

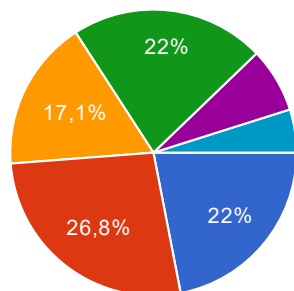
42 (a) answers

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Summary

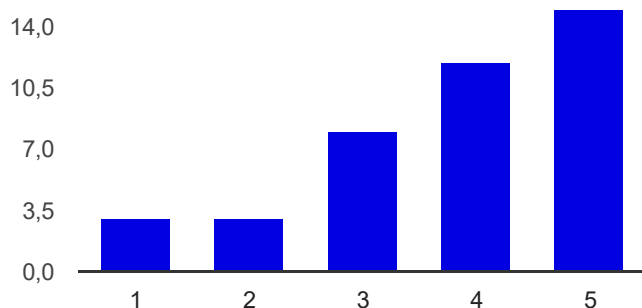
Cloudware

Cloudware 1. Software moving away from hardware



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 9 | 22% |
| It is a challenge for 2018-2020 | 11 | 26.8% |
| It is a challenge for 2015-2017 | 7 | 17.1% |
| It is a challenge to which my team/project works | 9 | 22% |
| It is not/no more a challenge | 3 | 7.3% |
| Other | 2 | 4.9% |

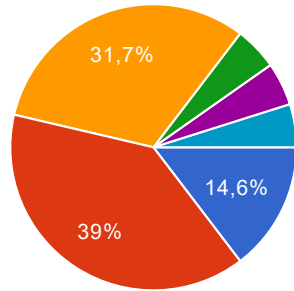
How important is Cloudware 1



| | | |
|------------------|----------|------|
| Not important: 1 | 3 | 7.3% |
| 2 | 3 | 7.3% |

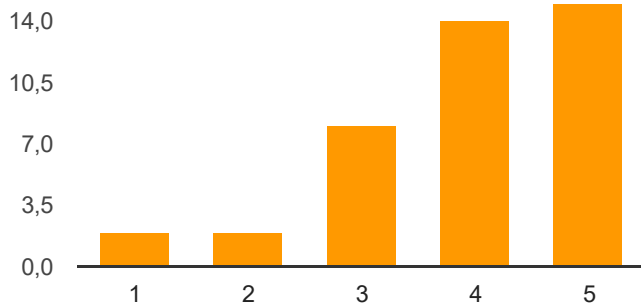
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|-------------------|---|----|-------|
| | 3 | 8 | 19.5% |
| | 4 | 12 | 29.3% |
| Highly important: | 5 | 15 | 36.6% |

Cloudware 2. Thin cloud connection



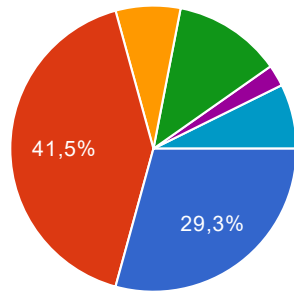
| | | |
|--|----|-------|
| It is a challenge to be tackle beyond 2020 | 6 | 14.6% |
| It is a challenge for 2018-2020 | 16 | 39% |
| It is a challenge for 2015-2017 | 13 | 31.7% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 2 | 4.9% |
| Other | 2 | 4.9% |

How important is Cloudware 2



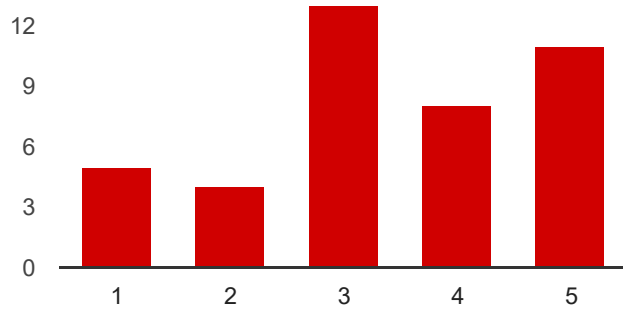
| | | | |
|-------------------|---|----|-------|
| Not important: | 1 | 2 | 4.9% |
| | 2 | 2 | 4.9% |
| | 3 | 8 | 19.5% |
| | 4 | 14 | 34.1% |
| Highly important: | 5 | 15 | 36.6% |

Cloudware 3. Social media-like evolution



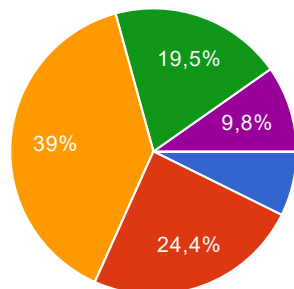
| | | |
|--|----|-------|
| It is a challenge to be tackled beyond 2020 | 2 | 2.4% |
| It is a challenge for 2018-2020 | 17 | 41.5% |
| It is a challenge for 2015-2017 | 3 | 7.3% |
| It is a challenge to which my team/project works | 5 | 12.2% |
| It is not/no more a challenge | 1 | 2.4% |
| Other | 3 | 7.3% |

How important is Cloudware 3



| | | |
|---------------------|----|-------|
| Not important: 1 | 5 | 12.2% |
| 2 | 4 | 9.8% |
| 3 | 13 | 31.7% |
| 4 | 8 | 19.5% |
| Highly important: 5 | 11 | 26.8% |

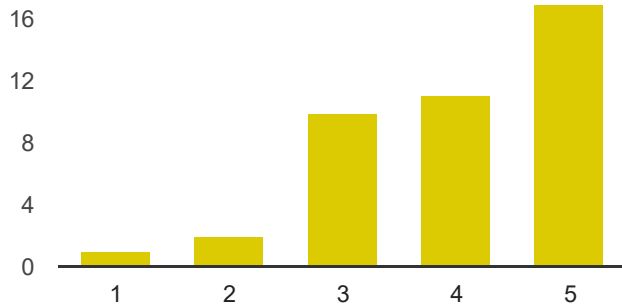
Cloudware 4. Containers



| | | |
|---|----|-------|
| It is a challenge to be tackled beyond 2020 | 3 | 7.3% |
| It is a challenge for 2018-2020 | 10 | 24.4% |

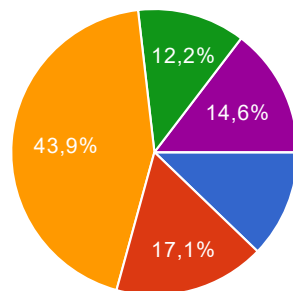
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|--|-----------|-------|
| It is a challenge for 2015-2017 | 16 | 39% |
| It is a challenge to which my team/project works | 8 | 19.5% |
| It is not/no more a challenge | 4 | 9.8% |
| Other | 0 | 0% |

How important is Cloudware 4



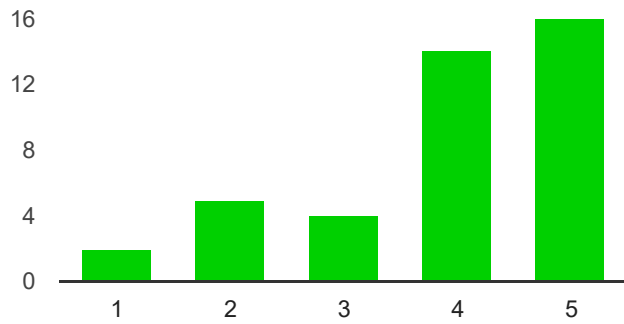
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 1 | 2.4% |
| 2 | 2 | 4.9% |
| 3 | 10 | 24.4% |
| 4 | 11 | 26.8% |
| Highly important: 5 | 17 | 41.5% |

