

D2.2.1

Version	1.0
Author	URJC
Dissemination	CO
Date	22/01/2015
Status	Final



D2.2: State-of-the-art revision document v1

Project acronym:	NUBOMEDIA
Project title:	NUBOMEDIA: an elastic Platform as a Service (PaaS) cloud for interactive social multimedia
Project duration:	2014-02-01 to 2016-09-30
Project type:	STREP
Project reference:	610576
Project web page:	http://www.nubomedia.eu
Work package	WP2
WP leader	Victor Hidalgo
Deliverable nature:	Report
Lead editor:	Luis Lopez
Planned delivery date	01/2015
Actual delivery date	22/01/2015
Keywords	State-of-the-art revision

The research leading to these results has been funded by the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 610576



FP7 ICT-2013.1.6. Connected and Social Media

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Version History

Version	Date	Authors	Comments
0.1	01-04-2014	Luis Lopez	Initial Version
	28-05-2014	Constantin Filote	First Reviewed
0.2	24-09-2014	Luis Lopez	Additional topics added.
0.3	15-11-2014	Luis Lopez	Additional topics added
0.4	26-12-2014	Luis Lopez	Additional topics added
1.0	22-01-2015	Luis Lopez	Added final contributions from partners

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1 Executive summary

This document contains a revision on state-of-the-art evolution with the objective of locating any technological or scientific idea or evolution, which might impact on NUBOMEDIA objectives. The structure of this document is as follows.

- A new section is opened for each release of the project. On each release (in periods of 4 months), the partners comment on relevant events, news and trends
- At the end of the document, a section is devoted to specifying common sources of information used by the partners for obtaining latest trends, novelties and news related to the technological and societal aspects of the project.

2 Release 3

2.1 Internal comments on news and trends

This section is open to reviews, comments recommendations and advice provided by project experts in relation to how state-the-art evolutions could affect NUBOMEDIA roadmap and expected success.

2.1.1 Cloud orchestrators with auto scaling capabilities: solutions and trends

Source: TUB (Lorenzo Tomasini)

Keywords: Cloud, orchestrator, manager, auto scaling, template, PaaS

Discussion: Cloud computing drastically changed the way services are managed and orchestrated. Traditionally, services were statically deployed on top of physical hosts. This made upgrades of resources or software components to involve several manual operations in most of the case causing also downtime. Using clouds it is possible to request new resources on demand. However, for avoiding such manual interventions, a component which orchestrates the lifecycle of services in a simplified way is needed.

Generally those orchestrators have different tasks: apart from the lifecycle management of cloud resources, they have also to manage service topologies. With service topology we meant a combination of software components that represent services and the relationships among them in order to create a bigger service with more functionalities.

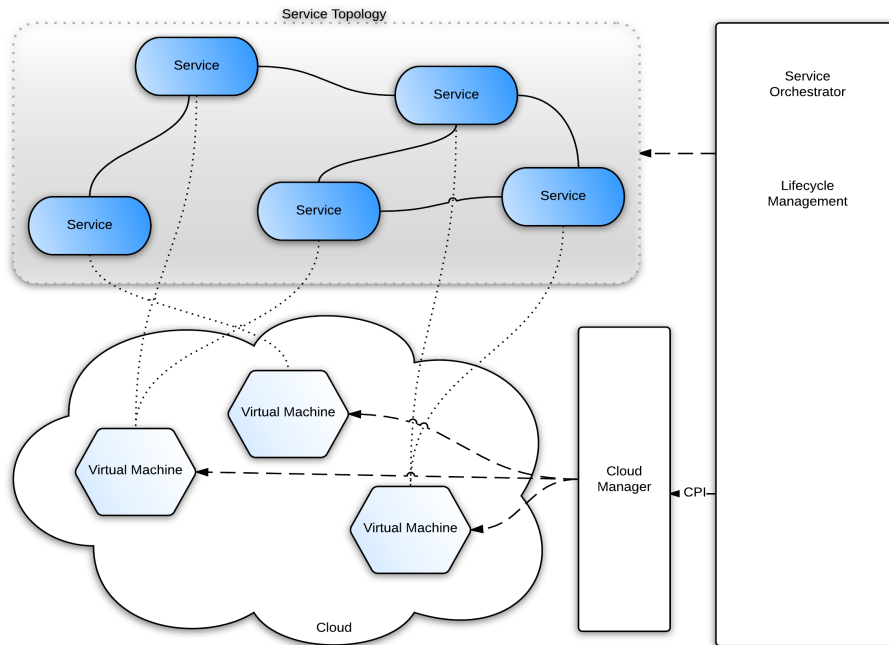


Figure 1 Basic overview of a Cloud Service Orchestrator

Therefore, a cloud orchestrator must offer functionalities for deploying those service topologies, usually described in a standard text format. Moreover it has to manage policies for each service topologies.

Since services need to be deployed in the cloud, the orchestrator also has the task of managing the connection with the Cloud Provider. A Cloud Provider offers an interface (CPI) in order to let the orchestrator to manage the virtual resources, i.e. Virtual Machines (VMs) or network resources (Figure 1).

The lifecycle management of virtualized resources starts from the request of deployment and it ends with the request of disposing them. During this process, the orchestrator has to follow these main phases:

1. Deployment of resources
2. Provisioning of the software
3. Runtime actions
4. Releasing resources

For the deployment phase, the orchestrator makes use of the CPI. Once the resources are ready, they are empty; hence the orchestrator must provide the software of the service component to be installed on them. After that, the service topology is ready to be started. Once the service topology is started the runtime actions will be activated by the cloud service orchestrator. One of the most important runtime actions is the “auto scaling”.

Auto scaling aims to keep High Availability, in order to reach this, it allows to automatically scale up or down the number of a virtual resource basing the choice on some parameters that could be CPU load, free Memory or even application level parameters.

In the following paragraphs, there is a general overview of some of the most popular open source cloud orchestrators: Cloudify, Bosh Cloud Foundry, Openshift, Heat.

Cloudify

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Cloudify [1] is an enterprise-class open source Platform as a Service (PaaS) stack that lays between the application and the chosen CPI. Thanks to it, an application is able to focus on doing what it does best, it will be the task of Cloudify to manage the resources it needs and to make sure that they are available independently of which cloud and stack will be employed. Thanks to its design, Cloudify is able to offer some features. For instance, without any changes to the code, it is possible to move your application to the cloud, without any concerns about the application stack, database store or any other middleware components it uses. Therefore no code has to be changed if you want to transfer your application to the Cloud. Moreover Cloudify supports public clouds (Amazon EC2, Windows Azure, Rackspace, etc.) and private clouds (OpenStack, CloudStack, VMWare vCloud, Citrix XenServer, etc.)

The application is completely isolated from the underlying CPI to support enterprises that want to deploy the same application in multiple environments (for cloud bursting). All the lifecycle of the application is managed by Cloudify's mechanism. Cloudify makes use of recipes in order to define an application, its services and their interdependencies, how to monitor, self-heal, scale them and their resources. So the process to deploy and manage an application results from:

1. Preparing the deployment
 - a. Set up the cloud and describe your machines in the cloud driver
 - b. Prepare the binaries required for your services
 - c. Describe the application lifecycle and its services in recipes
2. Deploying the services and application
 - a. Provisions machines in the cloud using cloud drivers
 - b. Downloads, installs, and configures services
 - c. Installs your application
 - d. Configures the monitoring and scaling features
3. Monitoring and managing the deployment using the Cloudify web management console or the Cloudify shell

Bosh Cloud Foundry



Cloud Foundry was the first open source PaaS. It is compatible with different frameworks, different services and different cloud providers. Bosh [2] was conceived in the context of the Cloud Foundry project. It is a general set of tools for deployment and lifecycle management of large scale distributed services. Bosh is the tool used to deploy the components of Cloud Foundry onto distributed VMs. The whole system is horizontally scalable thanks its design. This indicates that a Cloud Foundry instance can NUBOMEDIA: an elastic PaaS cloud for interactive social multimedia

have one or more copies of each component, thus to meet the load needed by a cloud. Moreover the components can be deployed on multiple distributed nodes. The three main components are also the prerequisites that are necessary to Bosh in order to deploy the whole system: a Stemcell, a Release and a deployment manifest

- A Stemcell is a VM template with an embedded Bosh Agent so that Bosh can take control of VMs cloned from the stemcell
- A Release is a container of collections of software bits and configurations that have to be installed onto the target system. When you deploy a VM, a collection of software, called job, is linked to it.
- In the Deployment Manifest is contained the actual values of parameters needed by a deployment. So deployment is something that turns a static release into runnable software on VMs.

Heat



The OpenStak Heat Orchestrator [2] is completely integrated with OpenStak [4] and is an utility able to manage multiple composite cloud applications using templates, over both an OpenStak-native ReST API and a CloudFormation-compatible Query API.

A Heat Orchestration Template (HOT) is sent to Heat in order to deploy a specific topology. The assignment of the Heat template is to define a topology infrastructure for a Cloud application, using a readable and writable way of representation. Heat templates typically take the shape of plain Yaml documents. Inside the HOT are also defined all the policies needed to enable the auto scaling. In particular we can set policies regarding CPU and memory of each VM (Media Server in our specific case). There are also relationships between resources thus to infer a particular launch order on OpenStak. Those ones are likewise represented in the templates and Heat will follow the correct launching order.

The HOT template provides different fields:

- `heat_template_version`
 - This key indicates that the YAML document is a HOT template of the specified version.
- `Description`
 - This *optional* key allows for giving a description of the template, or the workload that can be deployed using the template.
- `parameter_groups`

- This section allows for specifying how the input parameters should be grouped and the order to provide the parameters in. This section is *optional* and can be omitted when necessary.
- Parameters
 - This section allows for specifying input parameters that have to be provided when instantiating the template. The section is *optional* and can be omitted when no input is required.
- Resources
 - This section contains the declaration of the single resources of the template. This section with at least one resource should be defined in any HOT template, or the template would not really do anything when being instantiated.

