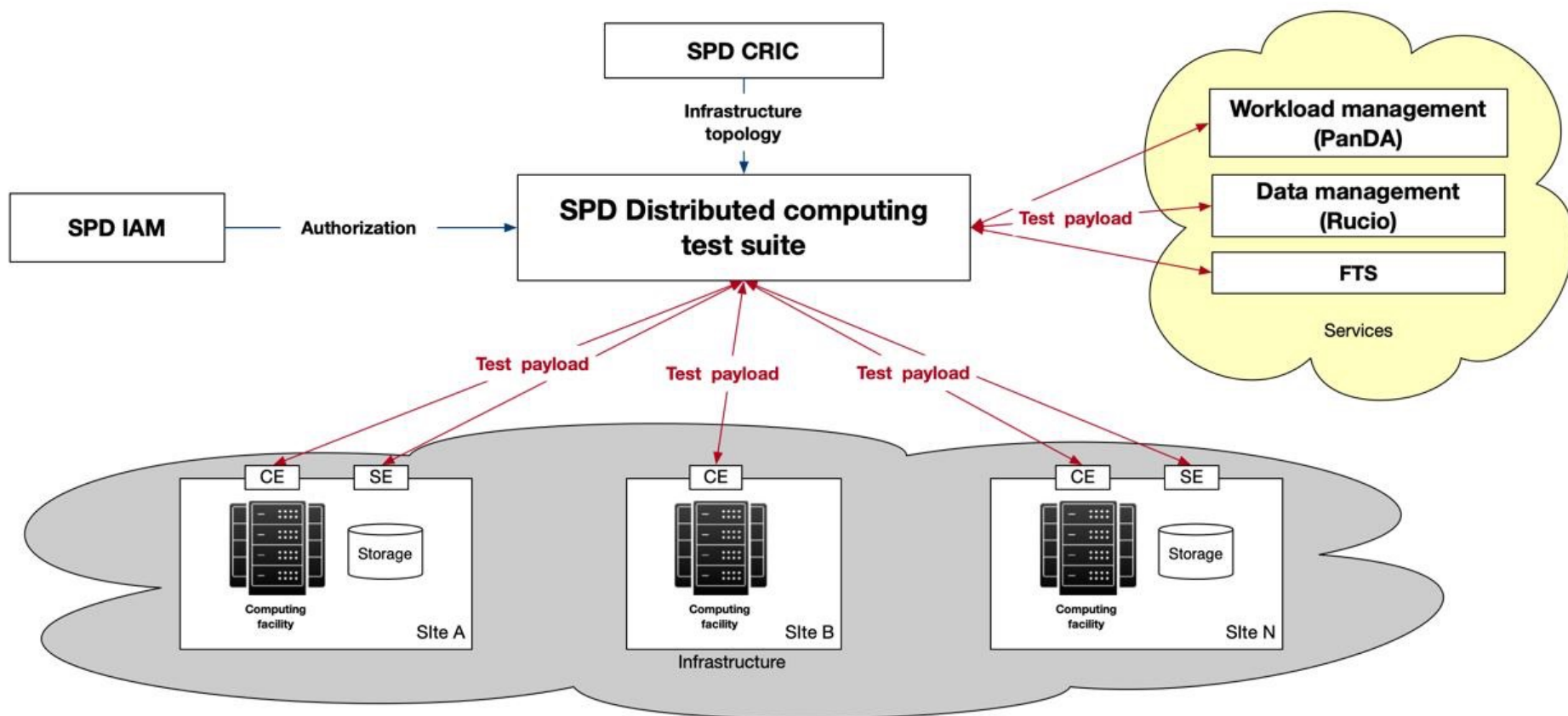


Currently deployed resources

- JINR
 - Computing: 2200 cores (~1200-1500 actually usable in our tests), **cp=1.0**
 - Storage: 5.3 PB (effective)
- PNPI
 - Computing: 300 cores, **cp=0.6**
 - Storage: 280 TB (effective)
- SSAU
 - Computing: 256 cores, **cp=1.8**
- SPbSU
 - Computing: 272 cores, **cp=1.0**

CorePower (cp) coefficient represents measured performance of a single core

Resource test suite



Resource test dashboard

latest results				
timestamp	service_name	result	endpoint	error type
12.03.26 09:09	INPBSU-SPD-STORM	fail	davs://grid02.hep.by:8443	ServiceNotFound
12.03.26 09:09	JINR-CE-T1	fail	https://ce03.jinr-t1.ru:443	Network
12.03.26 09:09	PNPI_EOS_xrootd	success	root://mss3.pnpi.nw.ru:1094	
12.03.26 09:09	JINR_SPD_EOS-XROOTD	success	root://eos-spd.jinr.ru:1094	
12.03.26 09:09	PNPI_EOS_webdav	success	davs://mss3.pnpi.nw.ru:8000	
12.03.26 09:09	JINR_SPD_EOS-WEBDAV	success	davs://eos-spd.jinr.ru:8000	
12.03.26 09:09	Rucio-prod	success	https://spd-rucio.jinr.ru:443	
12.03.26 09:09	PanDA-prod	success	https://vm221-129.jinr.ru:25443	
12.03.26 09:09	PanDA-pre-prod	success	https://vm221-129.jinr.ru:25443	
12.03.26 09:09	SPD-221-126	success	https://vm221-126.jinr.ru:8080	
12.03.26 09:09	SPD-FTS	success	https://spd-fts.jinr.ru:8446	
12.03.26 09:09	SSAU-CE	success	https://spd.ssau.ru:443	
12.03.26 09:09	SPbSU-CE	success	https://alice30.grid.pu.ru:443	
12.03.26 09:09	PNPI-CE	success	https://gt2.pnpi.nw.ru:443	
12.03.26 09:09	JINR-CE-T2	success	https://lcgce01.jinr.ru:443	
12.03.26 09:09	INPBSU-CE	success	https://grid04.hep.by:443	

Thank you!