Cloudware 5. Continuous development of Cloud-ready applications



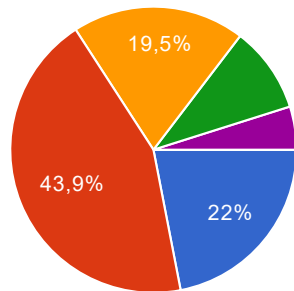
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 5 | 12.2% |
| It is a challenge for 2018-2020 | 7 | 17.1% |
| It is a challenge for 2015-2017 | 18 | 43.9% |
| It is a challenge to which my team/project works | 5 | 12.2% |
| It is not/no more a challenge | 6 | 14.6% |
| Other | 0 | 0% |

How important is Cloudware 5



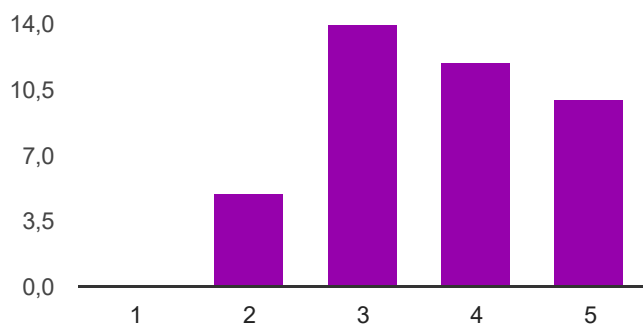
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| Not important: 1 | 2 | 4.9% |
| | 5 | 12.2% |
| | 4 | 9.8% |
| | 14 | 34.1% |
| Highly important: 5 | 16 | 39% |

Cloudware 6. Event-driven architecture



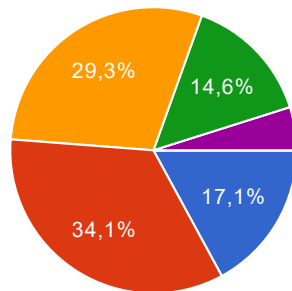
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|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 9 | 22% |
| It is a challenge for 2018-2020 | 18 | 43.9% |
| It is a challenge for 2015-2017 | 8 | 19.5% |
| It is a challenge to which my team/project works | 4 | 9.8% |
| It is not/no more a challenge | 2 | 4.9% |
| Other | 0 | 0% |

How important is Cloudware 6



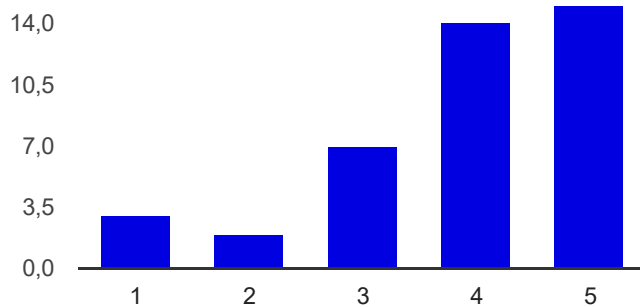
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|---------------------|-----------|-------|
| Not important: 1 | 0 | 0% |
| 2 | 5 | 12.2% |
| 3 | 14 | 34.1% |
| 4 | 12 | 29.3% |
| Highly important: 5 | 10 | 24.4% |

7. Modular Cloudware Cloud applications



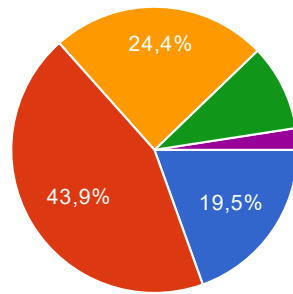
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|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 7 | 17.1% |
| It is a challenge for 2018-2020 | 14 | 34.1% |
| It is a challenge for 2015-2017 | 12 | 29.3% |
| It is a challenge to which my team/project works | 6 | 14.6% |
| It is not/no more a challenge | 2 | 4.9% |
| Other | 0 | 0% |

How important is Cloudware 7



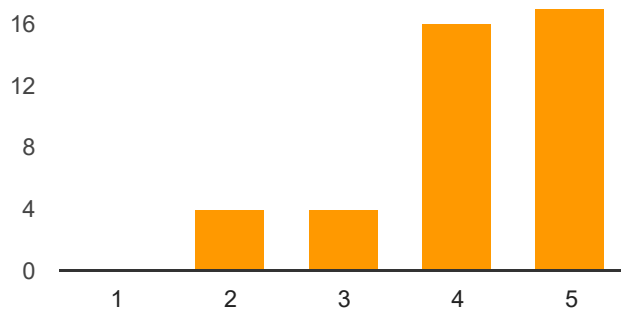
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|---------------------|-----------|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 2 | 4.9% |
| 3 | 7 | 17.1% |
| 4 | 14 | 34.1% |
| Highly important: 5 | 15 | 36.6% |

Cloudware 8: Failure proof systems



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 8 | 19.5% |
| It is a challenge for 2018-2020 | 18 | 43.9% |
| It is a challenge for 2015-2017 | 10 | 24.4% |
| It is a challenge to which my team/project works | 4 | 9.8% |
| It is not/no more a challenge | 1 | 2.4% |
| Other | 0 | 0% |

How important is Cloudware 8



| | | |
|---------------------|-----------|-------|
| Not important: 1 | 0 | 0% |
| 2 | 4 | 9.8% |
| 3 | 4 | 9.8% |
| 4 | 16 | 39% |
| Highly important: 5 | 17 | 41.5% |

Cloudware: What is missing?

n/a

Data locality is a current trend for Big Data type applications and it is not yet addressed. Modularity as an efficiency-requirement. Avoid vendor lock-in through Cloud federation.

- Usage of PaaS features while omitting vendor lock-in - Cloud application performance monitoring

The above questions well describe the future challenges

Making sure Cloudware 1-8 results are using the same standards. Making sure Cloudware 1-8 results are open sourced.

federated: private, private, hybrid clouds

-

Integration with the device-to-device system, which should be considered part of the Cloudware architecture.

An automatic way to include cloud computing in consumer application is the real missing in today's scenario.

There are numerous infrastructure cloud technologies (OpenStack, AWS, Google compute, CloudStack, Eucalyptus, ...), each of which allowing different incompatible APIs to be managed. Also, regarding multi-tier applications, there are a few standards (TOSCA) or de-facto standards (heat/cloudformations) which are not compatible. As a result, hybrid cloud remains a very difficult task. We cannot reasonably think that there will be one unique standard. However, interoperability remains a key issue.

Security is a serious and enormous challenge not considered appropriately. Too hard to handle on all levels with our old OS concepts and HW architectures. This will become very likely a major issue implying huge risks on a global scale for the daily life of the average person and company.

SDN is still a part that required research for academia and industries. Furthermore, complete / complex virtual environments with desired functionality should be developed as well..

Developing new technologies that precede the development of applications. Be proactive, not reactive.

Containers will be the norm in the cloud, virtual machines will only be used when extreme isolation is necessary.

Hyperscale SW stack will "breathe" with the requirements of distributed, mixed-critical cloudware applications.

Clouds are not "alone". With IoT exploding, an extremely complex ecosystem is going to emerge in which clouds will be a part of. Needed is research that will deal with this "whole ecosystem."

Nowadays Cloud technologies come as highly integrated systems. Hence, it is not possible to implement functional components in a stand-alone manner so that they work for arbitrary Cloud infrastructures. This observation is linked to various issues already mentioned: Modularity, devops, event based systems as possible architecture paradigm, etc. A proper mapping of software according to a suitable taxonomy and an implementation as interoperable components/services has the potential to provide novel forms of service management beyond ISO 20000.

cloudware to recognise the pattern of workload coming in and automating the process of mapping the application onto a heterogeneous resource platform.