In the resources field it is possible to define an auto scaling group that can scale arbitrary resources. The auto scaling system of Heat follows the concepts used by AWS

Amazon Elastic Compute Cloud (Amazon EC2) [5] is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale cloud computing easier for developers. It offers an auto scaling system that we can consider as State of the Art.

Auto Scaling helps you maintain application availability and allows to scale Amazon EC2 capacity up or down automatically according to defined conditions. Scaling starts with an event, or scaling action, which instructs Auto Scaling to either launch or terminate EC2 instances. The most important terms to understand in order to well learn the auto scaling are Cooldowns and Termination Policies. Cooldowns are periods of time during which Auto Scaling ignores any additional scaling actions. Termination Policies are criteria that determine which instances Auto Scaling should terminate first. There are different kinds of auto scaling implementations, for example:

- Manual Scaling
 - This scaling allows changing the number of running instances in your Auto Scaling group manually at any time.
- Dynamic Scaling
 - Use this scaling plan if you need to scale dynamically in response to changes in the demand for your application. When you scale based on demand, you must specify when and how to scale.

In the dynamic scaling it is possible to choose the “Scaling Based on Metrics”. In order to create a scaling method based on metrics it is necessary to create CloudWatch alarms that watch over the scale-in and scale-out metrics that must be specified when creating the policy. Then the alarms are associated with the scaling policies that have already been created. These alarms send messages to Auto Scaling when the specified metrics breach the thresholds that are specified in the policies.

Differences

The comparison of these orchestrators reveals that orchestrators might differ completely from the application-level point of view. For instance, Heat is one of the projects within the OpenStack environment building a complete deployment solution. It provides basic functionalities regarding the deployment and management of an virtual infrastructure. Furthermore, Heat is capable to settle auto scaling mechanisms in combination with OpenStack's Ceilometer. Thanks to this you can define scaling policies that are responsible to observe the addressed groups of resources adding or removing new and existing instances.

In contrast to that, Cloudify is more like a service orchestrator what means that it provides an advanced solution for automating and managing the application's deployment and post deployment processes. Using Cloudify in combination with OpenStak [6] enables the capability to use Cloudify as a service on-top of the heat environment where Heat sets up the OpenStak infrastructure (machines, storage, networking) and Cloudify provides a rich set of services, starting with application topology and modeling to complete monitoring analytics and deployment. In addition to that, Cloudify provides also interoperability across other platforms, such as AWS, CloudStack, Microsoft Azure and VMWare just to name a few of them. Nevertheless, next versions of Cloudify are going more and more in the direction of OpenStack but not becoming a piece of OpenStack-only software. [7] Besides that, the integration into OpenStack will not duplicate functions existing already in Heat. Cloudify will simply forwarded required steps to Heat gaining a seamless integration of the two tools. In conclusion, it can be claimed that Cloudify is a very powerful tool for productive orchestration across the borders of different clouds allowing to manage virtual machines of individual cloud providers.

Bosh's CloudFoundry is also more than a basic deployer for virtual infrastructures like Heat. It is an enhanced environment tool for managing and automating service orchestration providing also the ability to integrate it into the OpenStak environment. In contrast to Cloudify it doesn't use heat but nova and neutron to provide its services on top of a predefined infrastructure. In relation to Heat, Bosh lays more in a high level layer that Heat and it is focused more in the application level while Heat is more involved with the infrastructure resources.

Conclusion:

This section is going to describe the requirements of NUBOMEDIA in relation to orchestrators. The table below summarizes them and gives an overview of the functionalities to provided by the NUBOMEDIA orchestrator. Just as a reminder, the functionalities are the following:

- Deployment of the NUBOMEDIA infrastructure: Capability of deploying and managing virtual machines with specific images and configurations.
- Creation, Recovery and Management of media elements: Media elements are responsible for providing different types of application services exposed by virtual machines. In practical terms this means that: while creating new media elements of a given type that will be connected with other media elements, it is important to specify parameters as a hint for the placement algorithms. Furthermore, for recovering a specific media element through its unique id, the media element type shall be associated to a specific proxy that will enable to manage it remotely.
- Creation, Recovery and Management of distributed pipelines: NUBOMEDIA applications are built by chaining different media elements into a media pipeline applying a specific workflow over the media stream.
- Integration with Connectivity Manager: The Connectivity Manager contains the logic for monitoring and managing the computing infrastructure. It should expose an OCCI interface extended for offering more functions to the elastic media manager layer, including placement.
- Integration with OpenStak: The OpenStak environment is selected as the virtual infrastructure and therefore it is needed to integrate it with OpenStak.
- Auto scaling mechanisms: When specific instances are running out of resources, it is needed to provide further resources to fulfill the current amount of requests

properly, and vice versa in case of unused resources. By providing auto-scaling mechanisms we need also a monitoring system and furthermore the possibility to create application-related meters. Another important feature is the termination of specific instances during the scaling-in process. That is why we need explicit termination rules described below more in detail.

- **Monitoring/custom meters:** Auto scaling mechanisms are based on monitored resources of two different types. So on one hand it is required to provide a basic monitoring system and on the other hand it is needed a mechanism to take into account application-related meters. Application-related meters are mandatory because basic monitoring systems do not cover all the meters that may be needed for a high-level auto scaling system.
- **Termination rules:** It is required to define termination rules applied to the scaling-in process of media elements to take care about active sessions and essential instances. Otherwise, it may happen that the orchestrator terminates an instance that is active (e.g. processing requests). In this case the user requests will be canceled directly and leads to an undesired behavior of requested services. So the orchestrator has to provide a mechanism where we can define a specific termination rule. These termination rules depend on the provided services and therefore it is mandatory to provide the opportunity to define these rules as needed. In most cases we want to terminate completely idle instances only but it might be possible to need different termination rules.
- **Bootstrapping:** Starting and configuring services while adding new instances is done after the instance's boot-up. This is why the orchestrator has to provide a bootstrapping system that executes commands directly after the launching new instances.
- **RESTful API/Command line interface:** The RESTful programming application interface and command line interface is needed for managing the NUBOMEDIA infrastructure, for instance, deploying and disposing the NUBOMEDIA infrastructure or creating and managing services.

The following taxonomy depicts which of these features are provided, provided partially and not provided by existing orchestrators and what the NUBOMEDIA orchestrator called Elastic Media Manager (EMM), needs to support. Depending on the selected orchestrator it is needed to extend this one to fulfill the requirements completely.

	Cloudify	Bosh CloudFoundry	HEAT	EMM
Deployment of the basic infrastructure	YES	YES	YES	YES
Creation, Recovery and Management of Media Elements	PART¹	PART¹	PART¹	YES
Creation, Recovery and Management of distributed Pipelines	PART²	PART²	PART²	YES
Integration with the Connectivity Manager	NO	NO	NO	YES

Integration with OpenStack	YES	YES	YES	YES
Auto scaling mechanisms	PART³	PART³	PART³	YES
Monitoring / custom meters	YES / YES	YES / NO	YES / YES	YES / YES
Termination rules	NO⁴	NO⁴	NO⁴	YES
Bootstrapping	YES	YES	YES	YES
RESTful API / Command line interface	YES / YES	YES / YES	YES / YES	YES / YES
<p>¹⁾ In general, it is the main task of an orchestrator to deploy a basic cloud environment with certain components. But apart from that, the physical placement of these components must be provided by another NUBOMEDIA component, the Connectivity Manager and this is not provided by any existing orchestrator since the Connectivity Manager is part of the specific architecture of NUBOMEDIA and therefore must be integrated directly.</p> <p>²⁾ As mentioned above the distributed pipelines are responsible for applying a specific workflow over the media stream. This is also a very specific functionality of NUBOMEDIA and hence any existing orchestrator does not provide it.</p> <p>³⁾ Basic auto scaling mechanisms are provided by all of these orchestrators but what we need is an advanced auto scaling system that provides monitoring, enables the creation of custom meters and allows also the definition of certain termination rules.</p> <p>⁴⁾ As described above, termination rules are quite important for the lifecycle of virtual machines and its services. Obviously, each of these Orchestrators uses termination rules for the scaling-in process but these rules are very static and not editable. So the EMM have to provide a mechanism to define these termination rules depending on the provided services.</p>				

Considering the evolution of the NUBOMEDIA platform, and also its requirements, we started within Release 2 using Heat as orchestrator, while moved to our own implementation from Release 3. Indeed two of the most important requirements from the NUBOMEDIA infrastructure are related with:

- In-scaling procedures: it shall be possible to define a two steps procedure before removing completely a NUBOMEDIA component while performing in-scaling operations. Once a NUBOMEDIA component is selected for removal this procedure should allow first to signal it to stop accepting new incoming requests, and send a signal back once all the sessions it was serving are terminated
- Media session placement: the EMM shall expose an interface for runtime session placement on the media servers available inside the NUBOMEDIA infrastructure

While utilizing Heat during Release 2, it was analyzed that the above-mentioned requirements were not satisfied, not only by Heat but also by Bosh and Cloudify.

In particular Heat does not provide any placement algorithms: the selection of the Hardware on which the VMs are instantiated is done by the OpenStack scheduler and its algorithm cannot be modified while using Heat.

Regarding the in-scaling problem, Heat does not support any mechanisms for communicating runtime with the instantiated resources.

Conclusively, the NUBOMEDIA orchestrator implementation, the Elastic Media Manager, will be able, thanks to the integration with the Connectivity Manager NUBOMEDIA component, to provide a resource placement algorithm and a much more sophisticated auto-scaling process, involving the collaboration and synchronization with the deployed resources.

[1] GigaSpaces Technologies. Cloudify. See <http://www.cloudifysource.org/>.

[2] Cloudfoundry. Bosh. See <http://docs.cloudfoundry.com/docs/running/bosh/>.

