

IQMULUS INFRASTRUCTURE

Michel Krämer

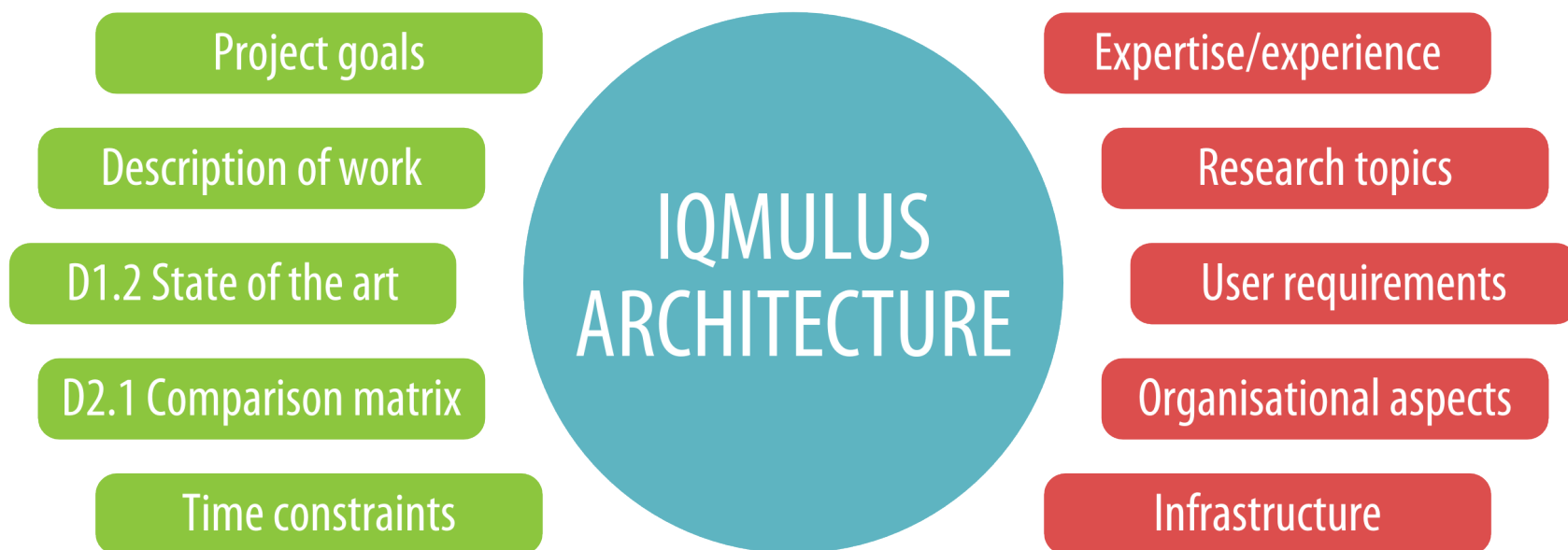
Fraunhofer IGD

IQmulus, Final Workshop

Bergen, September 21, 2016

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under *grant agreement* n° 318787.





Runtime

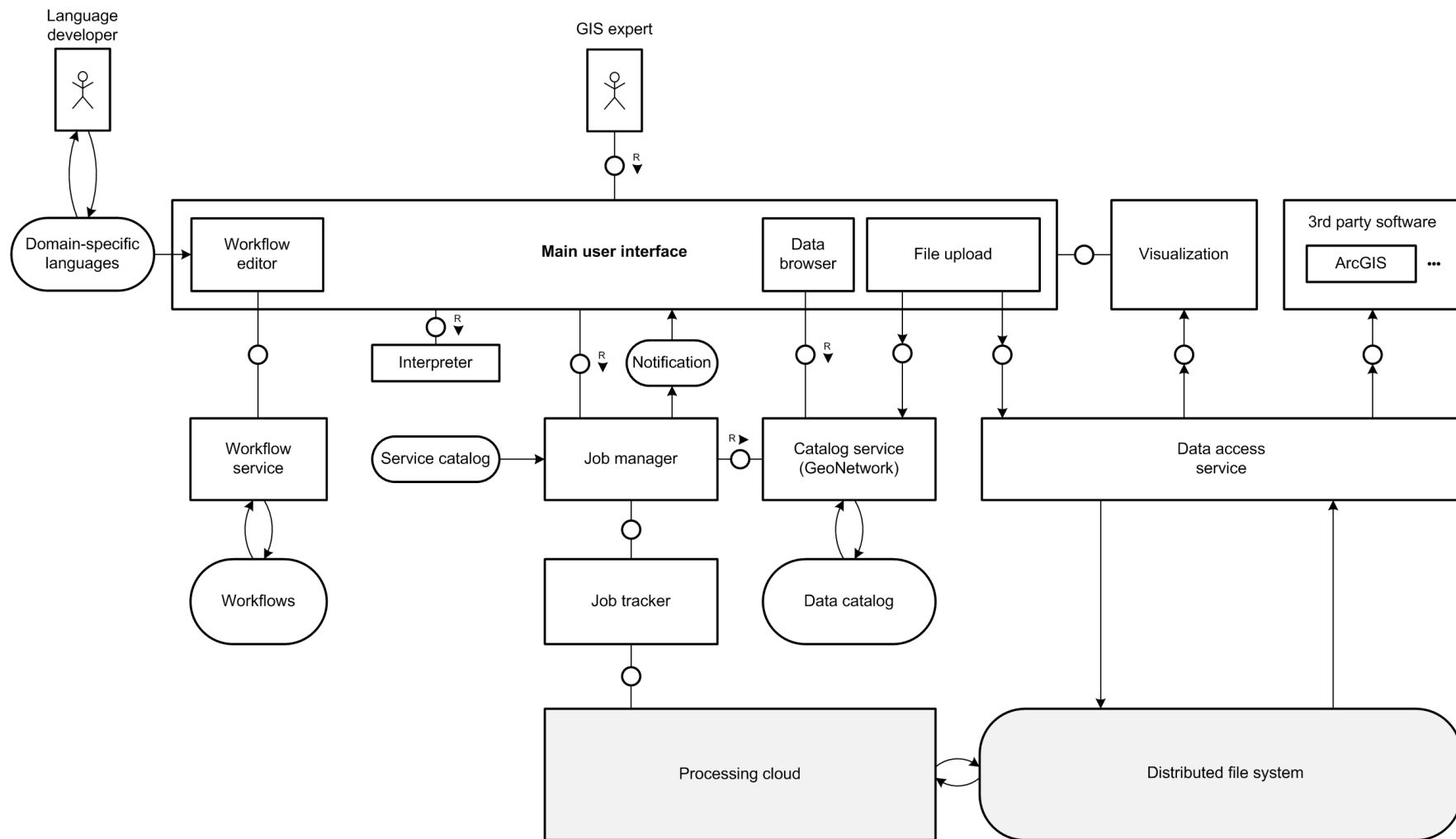
Functionality
Performance
Security
Availability
Interoperability