Design of new cloud software approaches, use of big data and big code analytics for

cloud software improvement.

None

Needs to know what are the main objectives of the CloudWare

What is primarily missing here are better ways to collect, analyze, and make sense of the log diarrhea that cloud applications currently experience. Most importantly, there is no existing way to correlate runtime faults to software defects.

self-organizing architectures

In the long term, I consider that also data security is an important issue especially when it comes to big data. Of course this can be included in the cloud security or even can be hidden by the use of containers. Taking a combination of big data and safety critical systems, one can imagine a cloud direction that can work with both critical and safe systems.

NA

Important challenges include interoperability among hybrid clouds, mobile clouds and fog computing

With virtualisation of compute and networking technologies, cloud applications must be able to benefit from the virtual infrastructure and communicate changing requirements to the virtualised infrastructure

Support to Big data and HPC applications. Will they converge?

N/A

There is no reference to the challenges in cloud security from an architectural point of view. Current CPUs provide tamper-resistant capabilities on chip. So theoretically, this technology can be exploited to securely store credentials, certificates and/or password hashes. How can this new technology be embraced by the cloud? How can be securely migrated between cloud providers?

Interoperability between different solutions

Partly covered by CloudWare 2, but I think that Edge Computing middleware will be very relevant in the next years. See <http://www.sigcomm.org/node/3872> or recent works in Fog Computing and decentralized clouds.

It should be remarked the distribution of intelligence between local processing, edge network (fog computing) and cloud computing.

we should put much more emphasis on hybrid system, composed by standard HW for "normal" app and specific HW (GPU, FPGA; DSP) for specialized app or app with high-performance requirements. This means also to find a cooperation between the current cloud approach with HPC needs.

This has to be kept simple. Too much complication will make fog out of cloud.

Standardized and secure data portability and interoperability. Increased data protection and control by users.

Firstly, we need to stop kidding ourselves on with weak claims of 'it's research' hiding poor outcomes from projects. Until industry becomes the clear driving force, the model will be sub-optimal, especially SMEs. The end result of projects should be monetizing services. You also need more reviewers in your pool from industry. To

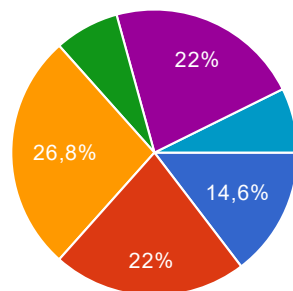
drive forward, large telcos should be encouraged to work with innovative cloud providers. The telcos have the ready made customer base and the cloud SMEs have the know how. Academia should then react to these needs. Specifically, we should be doing these things: 1. Sufficient quality of management across all of common clouds. 2. Consistency across multiple clouds when automating the deployment and configuration of applications. 3. Cloud software must interface with other software. 4. Make clouds the transparent home for data capture and analysis.

In these days, several kinds of hardware accelerators, such as GPUs and Xeon Phi processors, have become prevalent. However, the research of sharing accelerators between cloud users is not mature yet. More decent research for performance and QoS needs to be performed.

Work on testing and verification of critical cloud systems, e.g. ones hosting health and security data.

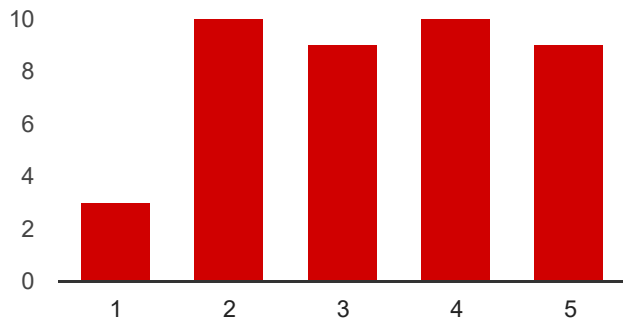
Cloud model evolution

Evolution 1. Fat cloud server

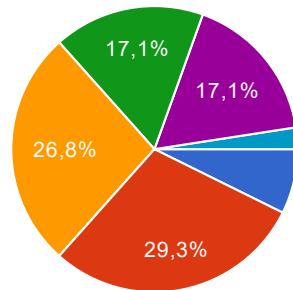


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| It is a challenge to be tackle beyond 2020 | 6 | 14.6% |
| It is a challenge for 2018-2020 | 9 | 22% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 3 | 7.3% |
| It is not/no more a challenge | 9 | 22% |
| Other | 3 | 7.3% |

How important is Evolution 1

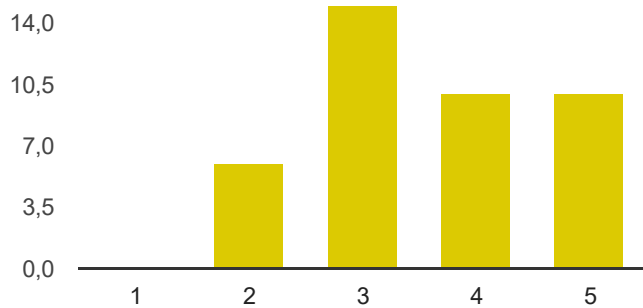


Evolution 2. Web-powered apps



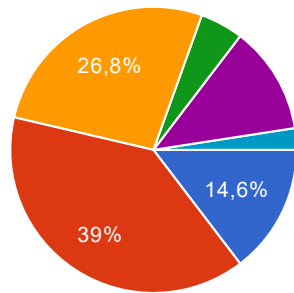
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|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 3 | 7.3% |
| It is a challenge for 2018-2020 | 12 | 29.3% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 7 | 17.1% |
| It is not/no more a challenge | 7 | 17.1% |
| Other | 1 | 2.4% |

How important is Evolution 2



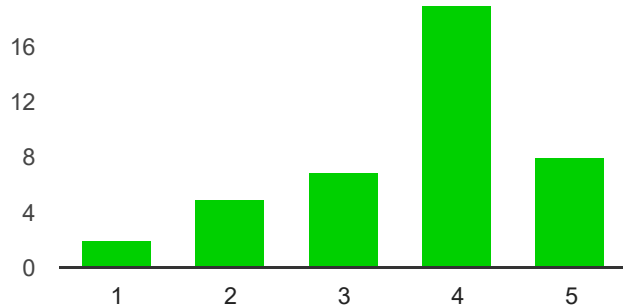
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 0 | 0% |
| | 6 | 14.6% |
| | 15 | 36.6% |
| | 10 | 24.4% |
| Highly important: 5 | 10 | 24.4% |

Evolution 3. Multi-tenancy in software



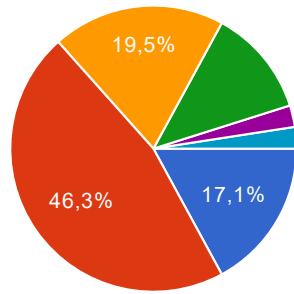
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|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 6 | 14.6% |
| It is a challenge for 2018-2020 | 16 | 39% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 5 | 12.2% |
| Other | 1 | 2.4% |