- [3] OpenStak. OpenStak heat orchestrator. See <https://wiki.openstack.org/wiki/Heat>.
- [4] OpenStak. Open source software for creating private and public clouds. See <http://www.openstack.org/>.
- [5] Amazon Elastic Compute Cloud (Amazon EC2). See http://aws.amazon.com/ec2/?nc2=h_13_c/.
- [6] Cloudify and OpenStak Heat. See <http://www.gigaspaces.com/system/files/private/free/resource/Cloudify%20and%20OpenStack%20Heat.pdf>.
- [7] Cloudify – ADMIN magazine. See <http://www.admin-magazine.com/Articles/Achieving-More-Harmonious-Cloud-Orchestration>

2.1.2 Diminished reality: necessity for augmented reality

Source: VTT (Sanni Siltanen)

Keywords: augmented reality, AR, diminished reality, indoor augmented reality,

Discussion: Augmented reality (AR) refers to an interactive and real-time system where digital information is embedded to the physical reality. Augmented reality enables visualizing plans and future changes in real environment. The user can see a 3D model in an authentic milieu which helps understanding spatial relations and dimensions. AR applications often benefit from a diminishing functionality that enables removing existing elements as explained below. In NUBOMEDIA, AR tools will be one available element for enriching the multimedia content.

Interior design is one prominent application area of AR. Interior design plans are traditionally 2D floor plan drawings and ordinary people have sometimes difficulties understanding them. Testing furniture at home is problematic; one cannot bring a bunch of couches to home and see how they fit to the living room. AR enables testing furniture in real home virtually and concretizes interior design plans in real setting.

There is, however, a major problem in using augmented reality in interior design; the spaces are typically already occupied with old furniture and when augmentation is rendered on top of an image with existing furniture partially overlapping with the augmentation, the result looks incongruous (Figure b). In case the old furniture is not supposed to be part of the new interior design, the solution is to remove them virtually. Such functionality is called diminished reality.

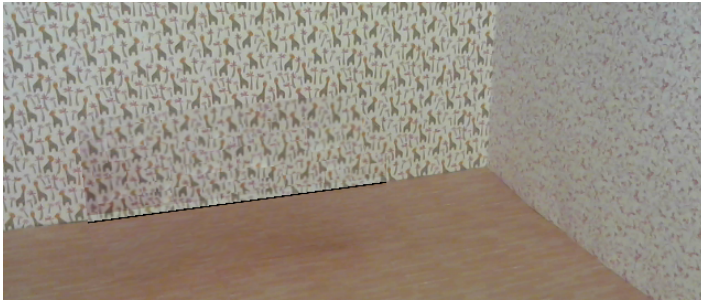
Diminished reality solution renders a patch over the existing furniture to hide it from the view. In ideal case the rendered patch resembles the real environment and the user is unable distinguish it from the view (Figure c). After diminishing, the space looks empty and the augmentation is possible. Augmentation over an empty space looks natural (Figure d).



a) original image



b) augmentation on top of original image



c) diminished image



d) augmentation on diminished image

Conclusion:

Real environment is seldom ideal; the space under planning contains objects that will be removed and that thus should not appear in visualizations. Diminished reality functionality enables the use of AR technology in such cases. Diminishing functionality is an enabler for real AR visualization applications.

References:

Siltanen, Sanni; Saraspää, Henrikki; Karvonen, Jari, "[DEMO] A complete interior design solution with diminished reality," Mixed and Augmented Reality (ISMAR), 2014 IEEE International Symposium on , vol., no., pp.371,372, 10-12 Sept. 2014

2.1.3 Computer Vision as a Service (CVaaS)

Source: VTOOLS (Victor Hidalgo)

Keywords: VCA, Cloud, PaaS

Discussion: Computer vision is a rapidly growing field devoted to analyzing, modifying, and high-level understanding of images. Its objective is to determine what is happening in front of a camera and use that understanding to control a computer or robotic system, or to provide people with new images that are more informative or esthetically pleasing than the original camera images. Application areas for computer-vision technology include video surveillance, biometrics, automotive, photography, movie production, Web search, medicine, augmented reality gaming, new user interfaces, and many more.

However, Computer vision is computationally expensive. Computer vision (CV) or Video content analysis algorithms (VCA) consume a prohibitive amount of resources such as memory or CPU. That is the reason why many problems in the field cannot be solved properly. For example, complex algorithms require many functions operating in parallel on a single image to extract all relevant content, and in many cases the users require that the algorithm processes the images in less than 40 milliseconds.

The emergence of cloud technology in the last years is considered to be one of the enabling technologies that allow such complex algorithms to be applied in practice. Running in the cloud VCA algorithms that can inter-operate with each other and that are accessible through comprehensive and simple APIs can open new horizons to computer vision applications.

Some of the benefits that cloud technology offers to computer vision are:

- Computational power and storage.
- Allows for having VCA algorithms or services on demand.
- Publishing algorithms for masses through simple APIs

Nevertheless, it does not appear to exist a mature solution for running VCA in the Cloud. At this point, we are going to make a classification between those solutions which try to bring a set of image analysis operations to the cloud and those which provide a specific solution.

In the first group, technology which tries to bring CV operations to the cloud, we could find some existing initiatives which tackle this problem. The first one which is worth to highlight is **CloudCV** [1] a large-scale distributed Computer Vision as a cloud service. The CloudCV is an open source project which arose from the Graphlab [3] project in summer 2012. The first version of CloudCV was available in summer 2013. This first version only provided an image stitching algorithm in order to combine multiple photographic images with overlapping fields of view to produce a segmented panorama or high resolution image. After this first version the CloudCV has introduced new algorithms. Currently, the algorithms which can be executed are:

- Image stitching
- Object detection
- Object classification, through which different objects in the image can be automatically identified.
- Decaf: A deep convolutional activation feature for generic visual recognition.

After seeing the algorithms that can be used through CloudCV, we are going to see a little more in depth its architecture. The following figure depicts a basic scheme of it.

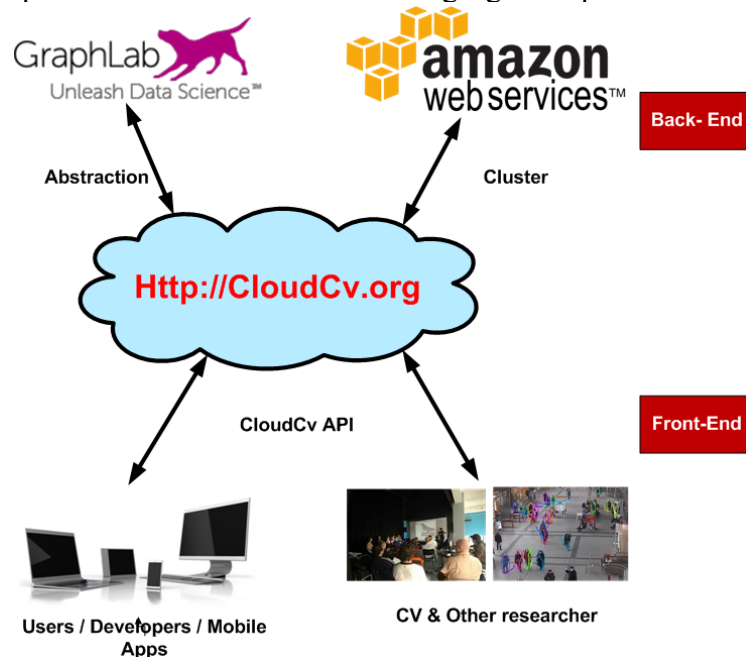


Figure 2: CloudCV Architecture

CloudCV provides computer vision algorithms as a service to researchers, students and app developers through its Matlab, python and web APIs. GraphLab provides a high level programming interface, allowing a rapid deployment of distributed machine

learning algorithms. In this case, the GraphLab carries out the deployment through amazon web services.

After reviewing the CloudCV platform, we are going to present another platform which tries to bring computer vision algorithms to the cloud. This platform is called **Rubix.io** [2]. At the time of this writing Rubix.io is still in beta. This software can be used through a Ruby API. A JavaScript API is under development. In this beta version, you can use through its API the following algorithms:

- Object Detection.
- Text recognition (OCR).
- An algorithm to detect Image similarities.
- They are currently working on a face recognition.

However, at the time of this writing Rubix.io seems not to be under active development because they took almost a year without making a commit to its repository at Github.

On the second group of the classification that we did at the beginning, we find **specific solutions**. For example, applications or prototypes such as face recognition or license plate recognition have been already developed on cloud systems. We can find many examples of Face Recognition on the net. For instance, in the paper “*Face Recognition for Social Media with Mobile Cloud Computing*” [4] a cloud solution is proposed for face recognition using mobile devices. In this solution the mobile devices are in charge of detecting the face on the image. Once the face has been detected, the part of the image where the face has been detected is sent to the cloud service to perform the face recognition. Another example of facial recognition in the cloud can be found in the paper “*Cloud-Vision: Real-Time Face Recognition Using a Mobile-Cloudlet-Cloud Acceleration Architecture*” [5]. The challenge of this study lies with how to perform task partitioning from mobile devices to cloud and distribute compute load among cloud servers to minimize the response time given diverse communication latencies and server compute powers. However, in this challenge the image processing is carried out in the mobile devices or some internal servers which are found in the previous step to send information to the cloud. In fact, with the aim to avoid becoming very network-intensive, the system only sends metadata corresponding to the HAAR features of the face. This metadata will be used to make the matching between the info sent and the corresponding databases of faces.

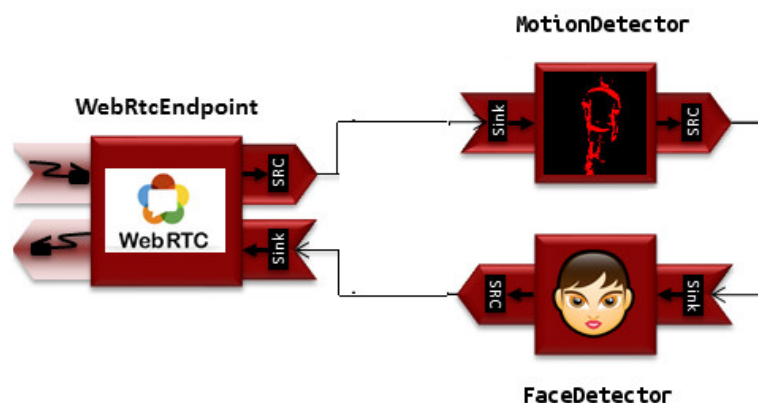
About License Plate Recognition, in the paper “*Cloud Based Anti Vehicle Theft by Using Number Plate Recognition*” a specific system has been design to efficient automatic theft vehicle identification system by using the vehicle number plate. The proposed algorithm follows the typical phases in license plate recognition: Vehicle identification, Extraction of number plate region, Recognition of plate characters and compare. In this system the only part which is executed on the cloud is the comparison part. Another example of this system which run the four typical phases for a license plate recognition on the cloud was developed by one of the industrial partners of this consortium, Visual Tools. It developed a vehicle identification system [6] in a European project call “Web Of Objects”. However, the system was designed to operate without real-time requirements and only with images and not video streams.