Non-runtime

Modifiability
Portability
Reusability
Integrability
Testability

Domain-specific

Sensitivity
Calibrability

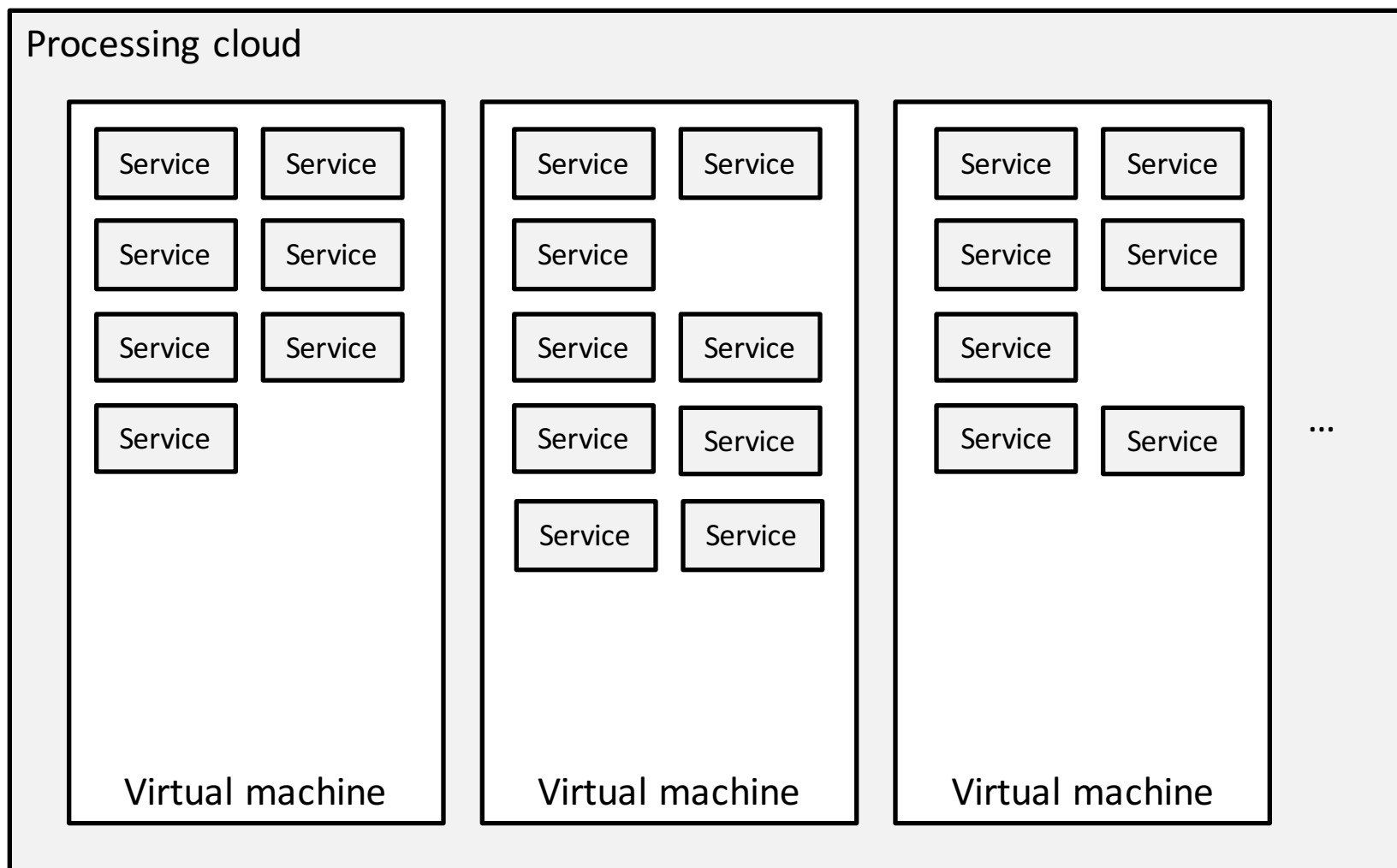


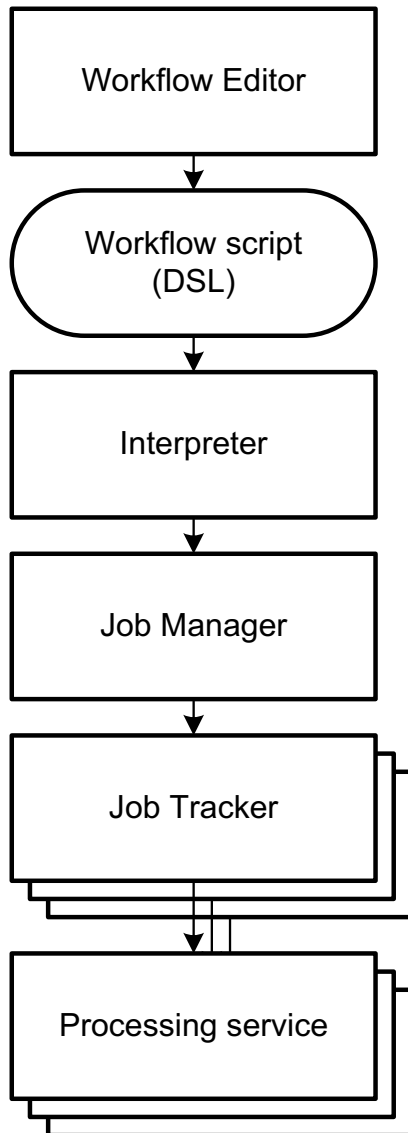
„In short, the **microservice architectural style** is an approach to developing a single application as a **suite of small services**, each running in its **own process** and **communicating with lightweight mechanisms**, often an HTTP resource API.“



- Martin Fowler

<http://martinfowler.com/articles/microservices.html>





User:

- Select/write workflow
- Upload/select data to process

Infrastructure:

- Select suitable processing services and parameters
- Generate executable process chains
- Monitor execution and use of resources


```

for each [PointCloudCollection] do
  # service 35
  apply Resampling
    using resolution: 0.3

  # 66 C++ (IGN)
  apply PointCloudDimensionality
    using minSizeNeighbourhood: 16
      and maxSizeNeighbourhood: 128
      and windowSize: 0

  # 59 C++ (IGN)
  apply MultiObjectClassification

  store

  # 119 C++ (TUDelft)
  apply PointCloudAttributeToTreeClass

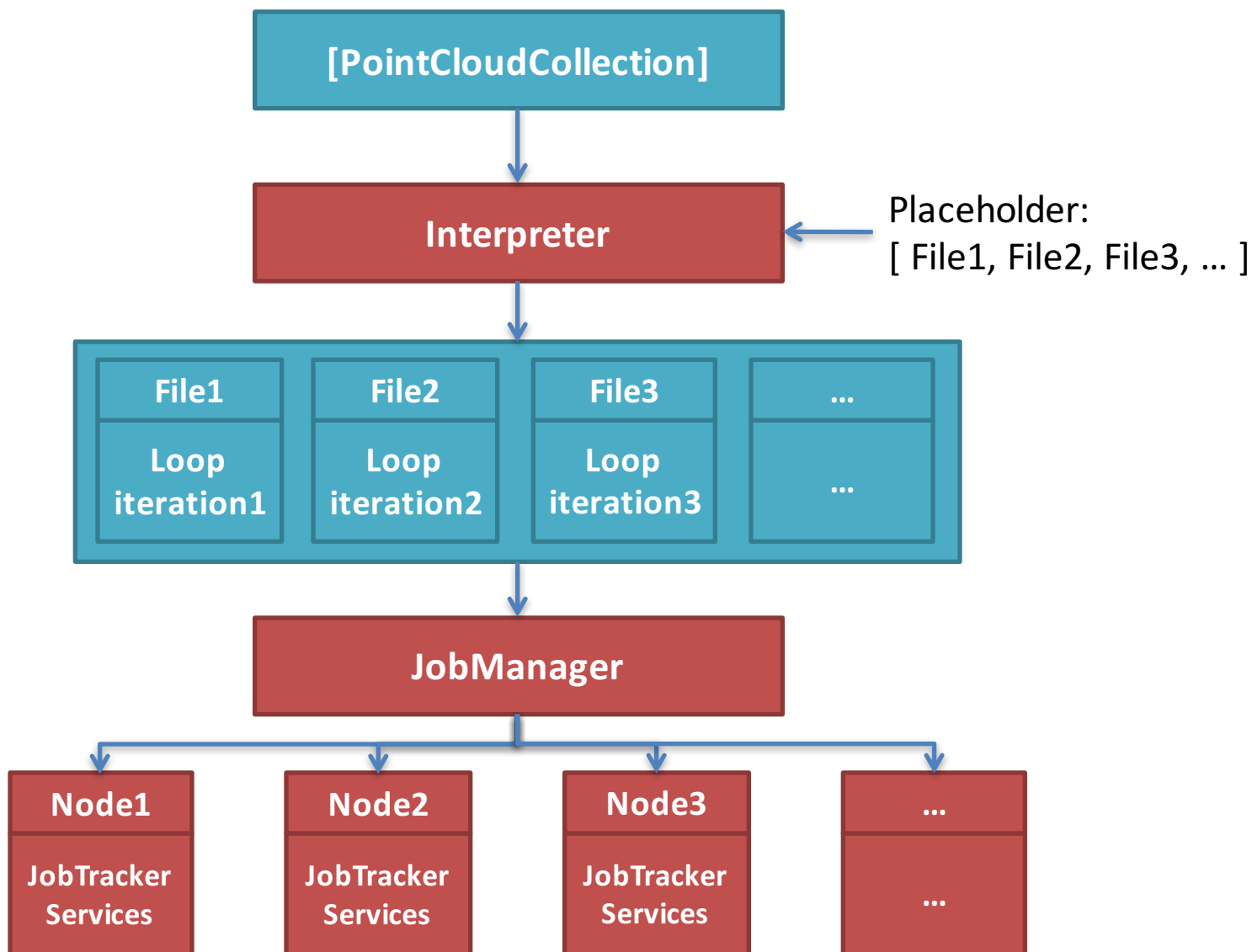
  // # 26 C++ (TUDelft)
  apply IndividualTreeDetection

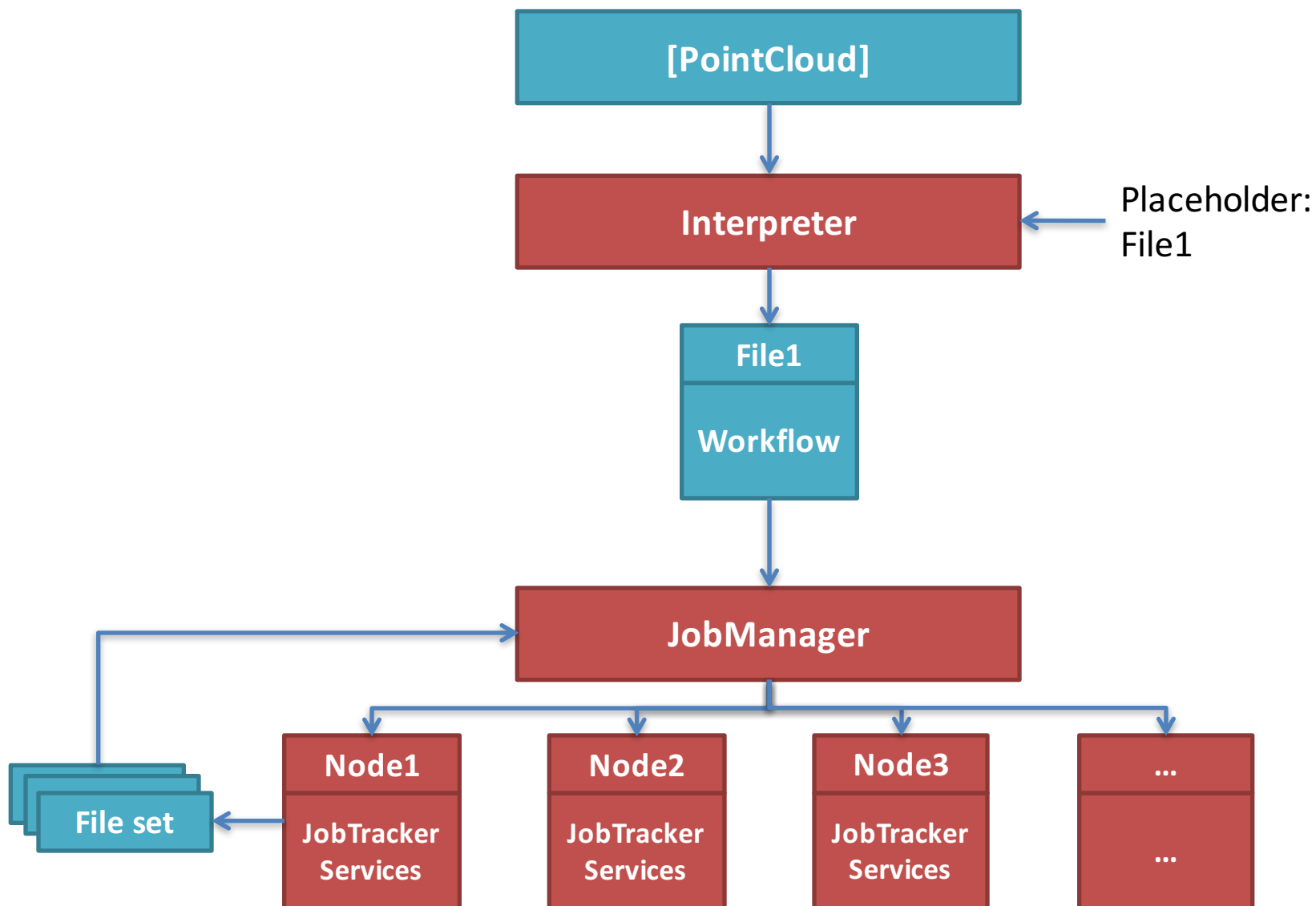
  store
end

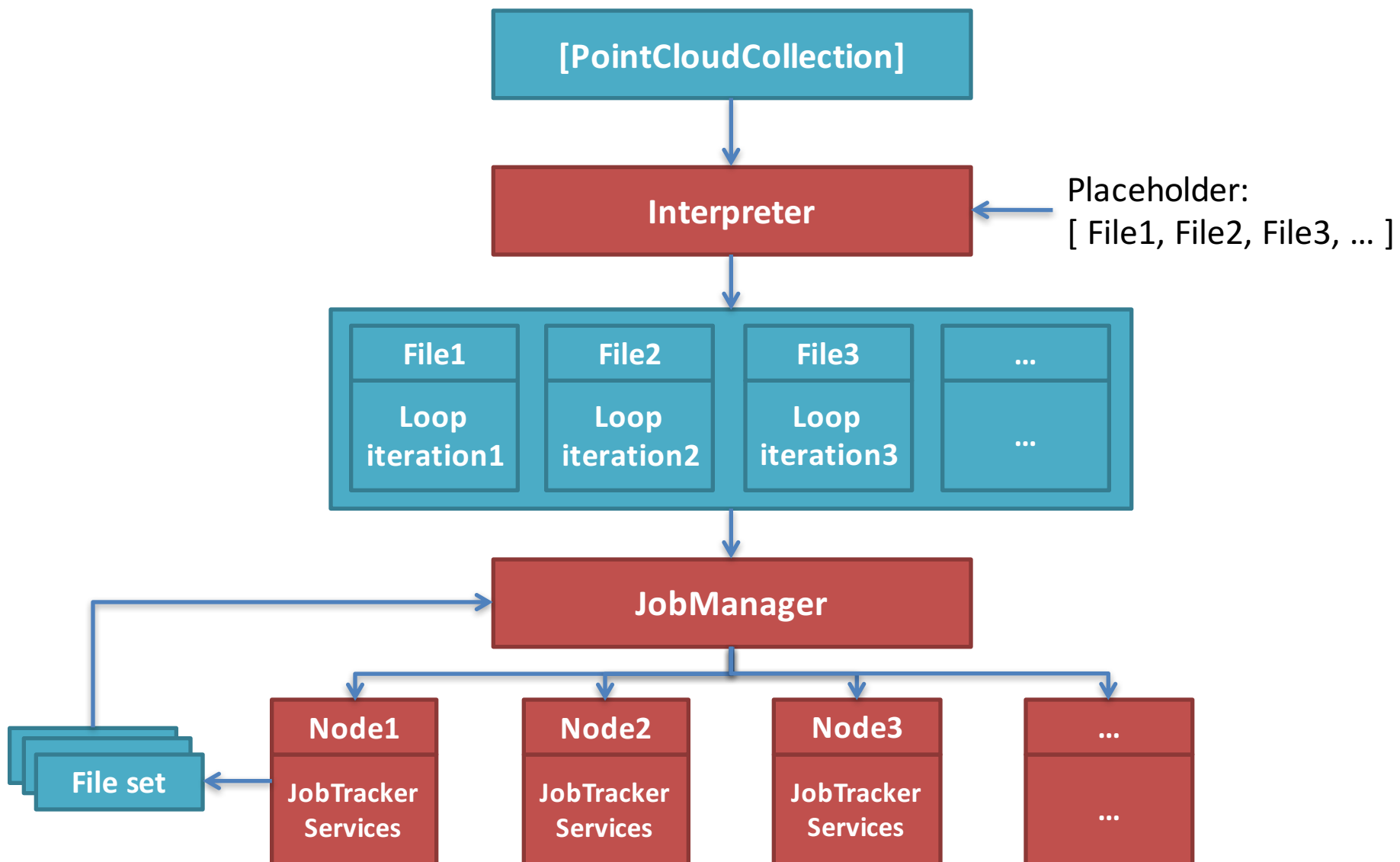
```