How important is Evolution 3



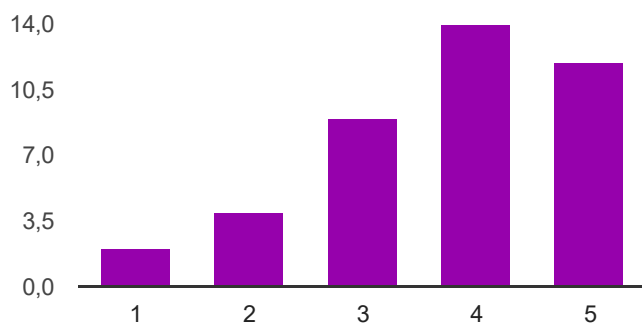
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|---------------------|-----------|-------|
| Not important: 1 | 2 | 4.9% |
| | 5 | 12.2% |
| | 7 | 17.1% |
| | 19 | 46.3% |
| Highly important: 5 | 8 | 19.5% |

Evolution 4. Inverse cloud models



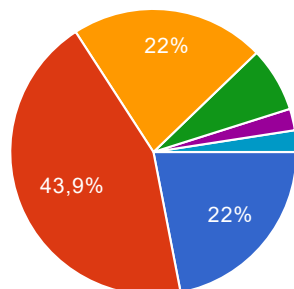
| | | |
|--|---|-------|
| It is a challenge to which my team/project works | 5 | 12.2% |
| It is not/no more a challenge | 1 | 2.4% |
| Other | 1 | 2.4% |

How important is Evolution 4



| | | |
|---------------------|----|-------|
| Not important: 1 | 2 | 4.9% |
| 2 | 4 | 9.8% |
| 3 | 9 | 22% |
| 4 | 14 | 34.1% |
| Highly important: 5 | 12 | 29.3% |

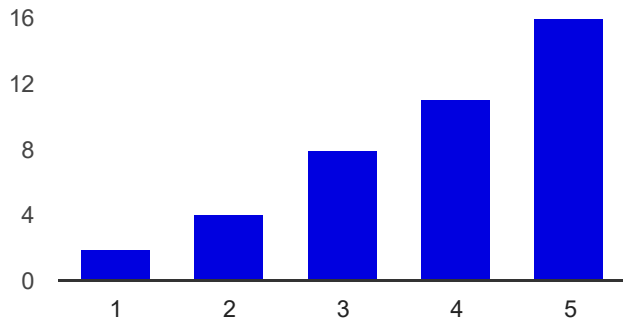
Evolution 5: Fog nodes integration



| | | |
|--|----|-------|
| It is a challenge to be tackle beyond 2020 | 9 | 22% |
| It is a challenge for 2018-2020 | 18 | 43.9% |
| It is a challenge for 2015-2017 | 9 | 22% |
| It is a challenge to which my team/project works | 3 | 7.3% |

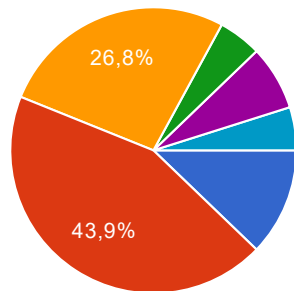
| | | |
|-------------------------------|----------|------|
| It is not/no more a challenge | 1 | 2.4% |
| Other | 1 | 2.4% |

How important is Evolution 5



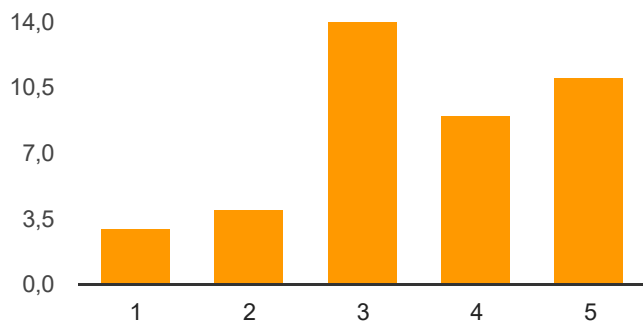
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 2 | 4.9% |
| 2 | 4 | 9.8% |
| 3 | 8 | 19.5% |
| 4 | 11 | 26.8% |
| Highly important: 5 | 16 | 39% |

Evolution 6: Smart gateways



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 5 | 12.2% |
| It is a challenge for 2018-2020 | 18 | 43.9% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 3 | 7.3% |
| Other | 2 | 4.9% |

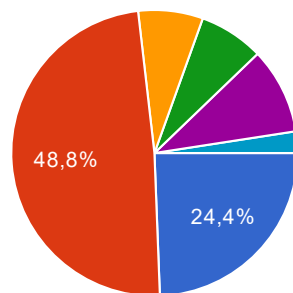
How important is Evolution 6



| | | |
|---|-----------|-------|
| 3 | 14 | 34.1% |
| 4 | 9 | 22% |

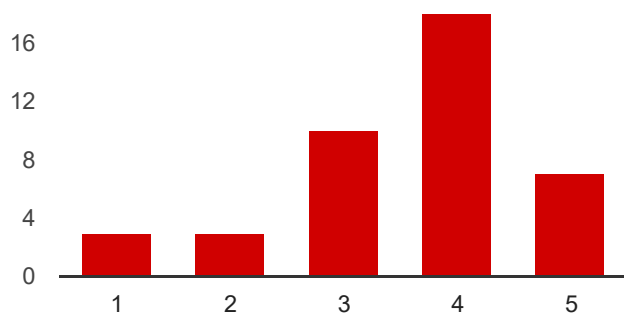
Highly important: 5 **11** 26.8%

Evolution 7: Integration with operational technologies



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 10 | 24.4% |
| It is a challenge for 2018-2020 | 20 | 48.8% |
| It is a challenge for 2015-2017 | 3 | 7.3% |
| It is a challenge to which my team/project works | 3 | 7.3% |
| It is not/no more a challenge | 4 | 9.8% |
| Other | 1 | 2.4% |

How important is Evolution 7



| | | |
|---------------------|-----------|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 3 | 7.3% |
| 3 | 10 | 24.4% |
| 4 | 18 | 43.9% |
| Highly important: 5 | 7 | 17.1% |

Evolution: What is missing?

n/a

The above questions well describe the future challenges

I'm not very familiar with this section topics

nothing

-

Cloud computing servers are expected to have more heavy cores such as Intel Xeon and performance-oriented accelerators such as GPGPUs. So, a cloud server will accommodate more virtual machines than now. However, in a congested situation, each virtual machine can interfere with each other in terms of using hardware, thus decreasing its performance. The research for preparing a fat cloud server is required in 2018-2020.

NA

Intelligent data center

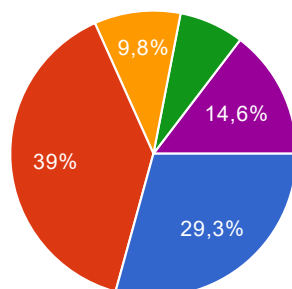
N/A

ok

Fog computing is a current trend in the market, however there is still a lot of work to do on the technical area (i.e. on security issues). Smart gateways are also the way to go on the IoT field.

Datacentre

Datacentre 1: Ecosystems

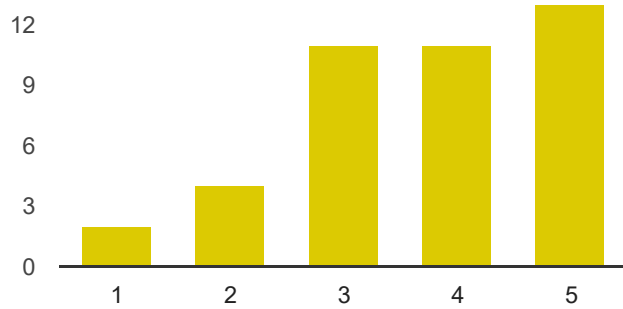


It is a challenge to be tackle beyond 2020 **12** 29.3%

It is a challenge for 2018-2020 **16** 39%

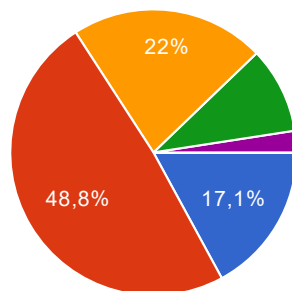
| | | |
|--|----------|-------|
| It is a challenge for 2015-2017 | 4 | 9.8% |
| It is a challenge to which my team/project works | 3 | 7.3% |
| It is not/no more a challenge | 6 | 14.6% |
| Other | 0 | 0% |

How important is Datacentre 1?