Conclusion: There is a big **lack of information** about **computer vision over cloud computing** on the net. This may be due that Cloud computing is a relative new technology with high potential but it still needs to be further exploited in certain fields like computer vision. In the examples we have seen related to specific solutions, some

of the applications make image processing outside of the cloud and then send the metadata or images at a specific time and in a not constant way to the cloud. Other systems work on images and not on a video stream without real-time requirements. As for the platforms that try to bring cloud-computing algorithms to the cloud, Rubix.io seems not to be very active. It does not provide many algorithms and does not specify if the platform also works for a video stream. In the same way, they do not mention anything about real-time results. Finally, CloudCV also provides few computer vision algorithms. However, it seems that it can work on video streams with real-time results. But even if there is little more information on this platform, this is still scarce and we have many issues to solve such as whether you can apply various algorithms at the same video stream, whether they will develop more algorithms in the future or what is the technology that it uses for real-time communications. Maybe, CloudCV can be a competitor for the NUBOMEDIA project. Therefore, the consortium will be alert how this platform evolves.

Due to this gap, The NUBOMEDIA project emerges with the aim of creating a cloud platform specifically designed for hosting real-time interactive multimedia services incorporating VCA and Augmented Reality. Apart from the benefits of cloud technology on VCA algorithms, the main positive impacts that the NUBOMEDIA project can have are:

- Exposition of capabilities through a simple to use API encapsulating and abstracting the complexities of VCA technologies. This API makes possible to create applications just by chaining individual media functions known as “Media Elements”. The creation of such chains with different VCA services is suitable for tackling complex problems. For example, combining a motion detector media element and a face recognition media element can be done with the media pipeline (chain of media elements) shown below. Particularly, every time the motion detector detects motion in the image the face detector will try to detect faces on the image.



- NUBOMEDIA enables many intelligent operations on video to be executed in real-time which are essential for many fields such as video surveillance or video games.
- NUBOMEDIA is Free Open Source Software (FOSS). This guarantees that the platform is open and can be openly accessed in order to create a community of contributors. Therefore, the number of VCA services, elements or algorithms could be widely increased generating a big library of computer vision functionalities.
- Combining VCA with Augmented Reality can enrich an even wider range of useful applications.
- Ease of Creation and composition of chains which allow for easy creation of customizable applications

In addition, building VCA systems is beyond the reach of people without deep understanding of image processing, modeling and expertise in computer programming. These prerequisites limit the ability of creating such applications to an insular community of researchers and advanced programmers and serve as a high barrier of entry for developers without skills in these areas.

- [1] www.cloudev.org
- [2] www.rubix.io
- [3] <http://graphlab.com/index.html>
- [4] <http://airccse.org/journal/ijccsa/papers/3113ijccsa02.pdf>
- [5] <http://www.cs.rit.edu/~jmk/papers/cloud-vision.pdf>
- [6] <http://www.web-of-objects.com/demonstrations.html>

2.1.4 Evaluation of Asynchronous Server Technologies

Source: Fraunhofer (Frank Schulze)

Keywords: Event-based, synchronous, server-framework

Hyperlinks: http://www.dhbw-stuttgart.de/fileadmin/dateien/KOS/pub_kos.content_1.2013.band2.pdf#page=143

Discussion: This paper discusses disadvantages of synchronous server technologies due to the development that have been raised in the last years in the area of cloud computing, big data, social media, and mobile computing.

Compares the concepts of event-driven and synchronous programming. It states that the concept of asynchronous processing is not suitable for applications with longer processing periods, because the concept relies on the idea that each module has only one computation thread with one event loop. Blocking this loop with computation intensive tasks makes this module unresponsive for new events on the event loop and this should be avoided.



Shows a market overview of different asynchronous frameworks for server-side asynchronous development and in particular it analyses the frameworks Node.js and Vert.x.

Besides technical details with source code examples it also compares non-functional requirements of these frameworks. Special attention is given to maintainability of those frameworks, which is stated as “the most important issue in the enterprise” due to the reason that developers “come and go”.

The paper also compares the frameworks according to their scalability and performance against two traditional web server solutions.

Conclusion: This paper outlines the advantages of asynchronous server side technologies. The performance tests showed that if the use case suits asynchronous processing paradigms, they are much more performing than traditional web server. But it must be mentioned that this is very use case dependent. This means the number of requests that can be handled depends much on the time it takes to process one single request, because in the event-based systems there is only one request processed at a time. If this processing is too long then also the performance lacks.

For the evaluating of this paper for the adaption of a server side framework for the NUBOMEDIA platform it can be concluded that this paper recommends the usage of an asynchronous server framework while always keeping in mind the principles of asynchronous processing.

2.1.5 WebRTC Media Servers: revision of the state of the art.

Source: NAEVATEC (José A. Santos and F. Javier López)

Keywords: WebRTC, media servers, media infrastructures.

Discussion:

In the context of RTC systems, a media server is a software stack (i.e. a subsystem) that provides media capabilities. Media capabilities are all the features related to the media itself (i.e. related with the bits of information representing audio and video). These may include:

- Media transport following specific RTC protocols
- Media recording and recovery
- Media transcoding
- Media distribution
- Media analysis
- Media augmentation and transformation
- Media mixing
- Etc.

In the RTC framework, sometimes media servers are frequently named depending on the specific capabilities they provide. For example, we speak about streaming media servers when dealing with media servers capable of streaming multimedia content, or we say recording media server when we have the capability of recording the audio and video received, etc.

The concept of media server is quite old and has been used in the RTC literature for long time. For example, in the area of [IMS standards](#), media servers were introduced as

the Media Resource Function (MRF), which provides to IMS systems capabilities such as group communications, transcoding, recording, etc.

In the last few years, RTC media servers are living again a new gold era due to the emergence of WebRTC technologies. Nowadays, WebRTC is the main trending topic in the multimedia RTC area and this is why WebRTC needs to be supported by any RTC media server wishing to play a role in the market. WebRTC services commonly require the presence of media servers, which are very useful when creating services beyond the standard WebRTC peer-to-peer call model. Some common examples of server-side media plane elements that could be used in WebRTC include:

- WebRTC media gateways – typical on services requiring protocol or format adaptations (as happens when integrating WebRTC with IMS)
- Multi Point Control Units (MCUs) and Selective Forwarding Units (SFUs) – used to support group communications
- Recording media servers – helpful when one needs to persist a WebRTC call
- Etc.

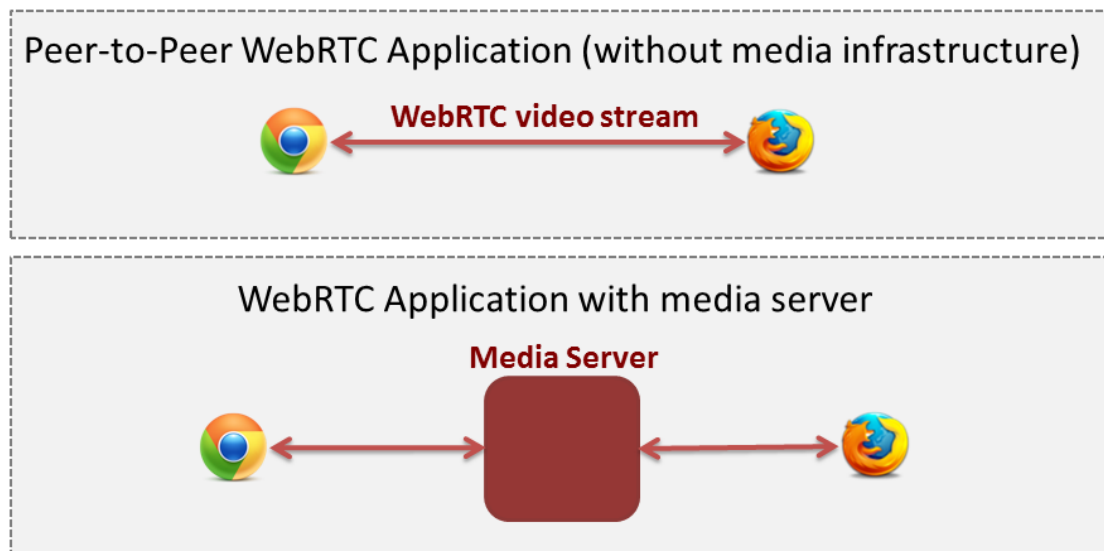


Figure 3: RTC applications, in general, and WebRTC applications, in particular, may use two different models. As shown at the top, the peer-to-peer model is based on direct communication among clients. This model provides minimum complexity and latency, but it also has important limitations. At the bottom, the infrastructure-mediated model, where a media server is mediating among the communicating clients. This model has higher latency and complexity, but it makes possible to enrich RTC services with additional capabilities such as transcoding (i.e. interoperability), efficient group communications (i.e. MCU or SFU models), recoding and media processing.

Currently, there are a large number of WebRTC capable media servers out there. Just for illustration, the following is a non-exhaustive list containing some of the most common open source software solutions:

- [Jitsi videobridge](#): An open source video bridge which is part of the Jitsi project. It implements SFU [2] capabilities useful for providing efficient and low latency group communications.
- [Lynckia](#): An open source project that, as Jitsi, provides an efficient SFU for group communications with some additional features such as WebM recording.