generate Visualization

← Unroll and parallelize
for loop







Nodes



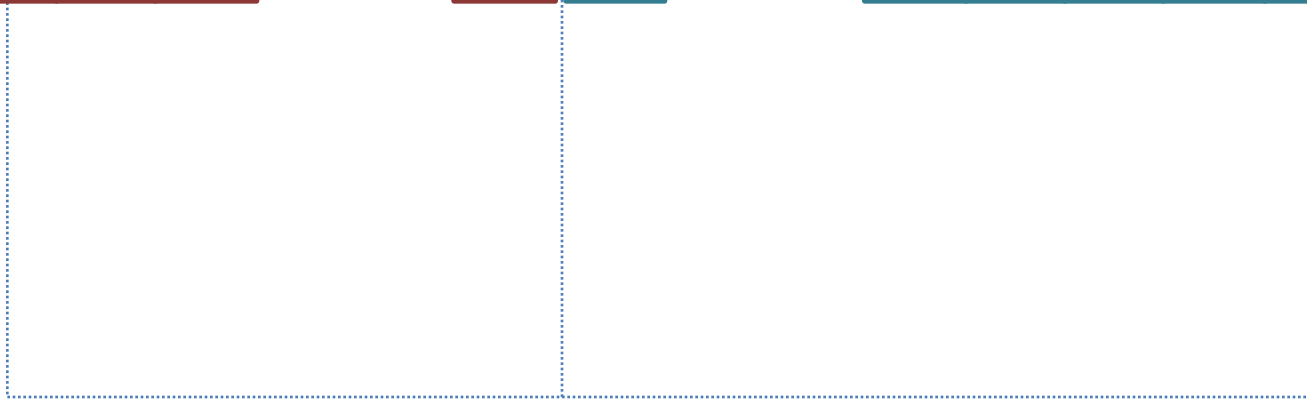
Process chains



Nodes



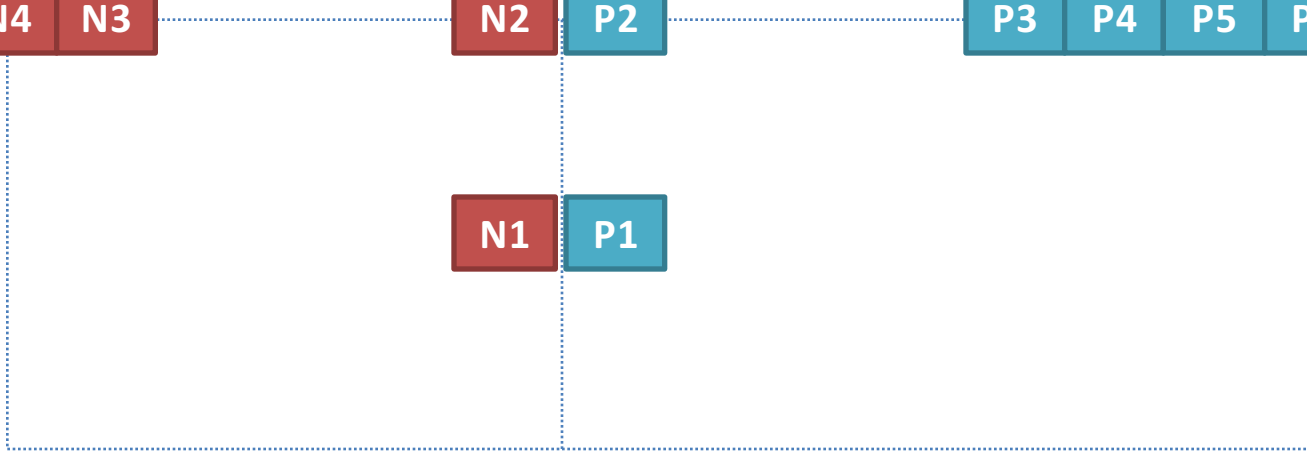
Process chains



Nodes

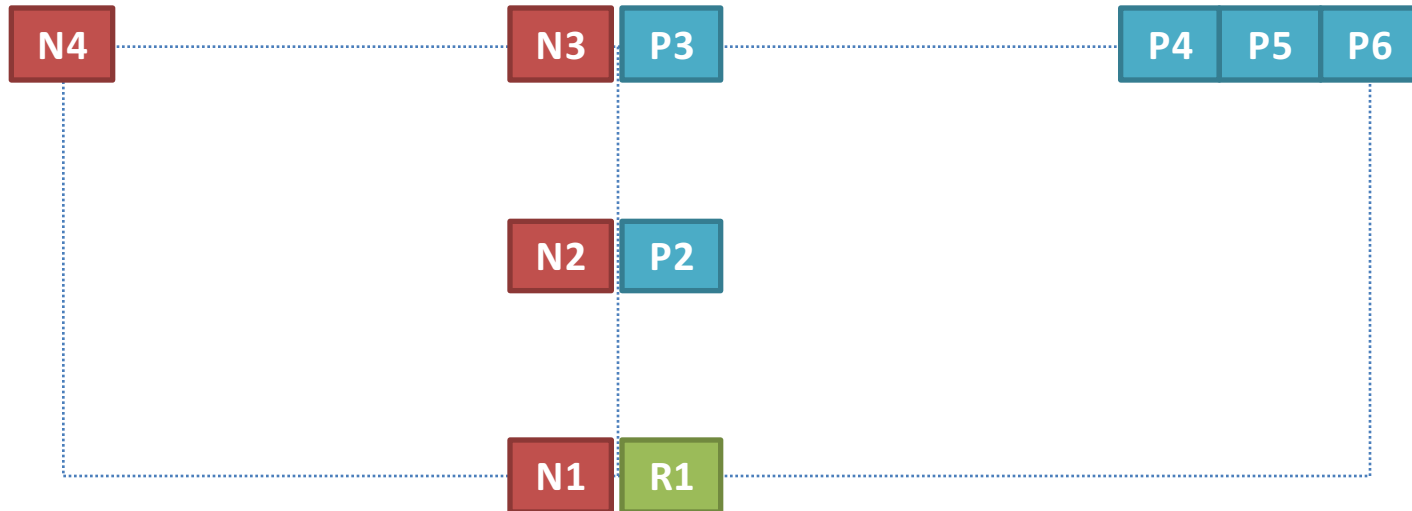


Process chains



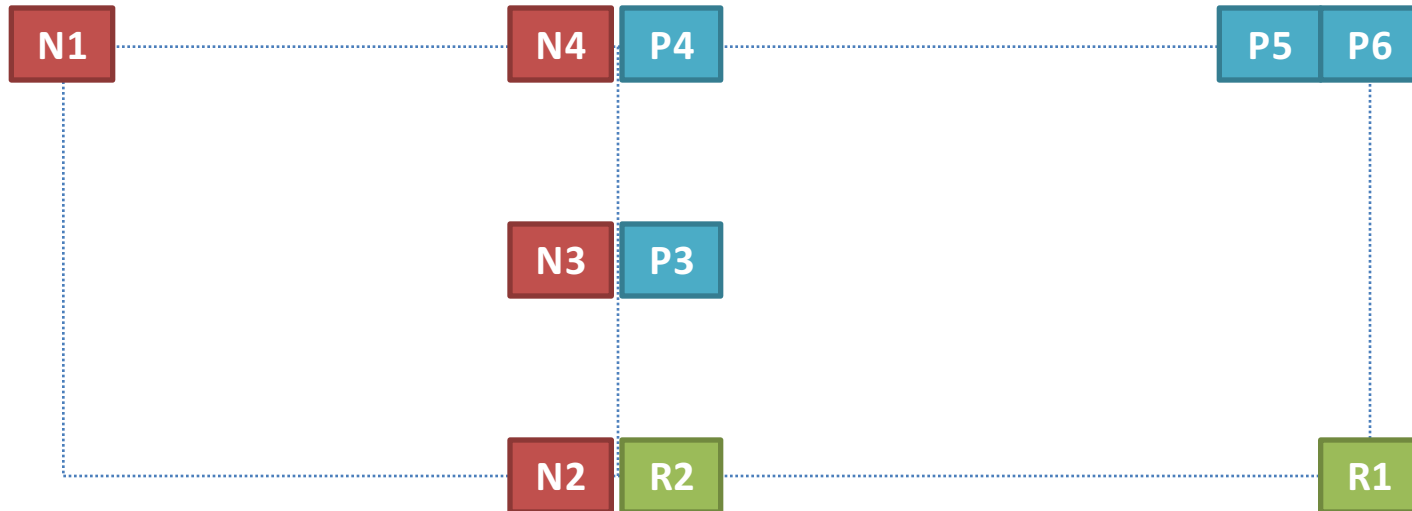
Nodes

Process chains



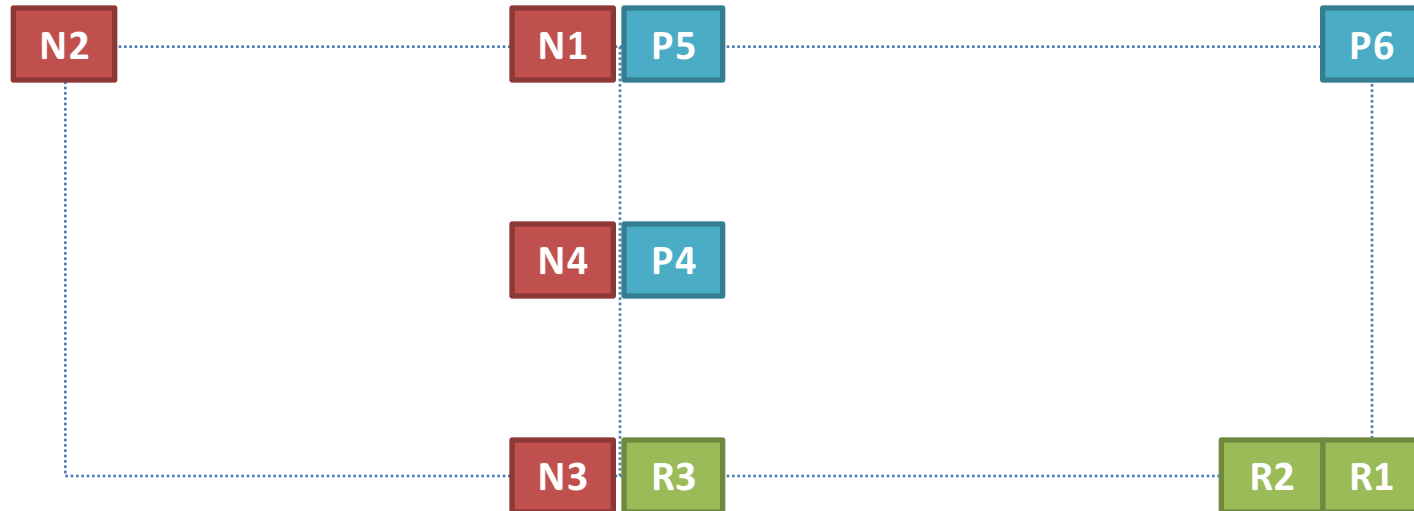
Nodes

Process chains



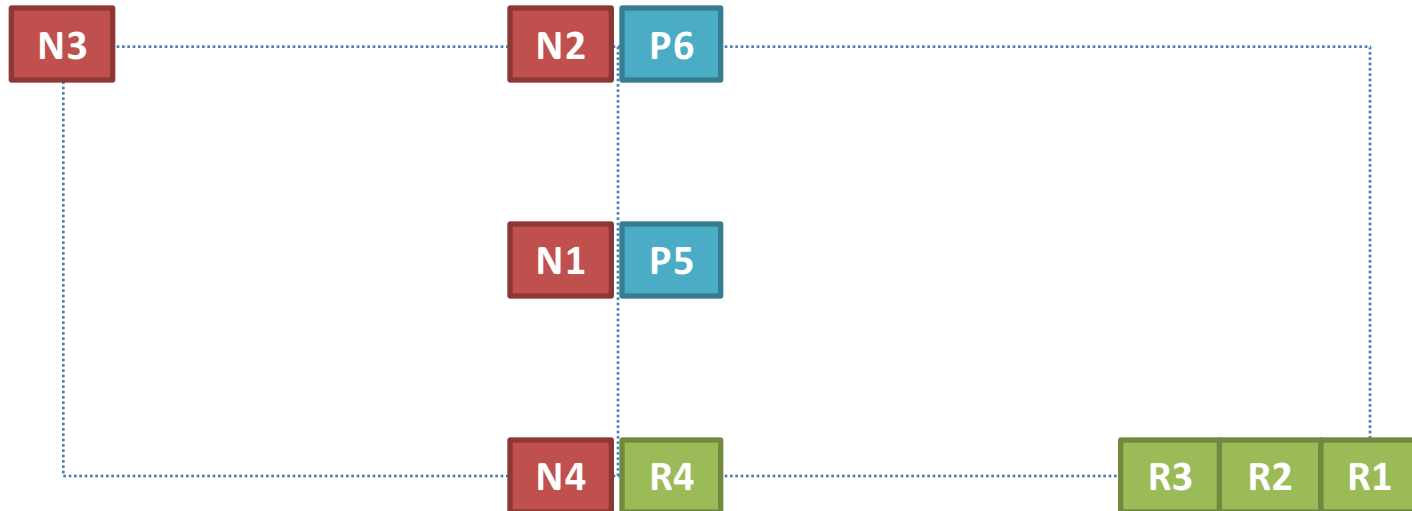
Nodes

Process chains



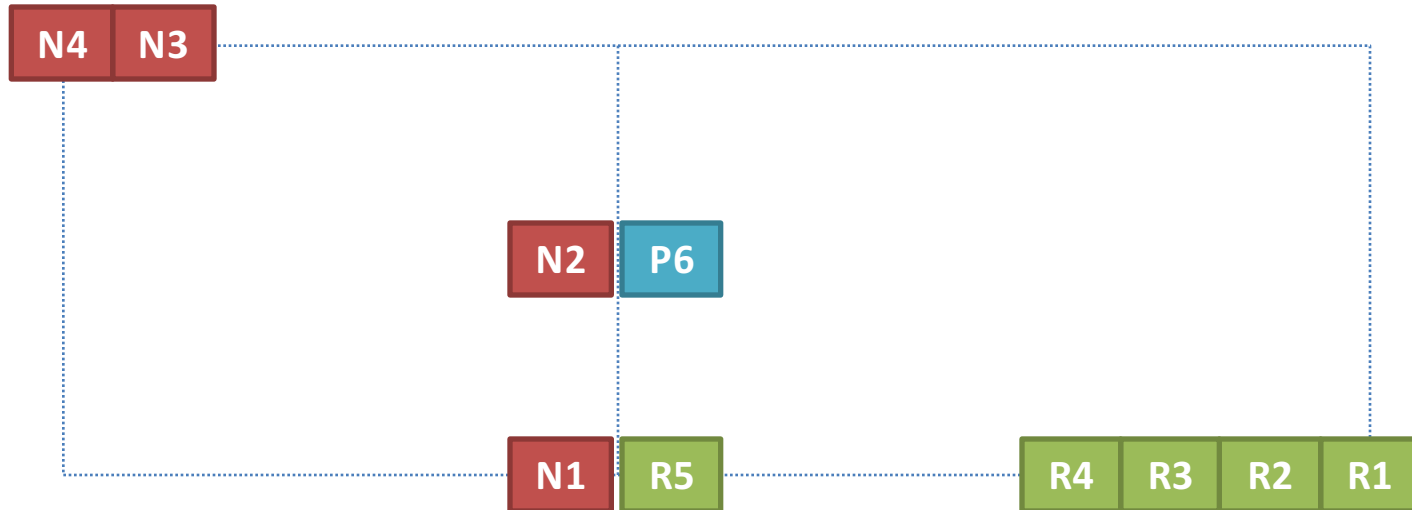
Nodes

Process chains



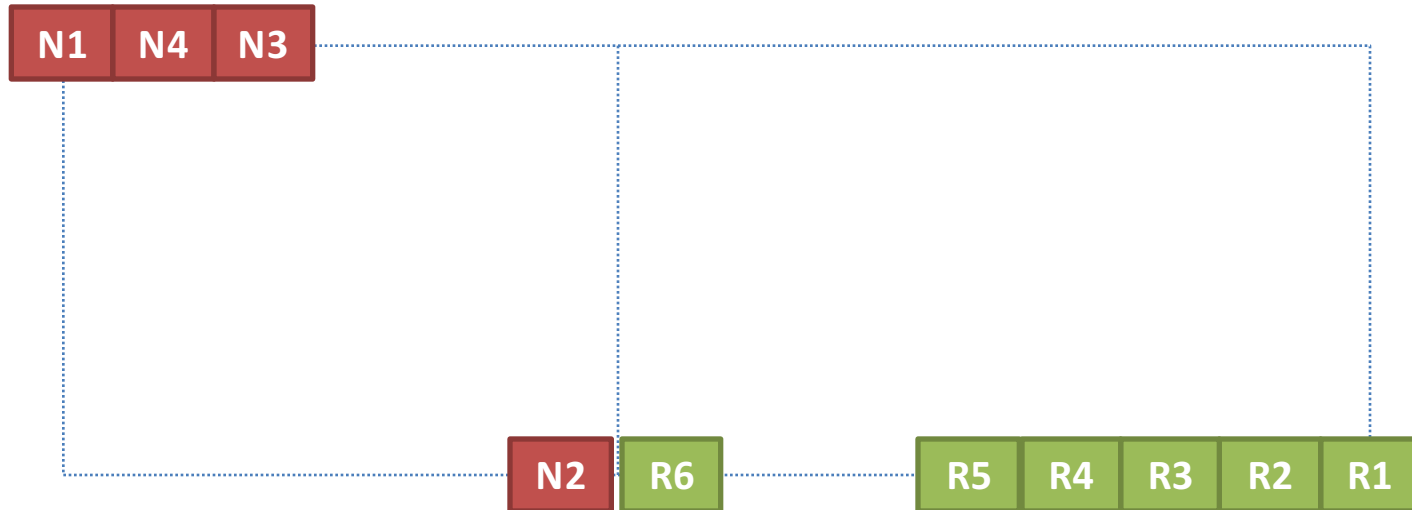
Nodes

Process chains



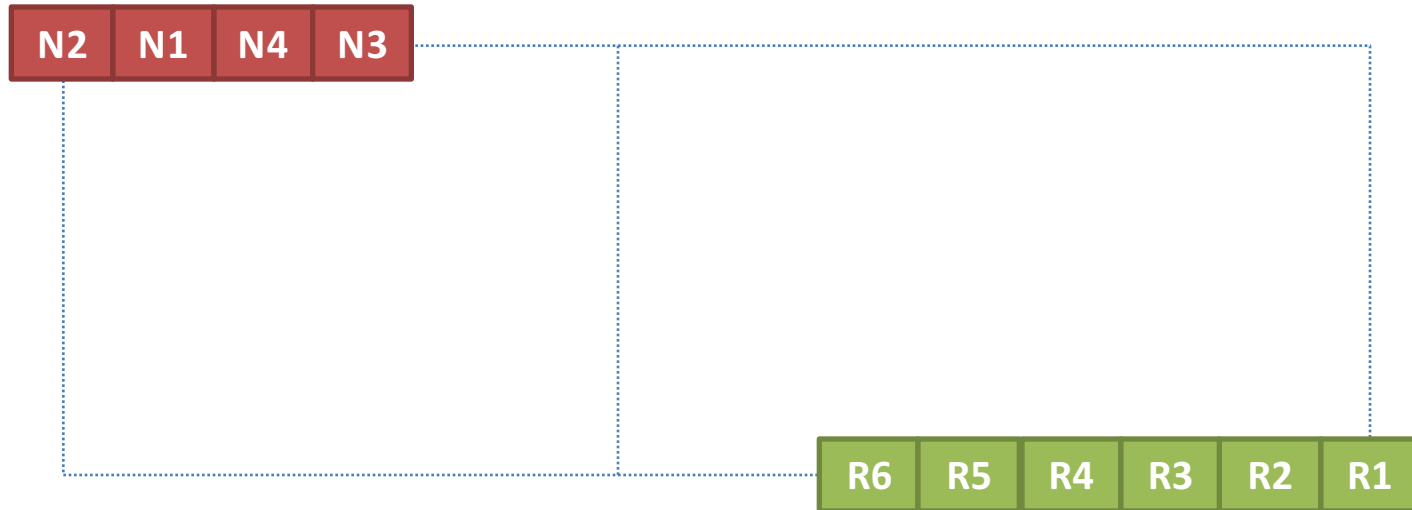
Nodes












































































































































Process chains








































































































Nodes

Process chains



	iqmulus2	Eingeschaltet	✓ Normal	Unbekannt	100,00 GB	100,00 GB	647 	4145 	20 
	iqmulus-cas	Eingeschaltet	✓ Normal	Unbekannt	20,09 GB	15,69 GB	26 	2836 	0 
	iqmulus-data-access-service	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	20,09 GB	16,50 GB	26 	3188 	0 
	iqmulus-dfs-node-1	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	1,02 TB	982,67 GB	107 	15552 	1 
	iqmulus-dfs-node-2	Eingeschaltet	✓ Normal	Unbekannt	9,02 TB	8,97 TB	55 	16444 	6 
	iqmulus-dfs-node-3	Eingeschaltet	✓ Normal	Unbekannt	9,02 TB	8,96 TB	55 	16444 	6 