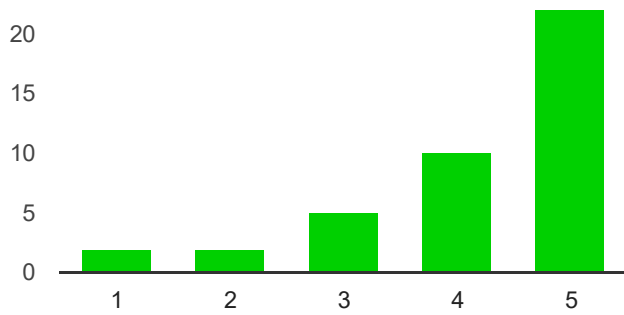
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|---------------------|-----------|-------|
| Not important: 1 | 2 | 4.9% |
| 2 | 4 | 9.8% |
| 3 | 11 | 26.8% |
| 4 | 11 | 26.8% |
| Highly important: 5 | 13 | 31.7% |

Datacentre 2: Software-defined



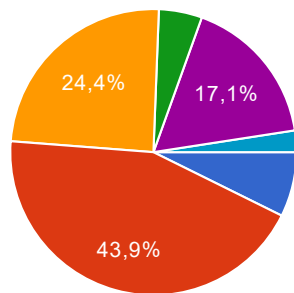
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| It is a challenge for 2015-2017 | 9 | 22% |
| It is a challenge to which my team/project works | 4 | 9.8% |
| It is not/no more a challenge | 1 | 2.4% |
| Other | 0 | 0% |

How important is Datacentre 2?



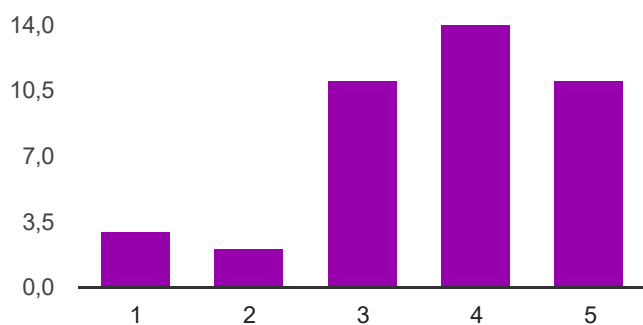
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| | 5 | 12.2% |
| | 10 | 24.4% |
| Highly important: 5 | 22 | 53.7% |

Datacentre 3: Private cluster on demand



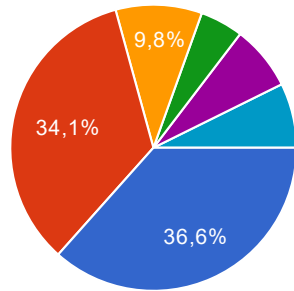
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 3 | 7.3% |
| It is a challenge for 2018-2020 | 18 | 43.9% |
| It is a challenge for 2015-2017 | 10 | 24.4% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 7 | 17.1% |
| Other | 1 | 2.4% |

How important is Datacentre 3?



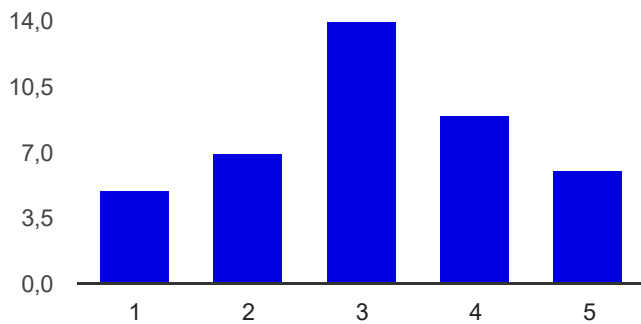
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 2 | 4.9% |
| 3 | 11 | 26.8% |
| 4 | 14 | 34.1% |
| Highly important: 5 | 11 | 26.8% |

Datacentre 4: Warehouse-scale computing



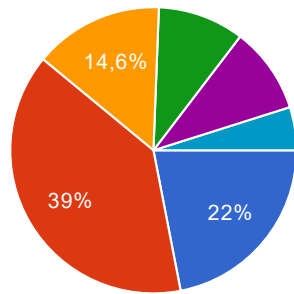
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 15 | 36.6% |
| It is a challenge for 2018-2020 | 14 | 34.1% |
| It is a challenge for 2015-2017 | 4 | 9.8% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 3 | 7.3% |
| Other | 3 | 7.3% |

How important is Datacentre 4?



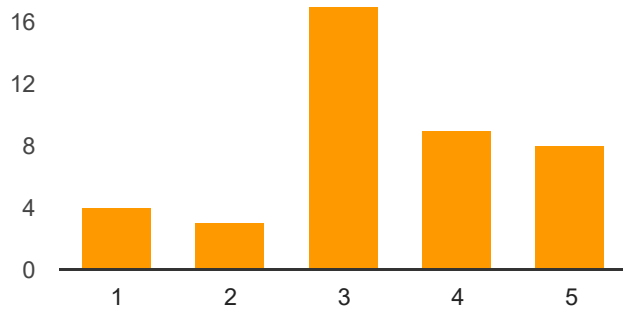
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 5 | 12.2% |
| 2 | 7 | 17.1% |
| 3 | 14 | 34.1% |
| 4 | 9 | 22% |
| Highly important: 5 | 6 | 14.6% |

Datacentre 5: New services



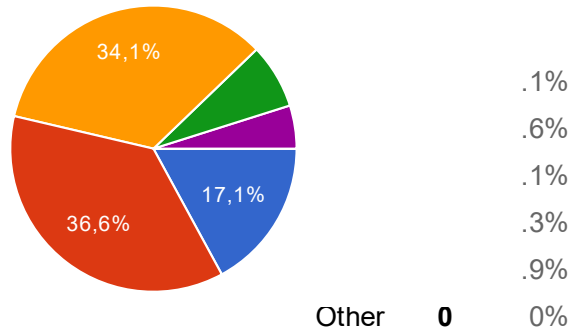
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 9 | 22% |
| It is a challenge for 2018-2020 | 16 | 39% |
| It is a challenge for 2015-2017 | 6 | 14.6% |
| It is a challenge to which my team/project works | 4 | 9.8% |
| It is not/no more a challenge | 4 | 9.8% |
| Other | 2 | 4.9% |

How important is Datacentre 5?