- [MCU Media Server](#): An open source media server providing different capabilities which include transcoding, group communications through a mixing MCU [2], recording, etc.
- [Janus](#): An open source media server providing different capabilities which include transcoding, group communications through an SFU model, recording, etc.
- [telepresence](#): The open source media server of the Doubango initiative which provides group communications through a MCU mixing model and some additional features which include recording, 3D sound, etc.

In the proprietary arena, there are currently many vendors offering different types of WebRTC Media Servers providing the above mentioned features, a non-exhaustive list containing some of them (in no particular order) is the following:

- The [Dialogic Power Media](#) product line offers different types of WebRTC capable media servers providing all the common media server capabilities (i.e. transcoding, MCU, recording, etc.)
- Some of the [Radisys MRF](#) products claim to offer common media server capabilities enabled for WebRTC endpoints.
- Oracle, rebranding the acquired Acme Packet media server product line, is also [offering a product line](#) containing different types of WebRTC middleboxes including media servers and session border controllers.
- Italtel [seems also to have adapted its media server](#) product line for providing WebRTC capabilities.
- Flahsponer also provides now a [WebRTC capable media server](#) for group communications.
- The NG Media media server [seems also to have introduces WebRTC](#) endpoint capabilities.
- The [Intel CS WebRTC SDK](#) provides a WebRTC capable media server which includes group communications, transcoding and MCU capabilities.
- Ericsson offers through its [Web Communication Gateway](#) different WebRTC media server capabilities.

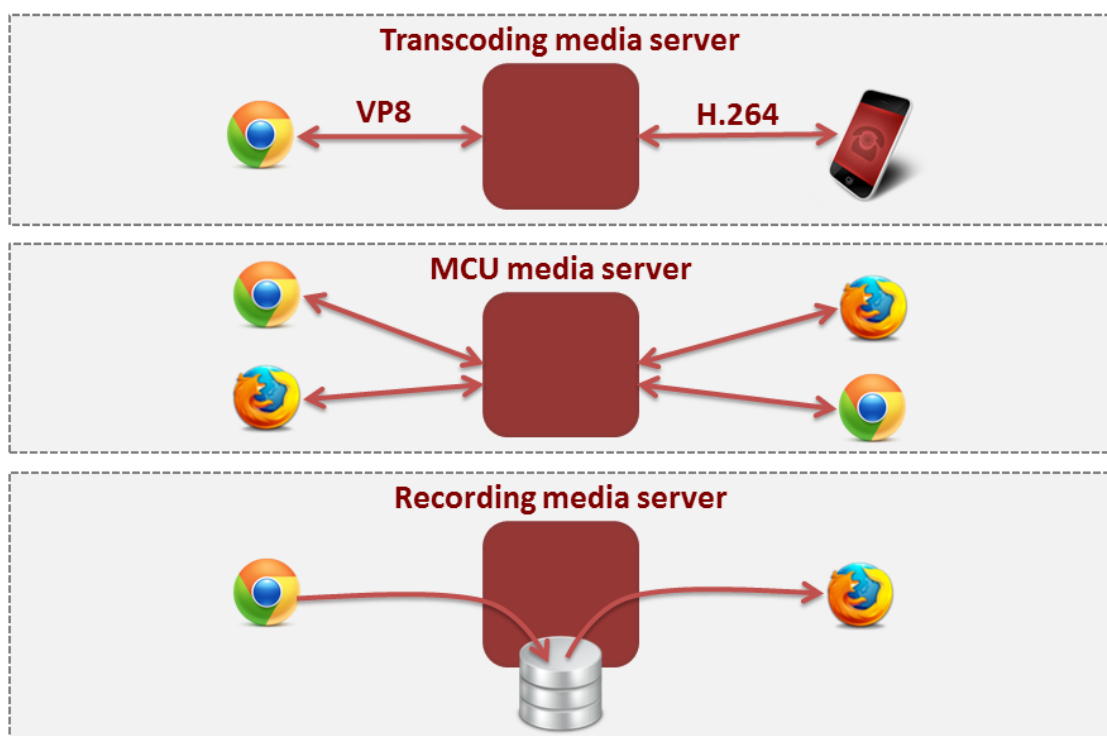


Figure 4: Media capabilities provided by state-of-the-art media server include: transcoding (top), group communications (middle) and archiving (bottom).

However, as NUBOMEDIA's own vision shows, there are many interesting things we can do with the media beyond the basic three capabilities enumerated above (i.e. transcoding, group communications, recording). Why not enrich it using augmented reality? Why not analyze it using computer vision or deep speech analysis? Why can't we blend, replicate or add special effects to the media as it is travelling? These kinds of capabilities might provide differentiation and added value to applications in many specific verticals including e-Health, e-Learning, security, entertainment, games, advertising or CRMs just to cite a few.

Due to this, NUBOMEDIA requirements cannot be satisfied with any of the above mentioned solutions. Hence, for the execution of the project we need a more flexible technology where advanced processing capabilities could be plugged seamlessly. For this, we have re-architected the only open source media server enabling such types of capabilities: [Kurento Media Server \(KMS\)](#).

KMS vision is based on transforming traditional media server technologies, which are tied to a set of specific features, into modular software having the ability of extending the provided features just adding further plug-ins. In this direction, KMS is just a container providing a number of basic building blocks for implementing low level operations that provide plumbing capabilities enabling to move media from one place to another. Modules are just specialized classes that are capable of receiving and sending media to other modules through that plumbing.

Due to this vision, KMS is a flexible technology capable of providing all types of features one can image for the media, which is a clear advantage and justification for NUBOMEDIA choosing it. However, KMS also has drawbacks. The first one is paid in terms of complexity. For example, the software complexity, in terms of source code lines, classes, files, dependencies or any other metric you may wish to use, of KMS is significantly higher to the ones shown by the rest of open source media server technologies described above. The second one is on performance. The required degree of flexibility makes the architecture to require on all modules the provision of capabilities that may be memory and CPU consuming, but which are not always used on a given specific application.

Conclusion:

As a final conclusion, it's important to remark that the explosion on WebRTC media servers in the market is an indication on the increasing interest from users, enterprises and organization on WebRTC technologies. This provides an opportunity to NUBOMEDIA for shining in a very emerging area given its features and flexibility, which are beyond the reach of other state-of-the-art solutions. This opportunity is catalyzed through the outstanding characteristics of KMS, the NUBOMEDIA media server solution. However, KMS also has inherent risks that need to be evaluated and minimized: first, an increase in complexity that may become unmanageable for a limited development team like the one of NUBOMEDIA; second, and as a consequence of this flexibility and complexity, a decrease in performance and in stability that may drive potential NUBOMEDIA adopters to choose other different solutions for the most common use cases (e.g. plain group communications, etc.), which are more numerous and where KMS features do not set the difference.

2.1.6 Cloud gaming: some trends.

Source: ZED (Teofilo Redondo)

Keywords: Cloud, gaming, MMORPG

Discussion:

Cloud-based gaming has become a hot topic among many prominent gaming studios in recent years, and for good reason: Streaming of high-end games could become available to nearly 150 million people, a five-fold increase, in 2015 thanks to the growth of so-called cloud-gaming services.

Strategy Analytics, a Boston-based market researcher, reported Dean Takahashi in November 2014, said that the addressable audience for cloud-gaming services PlayStation Now from Sony and the Grid Game Streaming Service from Nvidia could grow from nearly 30 million users by the end of 2014 to nearly 150 million by the end of 2015.



As a whole, the gaming industry is looking for the ultimate way to deliver online experiences with as little friction as possible, and everyone is experimenting with the idea of cloud-based gaming. Microsoft is working on the proven cloud-based gaming tech called DeLorean, which was used on the games Doom 3 and Fable 3.

Sony, for instance, can stream a library of older PlayStation 3, PlayStation 2, and PlayStation releases to its PS4, even though the hardware to process those older games isn't in the company's latest console.

For PC gamers, Steam has become the go-to platform for gaming, allowing consumers to purchase games online and downloading them onto their hard drives.

This variety of strategies reflects that no one method has won out, and for now, "a browser-based and native-client gaming hybrid seems to be the best fit for the current state of the gaming industry", according to David Baszucki, CEO of ROBLOX, a user-generated MMO site for kids.

Conclusion:

Massively multiplayer on-line role playing games (MMORPG) cloud benefit from NUBOMEDIA cloud platform efficiently. NUBOMEDIA will sit at the center of cloud-based gaming by providing an advanced infrastructure (elastic scalable cloud platform) especially designed for hosting interactive multimedia services, and functionally comparable with those provided by Microsoft Live, PlayStation Now from Sony and Nvidia Grid for on-demand Gaming as a Service (GaaS).

2.1.7 Shared Spaces

Source: LiveU (Noam Amram)

Keywords: Shared Spaces, COMPEIT, Experience Lab.

Hyperlinks: <http://experience.compeit.eu/>

Discussion: COMPEIT (www.compeit.eu) is a brother FP7 project to NUBOMEDIA and some of the development targeted in COMPEIT will use NUBOMEDIA cloud elements and even create new ones in the following months to come. One of the worth mentioning approaches used in COMPEIT is an early stage trials of the technology with real users. This is done throughout the experience Lab in the link above. A list of early stage technology is there for your feedback.

One of a very interested technology to Media partners is the Shared Spaces described in here. In the current implementation of “Immersive spaces”, the feelings of social and spatial connectedness are targeted by placing all participants in the communication together in front of the same background. This feature is referred to as SharedSpace. The background of the live video stream from each user is stripped from the foreground using a chromakey filter. The video streams are then super-positioned on top of each other to create the illusion with observers that the remote users are all together in the same space. A screenshot of the “SharedSpace” in action is shown in Figure 1 at a mediated group yoga session.



Figure 1. Using chroma key to share a virtual space between physical nodes. Picture in upper right shows the composite result in real time, in this instance a mediated yoga session carried out at KTH as part of a student course.