	iqmulus-dfs-node-b1	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	805,08 GB	53 	15035 	0 
	iqmulus-dfs-node-b2	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	706,60 GB	53 	15811 	0 
	iqmulus-dfs-node-b3	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	705,94 GB	53 	14836 	1 
	iqmulus-dfs-node-b4	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	1,02 TB	753,91 GB	80 	14939 	1 
	iqmulus-dfs-node-b5	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	1,02 TB	666,24 GB	161 	16355 	0 
	iqmulus-dfs-node-b6	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	795,06 GB	53 	13001 	0 
	iqmulus-dfs-node-b7	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	713,57 GB	55 	13096 	0 
	iqmulus-dfs-node-b8	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	712,02 GB	80 	11759 	1 
	iqmulus-dfs-node-b9	Eingeschaltet	✓ Normal	Unbekannt	1,02 TB	728,72 GB	53 	15219 	1 
	iqmulus-dfs-primary	Eingeschaltet	✓ Normal	Unbekannt	1,01 TB	972,32 GB	80 	7598 	21 
	iqmulus-moss-master	Eingeschaltet	✓ Normal	Unbekannt	17,09 GB	16,99 GB	80 	1049 	12 
	iqmulus-moss-node1	Eingeschaltet	✓ Normal	Unbekannt	22,09 GB	19,02 GB	80 	6196 	2 
	iqmulus-node-template-ubuntu...	Ausgeschaltet	✓ Normal	Unbekannt	17,19 GB	2,48 GB	0	0	0 
	iqmulus-node-template-ubuntu...	Ausgeschaltet	✓ Normal	Unbekannt	17,19 GB	4,41 GB	0	0	0 
	iqmulus-scd01	Eingeschaltet	✓ Normal	Unbekannt	104,09 GB	104,09 GB	107 	4124 	6 