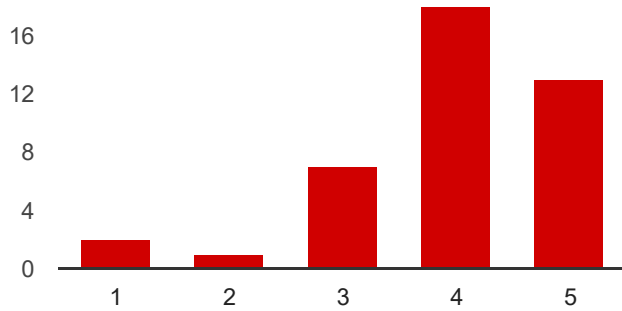


| | | |
|---------------------|-----------|-------|
| Not important: 1 | 4 | 9.8% |
| 2 | 3 | 7.3% |
| 3 | 17 | 41.5% |
| 4 | 9 | 22% |
| Highly important: 5 | 8 | 19.5% |

Datacentre 6: Orchestration through network awareness

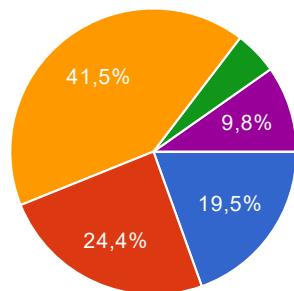


How important is Datacentre 6?



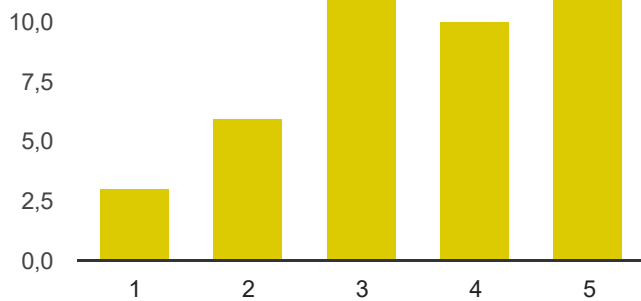
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 2 | 4.9% |
| 2 | 1 | 2.4% |
| 3 | 7 | 17.1% |
| 4 | 18 | 43.9% |
| Highly important: 5 | 13 | 31.7% |

Datacentre 7: Dynamic workflow management



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 8 | 19.5% |
| It is a challenge for 2018-2020 | 10 | 24.4% |
| It is a challenge for 2015-2017 | 17 | 41.5% |
| It is a challenge to which my team/project works | 2 | 4.9% |
| It is not/no more a challenge | 4 | 9.8% |
| Other | 0 | 0% |

How important is Datacentre 7?



| | | |
|---------------------|-----------|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 6 | 14.6% |
| 3 | 11 | 26.8% |
| 4 | 10 | 24.4% |
| Highly important: 5 | 11 | 26.8% |

Datacentre: What is missing?

n/a

Not enough the Software-defined approach. It is able to solve only partially the needs of the applications' market. The answer is again hybrid cloud (with HW accelerators well integrated).

Secure orchestration of networking and with quality of service

With global warming, research on green datacenter should continue.

Hardware acceleration and Exascale computing considerations?

The above questions well describe the future challenges

As software routers and switches can process tens of mega packets per second per core, they will replace old hardware ones in data centers soon. In the view of software defined networks, how to guarantee SLAs of each tenant will become an important issue.

Decentralized and reactive Software Defined platforms integrating computing, storage and networking

Security management in service composition, configuration and deployment, in order to guarantee privacy on user activities.

nothing

Allmost security related issues.

-

Flexible, adaptative scalable, self-recovery cloud based solutions and workflows delivering services, abstracted from the infrastructure over federated cluster clouds

geographically distributed , according to QoS, energy/cost efficiency parameters.

I agree that better integration of virtualised networks is a key challenge, and that application should be able to pass network requirements both at design and run-time to the virtualised network infrastructure.

Heterogenous datacenters, Self-organizing datacenters

I am not aware of anything that might be missing from this picture

IoT integration

No opinion

It is ok

Datacentre owners need to be encouraged to take the leap of faith to virtualise their environments in order to take advantage of the future technologies.

Integration of cloud and non-cloud services.

More distributed datacenters, closer to the users.

- / -

Energy-aware datacenter

Utilization of heterogeneous accelerators and coprocessors and their tying into the management framework.

Software-defined Data Centres Software-defined power in Data Centres; Energy-efficient management of both software and hardware, participation in demand response, etc; extensive piloting

Challenges need to be separated into - research worthy challenges and - things that are already being done by the industry... above a number of things are already being developed and we do not need to worry about these...

* Impact of the changes in IT on IT Service Management and Enterprise Architecture Management * Ensuring security on changing Cloud Stacks (currently: data-center -> hardware -> IaaS -> PaaS -> Cloud Applications)

NA

It should be necessary to transparently manage the computing resources of upcoming heterogenous chips that are going to integrate CPU+GPU+FPGA on the same die. Low-power latency-sensitive sequential workloads will be migrated to FPGA, whereas data-parallel workloads are going to be executed on GPUs. How can this be managed and monitored at the Datacentre level?

Energy efficiency

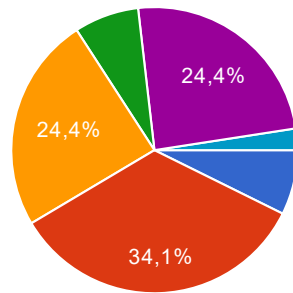
N/A

temperature awareness is missing along with the power aware scheduling. If we integrate HPC applications which will utilize the CPU/accelerators at the best then migrating the task to meet thermal demands needs to be considered.

high data availability via replication, redundancy and crosscheck-recovery

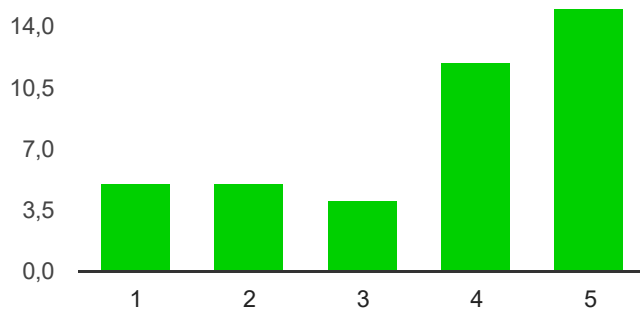
Market orientation

Market 1: BYOD



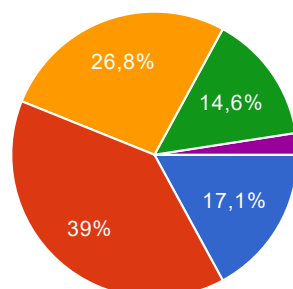
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 3 | 7.3% |
| It is a challenge for 2018-2020 | 14 | 34.1% |
| It is a challenge for 2015-2017 | 10 | 24.4% |
| It is a challenge to which my team/project works | 3 | 7.3% |
| It is not/no more a challenge | 10 | 24.4% |
| Other | 1 | 2.4% |

How important is Market 1?



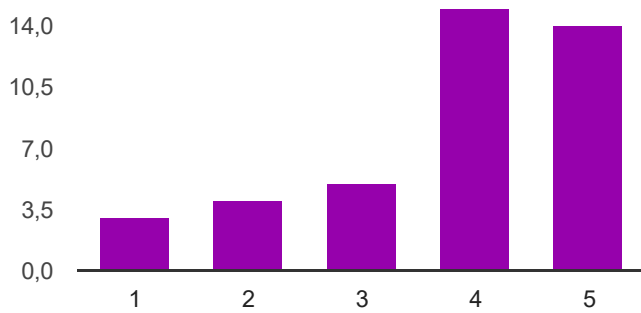
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 5 | 12.2% |
| 2 | 5 | 12.2% |
| 3 | 4 | 9.8% |
| 4 | 12 | 29.3% |
| Highly important: 5 | 15 | 36.6% |

Market 2: Cloud-ready



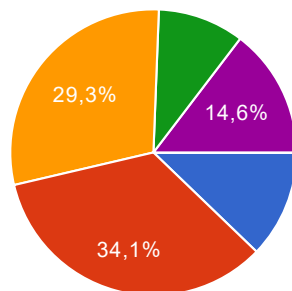
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 7 | 17.1% |
| It is a challenge for 2018-2020 | 16 | 39% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 6 | 14.6% |
| It is not/no more a challenge | 1 | 2.4% |
| Other | 0 | 0% |

How important is Market 2?