In [COMPEIT’s virtual SharedSpace](#), you can meet with friends anywhere in the world. Instructions:

1. Seat yourself in front of something green or blue (e.g. a wall, green screen or curtain), open a browser, and go to compeit.eu/sharedspaces.
2. Select a suitable venue for the meeting, for example Paris.
3. Click 'enable camera'... There you are!
4. Edit the calibration settings until the green/blue screen disappears.
5. Save the calibration... And your friends will pop up in Paris together with you!

3 Release 2

3.1 Internal comments on news and trends

This section is open to reviews, comments recommendations and advice provided by project experts in relation to how state-of-the-art evolutions could affect NUBOMEDIA roadmap and expected success.

3.1.1 Container virtualization based on Docker

Source: USV (Constantin Filote)

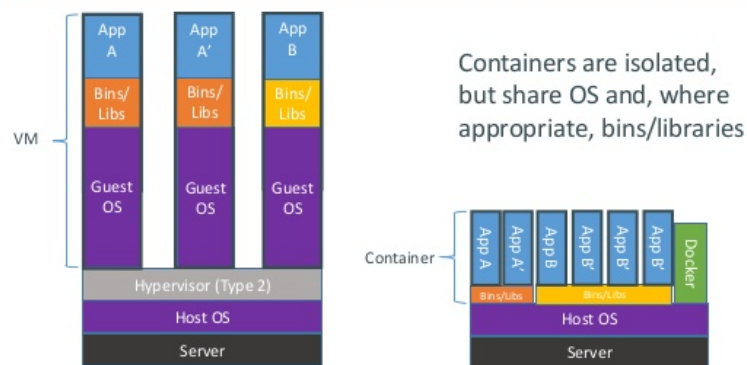
Keywords: Virtualization, Containers, Docker, NUBOMEDIA

Discussion: Docker is an open-source project that automates the deployment of applications inside self-sufficient software containers. It is mainly targeted at developers and system administrators to build, ship, and run distributed applications. However, it can also be used in production systems requiring more optimal utilization of hardware resources. Docker containers are independent of hardware, language, framework, and hosting provider. To achieve its goals, Docker is using kernel namespacing, cgroups, and LXC combined with a high level API. It provides a way to automate software development in a secure and repeatable environment. Hence, Docker is a way to manage LXC containers on a single machine.

Containers existed before Docker, but they were not standardized and not easy to use. The aim of Docker is to facilitate the use of containers and to make their use convenient on any platform. At this moment, Docker can run on any x86 Linux Kernel that supports cgroups and aufs, and it aims for full OpenStack compatibility.

In an architectural perspective, traditional virtual machines run on physical hardware via an intermediation layer, while containers run inside user space on top of an operating system kernel (currently Linux). This allows running multiple isolated user spaces on a single host. In addition, the elimination of hardware virtualization layers and the direct execution onto the metal provides higher performance.

Containers vs. VMs



Docker features include

- Higher start up speeds (containers are started in milliseconds)
- Developers focus on code and not on operations
- Portable deployment across machines
- Component re-use
- Versioning of builds
- Application centric
- Improved performance

Docker architecture is depicted on the figure below and is based on the following components

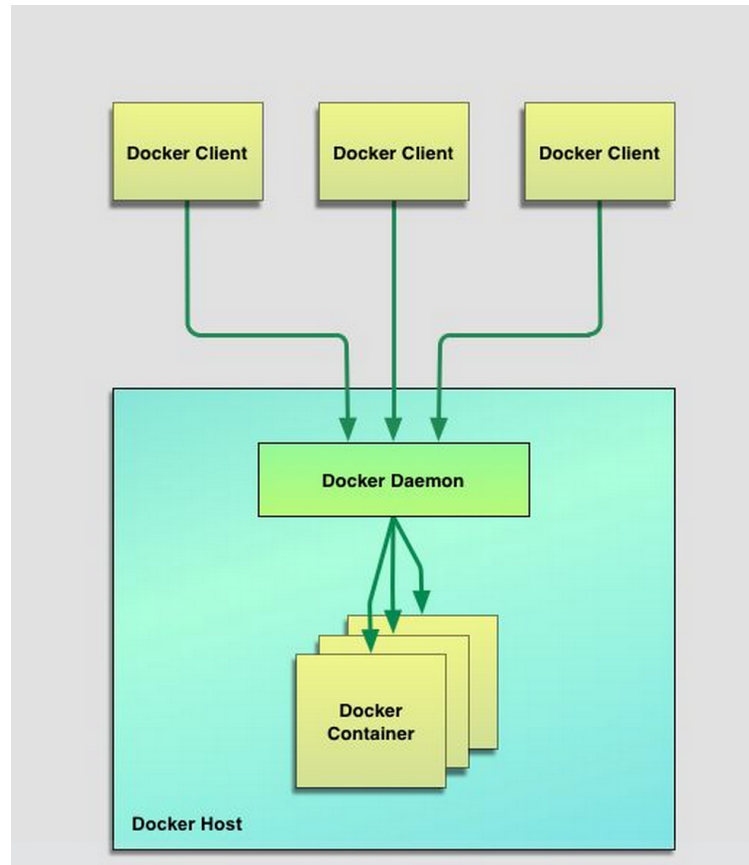
- Docker client and server.
 - Docker is a client-server application where client is talking to the server which runs the containers.
- Docker images.
 - Containers are started from images, and they are the starting source code on top of which the container will be built. They use Union file system.
- Registries.
 - Docker stores the images that were built on registries. Registries can be public or private. The company behind Docker operates a service to store images called DockerHub. Furthermore, private registries can be stored freely for your organization.
- Containers.
 - Docker helps you build and deploy containers inside which you can package your applications and services. Containers are launched from images and can contain one or more processes. A container can execute any piece of software, ranging from a web server to a NoSQL database.

Around Docker, an open source software ecosystem is currently growing where many interesting tools are emerging. Among them we can find:

- CoreOS, which is a Linux distribution that uses Linux containers (Docker) to manage services and clusters of servers. Cloud providers like Google and Digital Ocean have announced official support for CoreOS images.
- Atomic Project, which is sponsored by RedHat is similar with CoreOS, but it is mostly aimed for enterprise users, and oriented around RedHat ecosystem

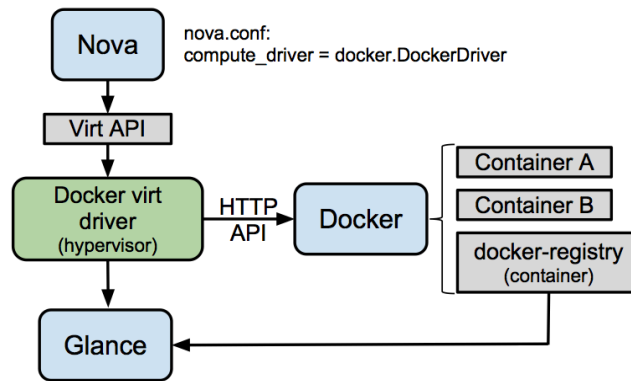
(RedHat Enterprise Linux, Fedora, CentOS). It provides an end-to-end solution around Docker and applications.

- Kubernetes, in which Google has open sourced its tools for Docker cluster management. Companies like Microsoft, RedHat, IBM have already announced their support for this open container framework, and they will work closely to support common tools and avoid vendor lock-in.



Conclusion: Docker may have a relevant impact in NUBOMEDIA given that it provides higher performance than traditional virtualization techniques and is closer to the hardware, which may be a critical issue in many scenarios involving real-time communications with tight latency and jitter requirements. Docker is currently being issued in NUBOMEDIA for Continuous Integration (CI) purposes. We use a Jenkins plugin named Docker plugin, that aims to provide Jenkins capability to use a Docker host to dynamically provision a slave, run a single build, then tear-down that slave. We configured a Jenkins slave node that hosts all Docker containers, and we created separate jobs to do nightly build images with Docker for each running environment needed in the CI system. When these jobs are done, fresh images are uploaded to Jenkins Docker machine, and new slave nodes with labels are added to the Jenkins master. The advantage of using this architecture is that Jenkins can run jobs on fresh and isolated Docker containers without installing any packages or changing configurations on a live Jenkins node.

In addition, Docker can be used in NUBOMEDIA as a hypervisor driver for OpenStack, and instances can be deployed on Docker Nova Driver instead of Xen or KVM. Docker will fetch images from OpenStack Image service (Glance), and load them onto Docker file system.



3.1.2 WebRTC and the disruption of traditional RTC models

Source: URJC (Luis Lopez)

Keywords: WebRTC, Real-Time Communications, NUBOMEDIA

Discussion: WebRTC is an emerging technology, which is gaining significant attention by Internet and telecommunication stakeholders. WebRTC brings the promise of incorporating Real-Time Communications (RTC) in a native and standard way onto WWW browsers. WebRTC is currently under heavy standardization effort both at the W3C (WebRTC WG) and at the IETF (RTCWeb WG). The impact of WebRTC onto NUBOMEDIA is significant and the project must take close attention to WebRTC technologies, standards and stakeholders. WebRTC is currently supported in Chrome and Firefox browsers. In particular Google is pushing very hard the creation of implementations and standards around WebRTC. Microsoft and Apple have not yet shown such deep interest. However, the WWW development community assume that both should, sooner or later, get into WWW RTC technologies either through current WebRTC ideas or through equivalent ideas that could be incorporated to latter releases of the standard. In particular, the following aspects of WebRTC intersect directly into NUBOMEDIA roadmap and require the attention of the project.

- WebRTC aims at being available at all HTML5 compatible browsers on all platforms (including PC, tablet and smartphone). This means that WebRTC might be a potential candidate for being used as base technology for the creation of the RTC multimedia client platforms required by NUBOMEDIA.
- WebRTC has introduced DataChannels for the low-latency exchange of arbitrary information additional to the audio-visual streams. This is very aligned with the concept of “multisensory multimedia” proposed in NUBOMEDIA. This means that NUBOMEDIA could consider the use of DataChannels for the implementation of that capability.
- WebRTC is introducing a set of standardized client-side APIs for media management that make possible the manipulation of streams and the handling of NAT traversal issues. These APIs are under heavy standardization effort and NUBOMEDIA could use (and abstract) them for creating higher level APIs.
- Many startups are being grown all around the world for the creation of cloud-based WebRTC infrastructures. These include ToxBox (OpenTok), Bistri, Crocodile RTC or temasys. All of them share architectural problems and challenges with NUBOMEDIA. Many of them have succeeded in raising important investments for creating their platforms. Currently, none of them have the open nature of NUBOMEDIA nor consider advanced media processing as part of their features. However, the consortium should carefully tract these cloud

platforms to guarantee that NUBOMEDIA incorporates their strengths and do not suffer their problems. This is important for guaranteeing the expected impact for the project.