	iqmulus-scd02	Eingeschaltet	✓ Normal	Unbekannt	108,09 GB	101,91 GB	107 	4258 	3 
	iqmulus-scd03	Eingeschaltet	✓ Normal	Unbekannt	116,09 GB	116,09 GB	53 	4048 	0 
	iqmulus-scd04	Eingeschaltet	✓ Normal	Unbekannt	104,09 GB	97,17 GB	107 	4115 	5 
	iqmulus-scd05	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	108,09 GB	101,61 GB	80 	4850 	1 
	iqmulus-scd06	Eingeschaltet	✓ Normal	Unbekannt	116,09 GB	109,53 GB	80 	5822 	1 
	iqmulus-scd07	Eingeschaltet	✓ Normal	Unbekannt	104,10 GB	97,42 GB	83 	3963 	5 
	iqmulus-scd08	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	108,09 GB	101,64 GB	107 	4428 	0 
	iqmulus-scd09	Eingeschaltet	✓ Normal	Unbekannt	116,09 GB	109,89 GB	3184 	16480 	15 
	iqmulus-scd10	Eingeschaltet	✓ Normal	Unbekannt	104,10 GB	97,81 GB	111 	4108 	6 
	iqmulus-scd11	Eingeschaltet	✓ Normal	Unbekannt	108,10 GB	104,57 GB	107 	4776 	1 
	iqmulus-scd12	Eingeschaltet	✓ Normal	Unbekannt	116,10 GB	116,10 GB	107 	16484 	2 
	iqmulus-wp1-fomi01	Eingeschaltet	✓ Normal	Unbekannt	46,09 GB	46,09 GB	26 	10275 	0 
	iqmulus-wp1-fomi02	Eingeschaltet	✓ Normal	Unbekannt	34,09 GB	33,37 GB	27 	3979 	2 
	iqmulus-wp1-fomi03	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	34,09 GB	33,83 GB	26 	4139 	3 
	iqmulus-wp1-fomi04	Eingeschaltet	✓ Normal	Unbekannt	34,09 GB	34,09 GB	0	4139 	0 
	iqmulus-wp2-igd-mk-ui	Eingeschaltet	✓ Normal	Unbekannt	96,60 GB	81,20 GB	107	15326	0
	iqmulus-wp3-igd-jobmanager	Eingeschaltet	✓ Normal	Unbekannt	1,03 TB	782,20 GB	167	19864	1