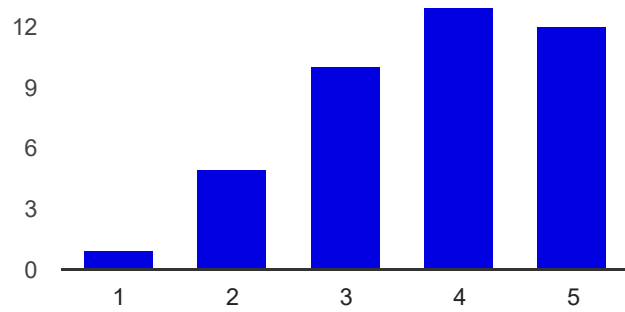
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 4 | 9.8% |
| 3 | 5 | 12.2% |
| 4 | 15 | 36.6% |
| Highly important: 5 | 14 | 34.1% |

Market 3: Connecting cloud services



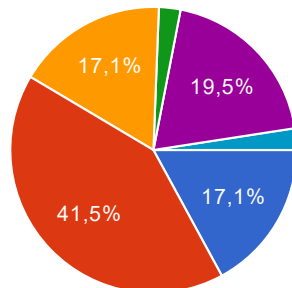
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 5 | 12.2% |
| It is a challenge for 2018-2020 | 14 | 34.1% |
| It is a challenge for 2015-2017 | 12 | 29.3% |
| It is a challenge to which my team/project works | 4 | 9.8% |
| It is not/no more a challenge | 6 | 14.6% |
| Other | 0 | 0% |

How important is Market 3?



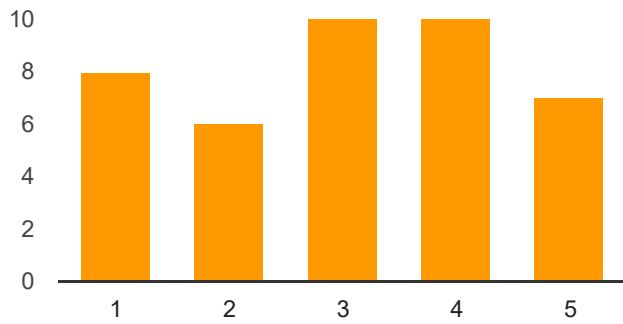
| | | |
|---------------------|-----------|-------|
| Not important: 1 | 1 | 2.4% |
| 2 | 5 | 12.2% |
| 3 | 10 | 24.4% |
| 4 | 13 | 31.7% |
| Highly important: 5 | 12 | 29.3% |

Market 4: Users as service providers



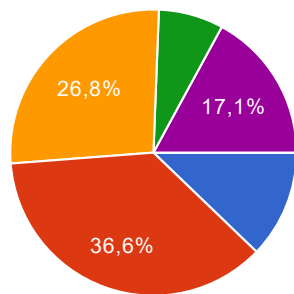
| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 7 | 17.1% |
| It is a challenge for 2018-2020 | 17 | 41.5% |
| It is a challenge for 2015-2017 | 7 | 17.1% |
| It is a challenge to which my team/project works | 1 | 2.4% |
| It is not/no more a challenge | 8 | 19.5% |
| Other | 1 | 2.4% |

How important is Market 4?



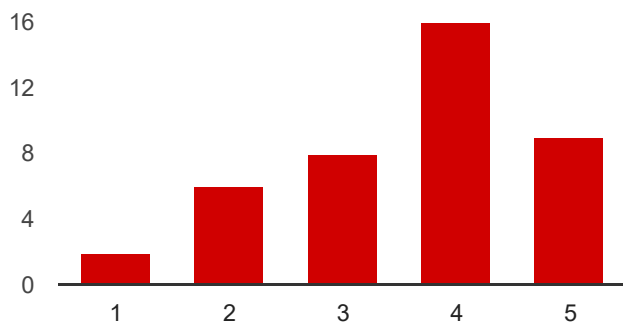
Highly important: 5 **7** 17.1%

Market 5: Personal cloud - data services



| | | |
|--|-----------|-------|
| It is a challenge to be tackle beyond 2020 | 5 | 12.2% |
| It is a challenge for 2018-2020 | 15 | 36.6% |
| It is a challenge for 2015-2017 | 11 | 26.8% |
| It is a challenge to which my team/project works | 3 | 7.3% |
| It is not/no more a challenge | 7 | 17.1% |
| Other | 0 | 0% |

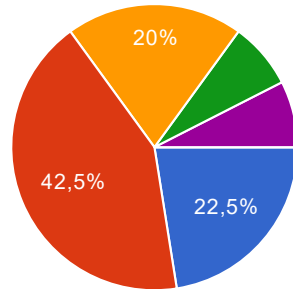
How important is Market 5?



| | | |
|------------------|----------|-------|
| Not important: 1 | 2 | 4.9% |
| | 6 | 14.6% |
| | 8 | 19.5% |

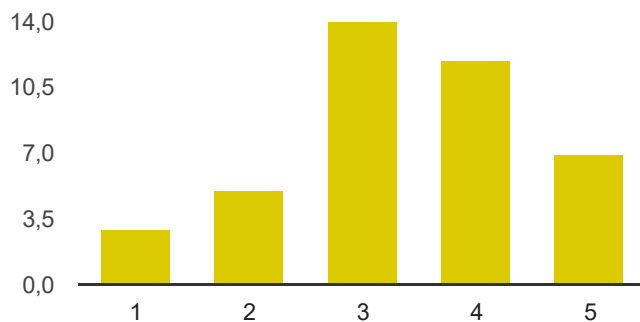
| | | | |
|---------------------|---|-----|-----|
| | 4 | 16 | 39% |
| Highly important: 5 | 9 | 22% | |

Market 6: Personal cloud - configurable services



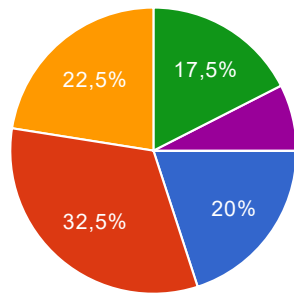
| | | |
|--|----|-------|
| It is a challenge to be tackle beyond 2020 | 9 | 22.5% |
| It is a challenge for 2018-2020 | 17 | 42.5% |
| It is a challenge for 2015-2017 | 8 | 20% |
| It is a challenge to which my team/project works | 3 | 7.5% |
| It is not/no more a challenge | 3 | 7.5% |
| Other | 0 | 0% |

How important is Market 6?