Conclusion: WebRTC is gaining a lot of momentum and is catching the attention of many different stakeholders. This is an opportunity for NUBOMEDIA because integrating WebRTC capabilities could significantly increase the potential impact of the platform. This is also a threat because many players, including big companies and startups, are working in ideas close to NUBOMEDIA ones, which might produce the emergence of other platforms competing with NUBOMEDIA and having much higher funding. Nevertheless, NUBOMEDIA none of these platforms have on its roadmap the inclusion of the advanced processing capabilities of NUBOMEDIA, which might be a strength.

4 Release 1

4.1 Internal comments on news and trends

This section is open to reviews, comments recommendations and advice provided by project experts in relation to how state-the-art evolutions could affect NUBOMEDIA roadmap and expected success.

4.1.1 Video Surveillance in Cloud: Platform and SaaS for people detection and software biometry.

Source: VTOOLS (Victor Hidalgo)

Keywords: Video Surveillance; Video Surveillance as a Service (VSaaS); Cloud computing; people detection; soft biometry

Hyperlinks:

<http://imagelab.ing.unimore.it/Pubblicazioni/pubblicazioni/VISERAS%20Imagelab%20CR.pdf>

Discussion: This paper tackles both the algorithmic and architectural perspective of video surveillance systems, by proposing the use of cloud-based architectures to build “video surveillance as a service”. The paper describes some recent experiences at ImageLab, a research laboratory located in Italy, in relation to three different research projects involving different types of video surveillance systems. The paper reviews history of video surveillance systems and, after that, concentrates on video analytics and video processing to show the need of integrating cloud computing concepts for them. In this direction, the paper mentions the need for evolving from a notion of “video-surveillance system” to a one of “video-surveillance service” taking advantage of economies of scale and decreasing capex investment. SaaS, IaaS and PaaS models are analyzed to show that PaaS are the ones offering more innovation possibilities.

Conclusion: This paper is a clear example of how to use video surveillance as a service in the Cloud. Especially, it is important to highlight the architecture followed to detect and tracking people with distributed cameras using for that 2D/3D algorithms and how they use the re-identification of people based on their aspects, dresses to carry out smart search of people within the video.

4.1.2 vSkyConf: Cloud assisted Multi-party Mobile Video Conferencing.

Source: VTOOLS (Victor Hidalgo)

Keywords: Cloud computing; Video Conferencing (VC); Mobile Devices; Virtual Machine; Scalable Video Coding (SVC); Multi-Party Video Conferencing

Hyperlinks: <http://culiuliu.net/downloads/papers/vskyconf.pdf>

Discussion: This paper presents some experiences on high-quality, multi-party mobile video conferencing. The paper insists in the need of incorporating infrastructure capabilities to the problem given the lack of computation and communication capacities on the mobile devices, to scale large conferencing sessions. After that, the paper presents a solution basing on the creation of surrogates (i.e. proxies), which implement all the required functions of a client in the cloud. The paper compares the solutions using as a reference traditional mesh video-conferencing systems, which are well known for being bandwidth inefficient (i.e. all participants on a group call need to stream to all participants driving to quadratic bandwidth consumption) and MCU based systems using mixing.

Conclusion: This paper presents a cloud-assisted mobile video conferencing solution, to improve the quality and scale of multi-party mobile video conferencing. Especially, it could be interesting for NUBOMEDIA the idea of creating surrogates (i.e. proxies) for each mobile user, to send and receive conferencing streams, and to transcode the streams into proper formats/rates. For the rest, the paper does not consider more modern group communication models (e.g. SFU, simulcast) that are pushing the state of the art in the opposite direction to the one claimed by the paper: to reduce processing on the cloud side and increase computing work at the device side.

4.1.3 CloudMedia: When Cloud on Demand Meets Video on Demand.

Source: VTOOLS (Victor Hidalgo)

Keywords: Cloud Computing; Video on Demand (VoD)

Hyperlinks: <http://www.culiuliu.net/downloads/papers/mediacloud.pdf>

Discussion: This paper introduces the paradigm of utilizing cloud services to support large-scale Internet-based applications. It shows how on-demand cloud resources provisioning can desirable meet the dynamic and intensive resources demands of Video on Demand over the internet.

Conclusion: The main interest of NUBOMEDIA in relation to this paper could be the algorithm that the authors of the paper propose, which can dynamically configure cloud resources to address the continuous demands for streaming different chunks and videos over time. However, that algorithm is very adapted to VoD scenarios, where content (either partially or completely) is previously pre-recorded into a file and distributed later following a CDN (Content Distribution Network) scheme where latency is not a critical parameter. This makes the algorithm to have limited possibilities for NUBOMEDIA, whose target objective is more related to RTC.

4.1.4 Cloud Standards ETSI report

Source: USV (Constantin Filote)

Keywords: Cloud, Cloud Standards, ESTI, Cloud Standards Coordination, report

Hyperlinks:

http://www.etsi.org/images/files/Events/2013/2013_CSC_Delivery_WS/CSC-Final_report-013-CSC_Final_report_v1_0_PDF_format-.PDF

Discussion: The final report from ETSI's Cloud Standards Coordination initiative was made public on December 11, 2013, in Brussels. ETSI produces globally-applicable standards for Information and Communications Technologies (ICT). This document provides the following information

- A definition of roles in cloud computing;
- The collection and classification of over 100 cloud computing Use Cases;
- A list of around 20 relevant organizations in cloud computing Standardization and a selection of around 150 associated documents, Standards & Specifications as well as Reports & White Papers produced by these organizations;
- A classification of activities that need to be undertaken by Cloud Service Customers or Cloud Service Providers over the whole Cloud Service Life-Cycle;
- A mapping of the selected cloud computing documents (in particular Standards & Specifications) on these activities.

Finally, the report offers a set of recommendations on the way forward. The analysis shows that cloud standardization is much more focused than anticipated and that standards are maturing in some areas.

Conclusion: The report provides relevant information in relation to cloud evolution in Europe as well as important reference information related to standards, use-cases and organizations that NUBOMEDIA should consider and track. However, the document is very concentrated on typical IT clouds and does not deal with the specific problem of RTC clouds. This makes the specific information provided to be far from NUBOMEDIA roadmap and needs.

4.1.5 First Field Demonstration of Cloud Datacenter Workflow Automation Employing Dynamic Optical Transport Network Resources Under OpenStack & OpenFlow Orchestration. ECOC 2013

Source: USV (Constantin Filote)

Keywords: OpenStack&OpenFlow orchestration, Cloud, Data Center, demonstrator, network automation

Hyperlinks: <http://digital-library.theiet.org/content/conferences/10.1049/cp.2013.1693>

Discussion: The paper demonstrates an orchestration of elastic datacenter with inter data center transport network resources using a combination of OpenStack & OpenFlow orchestration. The paper provides relevant information related to the following aspects:

- Use of OpenStack independent services modules that include management and dynamic orchestration of virtualized: compute (OpenStack Nova), storage (OpenStack Cinder&Shift), networking (OpenStack Neutron);
- H/W&S/W components and logical layers for a demonstrator;

- Use of OpenStack Horizon dashboard as RESTful API to invoke services from OpenStack Orchestration Layer.

Conclusion: OpenStack is the most advanced FOSS solution for management and dynamic orchestration of elastic datacenter and also for network automation. OpenStack has been chosen for acting as cloud management solution for NUBOMEDIA. This paper presents some experiences and idea that may be inspiring for creating NUBOMEDIA's virtual infrastructure.

5 Sources of information

This section contains sources of information external to the project, which are useful for performing the revision of the state-of-the-art and for analyzing the best strategy to follow by NUBOMEDIA.

5.1 URJC

W3C WebRTC Working Group

- **Keywords:** W3C, APIs, WWW, Standards
- **Review period:** Monthly
- **Hyperlinks:** <http://www.w3.org/2011/04/webrtc/>
- **Summary:** Working Group at the W3C for the standardization of browser WebRTC APIs. Drafts and discussions available.

WebRTC Hacks

- **Keywords:** WebRTC, technical, blog
- **Review period:** Weekly
- **Hyperlinks:** <https://webrtchacks.com/>
- **Summary:** One of the most popular blogs dealing with WebRTC technical aspects

WebRTC World

- **Keywords:** WebRTC, influencers, conference, blog
- **Review period:** Weekly
- **Hyperlinks:** <http://www.webrtcworld.com>
- **Summary:** Blog and news of the companies organizing the most important WebRTC industrial conference world-wide.

WebRTC Conference & Expo Paris

- **Keywords:** WebRTC, influences, conference, blog
- **Review period:** Monthly
- **Hyperlinks:** <http://www.upsidesideconferences.com/webrtc/index.html>
- **Summary:** Blog and news of the company organization the most important WebRTC industrial conference in Europe.

Blog Geek

- **Keywords:** WebRTC, business, tendencies
- **Review period:** Weekly
- **Hyperlinks:** <https://bloggeek.me/>
- **Summary:** Very popular blog showing tendencies in the WebRTC ecosystem.

Techcrunch

- **Keywords:** Technology, trends, startups
- **Review period:** Weekly
- **Hyperlinks:** <http://techcrunch.com/>
- **Summary:** Blog containing news related to trends and new startups. We concentrate our attention in RTC posts.

Disruptive Dean

- **Keywords:** Consultant, WebRTC, Telco
- **Review period:** Weekly
- **Hyperlinks:** <https://twitter.com/disruptivedean>
- **Summary:** Twitter of one of the most popular consultants working in the integration of WebRTC technologies into operators' business models and infrastructures.