	iqmulus-wp3-igd-jobmanager	Eingeschaltet	✓ Normal	Unbekannt	1,03 TB	782,20 GB	615		19864		0	
	iqmulus-wp4-ifremer01	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	24,09 GB	22,88 GB	0		7744		0	
	iqmulus-wp4-ign01a	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	24,02 GB	377		8252		15	
	iqmulus-wp4-ign02a	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	24,09 GB	23,21 GB	53		7964		2	
	iqmulus-wp4-ign03a	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	23,30 GB	53		8111		0	
	iqmulus-wp4-ign04a	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	23,22 GB	53		7973		1	
	iqmulus-wp4-imat01	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	26		8253		1	
	iqmulus-wp4-imat02	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	26		8254		0	
	iqmulus-wp4-imat03	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	47,32 GB	26		8253		2	
	iqmulus-wp4-imat04	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	47,68 GB	26		8244		2	
	iqmulus-wp4-imat05	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	47,68 GB	26		8253		5	
	iqmulus-wp4-imat06	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	47,21 GB	26		8252		2	
	iqmulus-wp4-imat07	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	48,09 GB	46,81 GB	26		8252		4	
	iqmulus-wp4-imat08	Eingeschaltet	✓ Normal	Unbekannt	56,09 GB	56,09 GB	26		16470		0	
	iqmulus-wp4-sintef01	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	32,09 GB	31,04 GB	26		14977		0	
	iqmulus-wp4-sintef02	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	22,78 GB	26		8255		1	
	iqmulus-wp4-sintef03	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	24,09 GB	22,76 GB	26		7982		1	
	iqmulus-wp4-sintef04	Eingeschaltet	✓ Normal	Unbekannt	24,10 GB	22,78 GB	27		8013		2	
	iqmulus-wp4-tudelft	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	48,09 GB	47,04 GB	26		8253		3	
	iqmulus-wp4-ubo	Eingeschaltet	✓ Normal	Unbekannt	56,11 GB	55,80 GB	55		16509		0	
	iqmulus-wp4-ubo02	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	23,06 GB	27		8106		0	
	iqmulus-wp4-ubo03	Eingeschaltet	✓ Normal	esx2.igd.fraunhofer.de	24,09 GB	22,99 GB	26		8205		1	
	iqmulus-wp4-ubo04	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	24,09 GB	23,05 GB	26		8255		0	
	iqmulus-wp4-ubo05	Eingeschaltet	✓ Normal	Unbekannt	24,09 GB	23,06 GB	26		8254		0	
	iqmulus-wp4-ubo06	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	24,09 GB	23,05 GB	26		8254		1	
	iqmulus-wp4-ud02	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	26		8253		0	
	iqmulus-wp4-ud03	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	0		8217		1	
	iqmulus-wp4-ud04	Eingeschaltet	✓ Normal	Unbekannt	48,10 GB	48,10 GB	27		8005		2	
	iqmulus-wp4-ud05	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	53		7675		2	
	iqmulus-wp4-ud06	Eingeschaltet	✓ Normal	Unbekannt	48,09 GB	48,09 GB	26		8254		1	
	iqmulus-wp4-ud10	Eingeschaltet	✓ Normal	esx1.igd.fraunhofer.de	48,09 GB	48,09 GB	26		8253		0	
	iqmulus-wp4-ud11	Eingeschaltet	✓ Normal	Unbekannt	20,09 GB	19,15 GB	188		4131		3	
	iqmulus-wp5-igd01	Eingeschaltet	✓ Normal	Unbekannt	132,09 GB	129,77 GB	26		4134		29	

File system

Path: /fs/
Capacity: 29 TB
Used: 15 TB
Free: 14 TB

Nodes

Name	Capacity	Used	Free
iqmulus-dfs-node-3.igd.fraunhofer.de	8 TB	2 TB	5 TB
iqmulus-wp4-ubo.igd.fraunhofer.de	28 GB	20 GB	7 GB
iqmulus-wp4-tudelft.igd.fraunhofer.de	28 GB	19 GB	8 GB
iqmulus-wp4-sintef03.igd.fraunhofer.de	3 GB	2 GB	629 MB
iqmulus-sct05.igd.fraunhofer.de	79 GB	67 GB	12 GB
iqmulus-dfs-primary.igd.fraunhofer.de	952 GB	726 GB	226 GB

- 69 virtual machines
- about 70 Docker images
- about 570 Docker containers
- 4 Spark clusters (24 VMs)
- 1 Hadoop cluster (4 VMs)
- HDFS (30 TB, 15 TB used, 61 VMs)

- Docker
- Spark
- Hadoop
- Ansible
- Angular JS + Bootstrap
- MongoDB/PostgreSQL
- Elasticsearch + Logstash + Kibana (ELK)
- Artifactory
- C/C++/Java/Scala/Groovy/Python/TypeScript/JavaScript