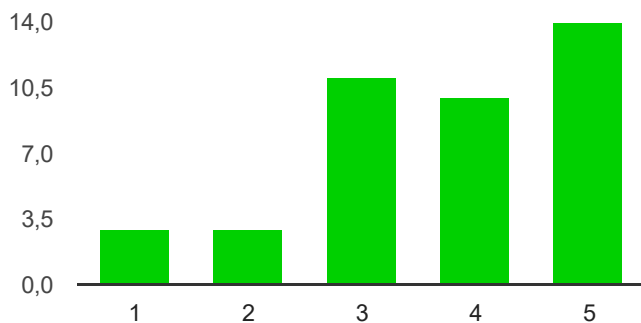
| | | |
|---------------------|----|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 5 | 12.2% |
| 3 | 14 | 34.1% |
| 4 | 12 | 29.3% |
| Highly important: 5 | 7 | 17.1% |

Market 7: Specialised clouds



| | | |
|--|---|-------|
| It is a challenge for 2018-2020 | 7 | 22.5% |
| It is a challenge for 2015-2017 | 9 | 22.5% |
| It is a challenge to which my team/project works | 7 | 17.5% |
| It is not/no more a challenge | 3 | 7.5% |
| Other | 0 | 0% |

How important is Market 7?



| | | |
|---------------------|----|-------|
| Not important: 1 | 3 | 7.3% |
| 2 | 3 | 7.3% |
| 3 | 11 | 26.8% |
| 4 | 10 | 24.4% |
| Highly important: 5 | 14 | 34.1% |

Market: What is missing?

n/a

Along with bigdata and streaming application there are many other HPC applications that needs attention in cloud environment.

The above questions well describe the future challenges

Highly secure systems protecting the confidential data being processed.

Automated orchestration between personal clouds and public or enterprise clouds

Clouds of FPGA devices are going to play a major role in the future due to the fact that is going to be the only option for scaling single-threaded applications. We envision an FPGA as a Service infrastructure

We are already witnessing the compisition of services, e.g. embedding of Facebook

likes in other pages. But we need open technologies to do this, and not depend on US technology.

new revenue chains enabled in clouds

Consolidated market trends such as Big Data and IoT, have brought several new concepts to the market such as personal clouds, BYOD, energy- and cost-efficiency, etc. However, although several studies reinforce these needs there is still missing some consolidated support technology to cover them. Next topics should cover all these concepts to cover market needs and expectations.

Technology that makes GPU code execution independent on the hardware architecture.

Cannot think of something

- Multi-Cloud requires multiple contracts -> framework should be considered for this -
Trends like BYOD increase security risks -> how can these risks be mitigated?

nothing

-

.

Combine BYOD paradigm with cloud offloading of hardware-intensive tasks (CPU, RAM, HDD, GPU, etc.) for both business and personal use

I see the above as -- not worthy research funding -- they will naturally materialize as provided by start-ups and industry.

?

Brokerage of XaaS

Combination of personal clouds that are used in order to monitor individuals health status. Another interesting topic would be inclusion of cloud services in medicine. Maybe the specialised clouds could be modeled to handle different signals (big amount of them).

No opinion

More emphasis about the Cloud Operating System such as Open Stack and support for PPP actions to enhance and proliferate this kind of open platforms into SMEs.

- / -

The amount of data generated by users will increase rapidly and the cloud should be ready to process and store all this data.

No additional comments to provide

pricing model

I would also add Personal Cloud Edge Services and middleware as a major topic.

NA

With the awareness of green technologies, being able to select the placement of services based on user requirements that it be green could lead to a large market adoption.

N/A

ISP licencing adjustments (pay-as-you-go)!

SME access and support to such cloud services and integration migration support from legacy environments.

In using cloud services, people generally have doubts about security and privacy. It is required to show how much a cloud service is safe by some measurable methods.
ok

Final remarks

Which category is missing?

Security

-

My impression is that a number of people involved in the making of this questionnaire have a rather conservative view on existing developments. Many of those "2018-2020" challenges are actually 2012-2013 developments.

Edge Computing, Personal Cloud Edge Computing

The thing that is always missed, BILLING! The actual marketplace places this as one of the most important parts of any platform. Always largely ignored in EU projects.

Security and standards

Energy efficiency

It is fine, although resources trust and privacy should be remarked.

Which key developments you envision that are not reflected in this form?

-

Personal Cloud Edge platforms, Adaptive hybrid middleware leveraging both end-user and data-center resources.

infrastructure visualization and modeling

Nothing

New secure architectures and systems.

With the upcoming slow-down and ending of Moore's Law, it would be required to combine multiple hardware technologies (e.g. FPGA, GPU, CPU) for increase the performance applications. Frameworks and software layers to transparently compile/execute and schedule applications on these devices will be required.

New integration of Open Source movements such as OpenStack into embedded personal networks, fog computing etc.

Which keyword or phrase will drive the funds for research and development in 2018-2020?

Personal Cloud platforms

Confidential-data-protection.

-

energy- and cost-efficiency

Green, interoperable

Operational Technology infrastructure on-demand

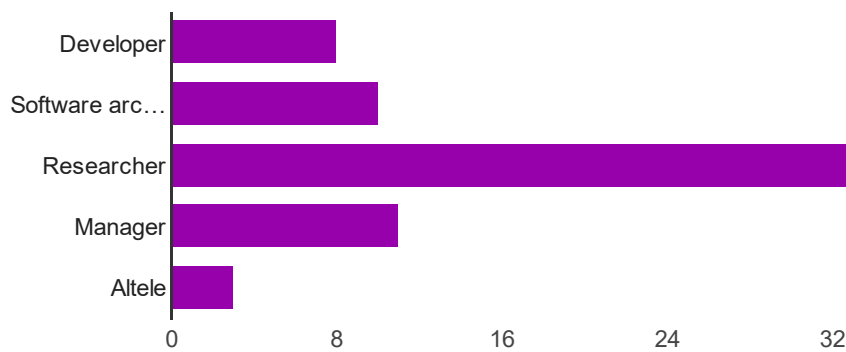
self-organizing, self-management, and self-healing

As stated earlier, one needs to carefully distinguish between areas that truly require EC funding and areas that will materialize as they are already (are about to being) pursued by the industry. As a metaphor -- there is no reason to pump money to -- drones / self-driving cars / virtual reality / augmented reality -- they are exploding on their own. Similarly with clouds -- what can be done by the industry, will be done and there is no reason to fund it further.

multi-tenancy hybrid cloud HPC energy efficiency

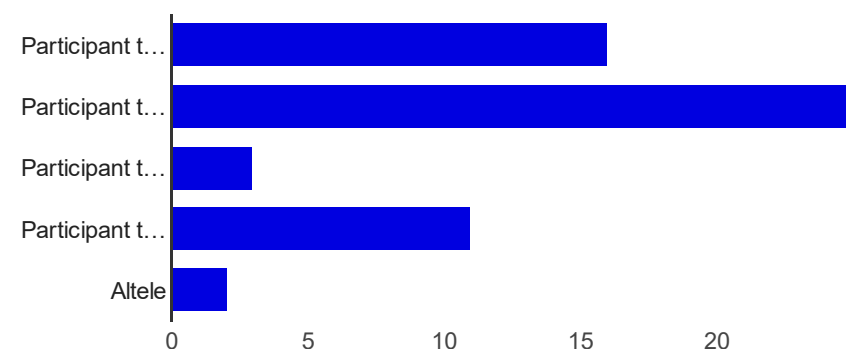
Multi-cloud auto scaling. Cloud data mining.

Which is your experience in the field?



| | | |
|--------------------|----|-------|
| Developer | 8 | 19.5% |
| Software architect | 10 | 24.4% |
| Researcher | 33 | 80.5% |
| Manager | 11 | 26.8% |
| Other | 3 | 7.3% |

Involvement in the community



| | | |
|---|-----------|-------|
| Participant to project(s) funded by E2 unit of European Commission | 16 | 41% |
| Participant to project(s) funded by ICT programme of European Commission (not E2) | 25 | 64.1% |
| Participant to project(s) funded by other programmes of European Commission (not ICT) | 3 | 7.7% |
| Participant to national projects related to the topics of the questionnaire | 11 | 28.2% |
| Other | 2 | 5.1% |

Number of replies per day