5.2 VTOOLS

Security Info Watch

- **Keywords:** Video Surveillance; Video IP; Video Surveillance Market
- **Review period:** Weekly
- **Hyperlinks:** <http://www.securityinfowatch.com/products/video-surveillance/news-archive>
- **Summary:** This web is a resource where we can find out the last news in video surveillance field, Video IP and different reports about the market.

IPVM

- **Keywords:** Video Surveillance; Video IP; Video Manager Systems (VMS); Network Video Recorders (NVR); Video Surveillance as a Service (VSaaS); Cloud computing;
- **Review period:** Montly
- **Hyperlinks:** www.ipvm.com/topics/SaaS
- **Summary:** This web is a resource where we can find out the last news about video surveillance and also reviews and test results on IP cameras, VMS, NVRs, VSaaS, video analytic and more.

Linkedin VSaaS group

- **Keywords:** Video Surveillance; Video Surveillance as a Service (VSaaS); Cloud computing;
- **Review period:** Weekly
- **Hyperlinks:** <http://www.linkedin.com/groups/VSaaS-3715746>
- **Summary:** On this group we can find professional and commercial discussion about the different aspect in the Video Surveillance as a Service field.

Linkedin Video Surveillance group

- **Keywords:** Video Surveillance; Computer vision
- **Review period:** Weekly
- **Hyperlinks:** <http://www.linkedin.com/groups/Computer-vision-applied-Video-Surveillance-2121045>
- **Summary:** Professional group devoted to video surveillance technologies on LinkedIn

5.3 LIVEU

New Media Info Watch

- **Keywords:** Video IP; immersive spaces, telecommunication, new media
- **Review period:** Monthly
- **Hyperlinks:** <http://www.eitictlabs.eu/>
- **Summary:** The EIT ICT Labs has a lot of research of new technologies and business worth following, LiveU also attended conferences (such as in Helsinki Dec 2014) and promoting NUBOMEDIA technology there.

5.4 FRAUNHOFER

Vert.x Blog

- **Keywords:** vert.x, asynchronous application development
- **Review period:** Monthly
- **Hyperlinks:** <http://vertxproject.wordpress.com/>
- **Summary:** Blog about Vert.x I/O

Google Group Of Vert.x

- **Keywords:** vert.x, development, Hazelcast
- **Review period:** Weekly
- **Hyperlinks:** <https://groups.google.com/forum/#!forum/vertx>
- **Summary:** Forum about Vert.x I/O

Twitter

- **Keywords:** webrtc
- **Review period:** Weekly
- **Hyperlinks:**
 - https://twitter.com/Alan_Quayle
 - <https://twitter.com/OpenWebRTC>
 - <https://twitter.com/tokbox>
 - <https://twitter.com/webrtcblogs>
 - <https://twitter.com/WebRTCmeetup>
 - <https://twitter.com/webrtcHacks>
 - <https://twitter.com/victorpascual>
 - <https://twitter.com/disruptivedean>
- **Summary:** Twitter accounts dealing with news, blogs and interviews about WebRTC related topics

5.5 NAEVATEC

Medical Augmented Reality

- **Keywords:** Augmented reality, e-health
- **Review period:** Weekly
- **Hyperlinks:** <http://medicaugmentedreality.com/>
- **Summary:** One of the most popular blogs in the world dealing specifically with AR solutions for the health sector.

GStreamer official website

- **Keywords:** GStreamer, multimedia, infrastructure
- **Review period:** Monthly
- **Hyperlinks:** <http://gstreamer.freedesktop.org/>
- **Summary:** Official website of the GStreamer project where news, bugs, patches and new releases are announced.

GStreamer official twitter account

- **Keywords:** GStreamer, multimedia, infrastructure
- **Review period:** Weekly
- **Hyperlinks:** <https://twitter.com/gstreamer>
- **Summary:** Official twitter of GStreamer where trends and relevant news for the community are announced and commented.

OpenWebRTC

- **Keywords:** Ericsson, WebRTC, GStreamer
- **Review period:** Monthly
- **Hyperlinks:** <https://twitter.com/OpenWebRTC>
- **Summary:** Twitter of the “other” WebRTC stack existing in the market basing on GStreamer. Relevant news coming from there.

IETF RTCWeb Working Group

- **Keywords:** IETF, RTC, Standards
- **Review period:** Monthly
- **Hyperlinks:** <https://tools.ietf.org/wg/rtcweb/>
- **Summary:** Website of the most relevant WG at the IETF working on WebRTC related protocols and standards.

5.6 VTT

Augmented reality blog by Tobias Kammann

- **Keywords:** Augmented reality, applications, tracking
- **Review period:** Monthly
- **Hyperlinks:** <http://www.augmented.org/blog/>
- **Summary:** Website with latest relevant Augmented Reality News & Blog

Augmented blog by Metaio

- **Keywords:** Augmented reality, applications, tracking
- **Review period:** Weekly
- **Hyperlinks:** <http://blog.metaio.com/>
- **Summary:** Website is a Metaio corporate blog with information of exciting and compelling Augmented Reality projects from all around the globe and Metaio technology updates.

Augmented reality bulletin

- **Keywords:** Augmented reality, applications, trends
- **Review period:** Weekly
- **Hyperlinks:** https://twitter.com/AR_bulletin

- **Summary:** Twitter account of The Augmented Reality Bulletin with latest trends and news about augmented reality

Augmented reality

- **Keywords:** Augmented reality, applications
- **Review period:** Weekly
- **Hyperlinks:** <https://twitter.com/AugmentedReal>
- **Summary:** Twitter account of Augmented Reality research and development as well as augmented advertising and communication.

5.7 USV

Cloud networking

- **Keywords:** VXLAN, Cloud, Cloud networking, OpenStack, ML2, Virtual Extensible LAN
- **Review period:** Weekly
- **Hyperlinks:** [VXLAN | OpenStack over VXLAN](#)
- **Summary:** Virtual Extensible LAN (VXLAN) is a network virtualization technology that attempts to ameliorate the scalability problems associated with large cloud computing deployments. It uses a VLAN-like encapsulation technique to encapsulate MAC-based OSI layer 2 Ethernet frames within layer 4 UDP packets.
- **Impact to NUBOMEDIA:** VXLAN helps us to move to a software defined datacenter model and enables us to use Layer 3 features over Layer 2 without the need of software upgrades or special code versions on the switches. This helps us to deploy NUBOMEDIA platform, including OpenStack on commodity hardware.

Cloud networking

- **Keywords:** ML2, Cloud, Cloud networking, OpenStack, ML2 plugin, Neutron plugin
- **Review period:** Weekly
- **Hyperlinks:** [ML2 | Neutron ML2 on OpenStack](#)
- **Summary:** The Modular Layer 2 (ml2) plugin is a framework allowing OpenStack Networking to simultaneously utilize the variety of layer 2 networking technologies found in complex real-world data centers. It currently works with the existing openvswitch, linuxbridge, and hyperv L2 agents, and it is intended to replace and deprecate the monolithic plugins associated with those L2 agents. The ml2 framework is also intended to highly simplify by adding support for new L2 networking technologies, requiring much less initial and ongoing effort than would be required to add a new monolithic core plugin. A modular agent may be developed as a follow-on effort.
- **Impact to NUBOMEDIA:** ML2 plugin for OpenStack Neutron helps us to use VXLANs, GRE tunnels, VLANs and flat networking at the same time, and test performances of NUBOMEDIA platform on each architecture model. Furthermore, ML2 plugin is currently the only one that supports DVR (Distributed Virtual Routing) on OpenStack.

Cloud networking

- **Keywords:** DVR, Cloud, Cloud networking, OpenStack, Neutron DVR, Distributed virtual routing, Distributed virtual router
- **Review period:** Weekly
- **Hyperlinks:** [DVR](#) | [Neutron OVS DVR](#) | [Distributed Virtual Router](#)
- **Summary:** Neutron Distributed Virtual Router implements the L3 Routers across the Compute Nodes, so that tenants intra VM communication will occur without hitting the Network Node. (East-West Routing)
- **Impact to NUBOMEDIA:** DVR can help instances running on NUBOMEDIA platform like media-servers to communicate directly through the compute node's Ethernet card without the need to send all their traffic to the router on master node / networking node.

Cloud management

- **Keywords:** Cloud, Cloud management, OpenStack, Ubuntu OpenStack, Landscape system management
- **Review period:** Monthly
- **Hyperlinks:** [Cloud management](#) | [Cloud](#) | [Ubuntu](#)
- **Summary:** Ubuntu OpenStack is fully supported through Ubuntu Advantage from Canonical, the company behind Ubuntu.
- **Impact to NUBOMEDIA:** Ubuntu OpenStack is the fastest route to creating a fully supported OpenStack cloud. With the Landscape systems management tool, we can automate updates and manage physical, virtual and cloud-based systems from a single interface.

Cloud Standards

- **Keywords:** Cloud, Cloud Standards, ETSI, Cloud Standards Coordination, report
- **Review period:** Monthly
- **Hyperlinks:** http://www.etsi.org/images/files/Events/2013/2013_CSC_Delivery_WS/CSC-Final_report-013-CSC_Final_report_v1_0_PDF_format-PDF
- **Summary:** The final report from ETSI's Cloud Standards Coordination initiative was made public on December 11, 2013, in Brussels. ETSI produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, aeronautical, broadcast and internet technologies and is officially recognized by the European Union as a European Standards Organization.
- **Impact to NUBOMEDIA:** The report provides:
 - A definition of roles in cloud computing;
 - The collection and classification of over 100 cloud computing Use Cases;
 - A list of around 20 relevant organizations in cloud computing Standardization and a selection of around 150 associated documents, Standards & Specifications as well as Reports & White Papers produced by these organizations;
 - A classification of activities that need to be undertaken by Cloud Service Customers or Cloud Service Providers over the whole Cloud Service Life-Cycle;
 - A mapping of the selected cloud computing documents (in particular Standards & Specifications) on these activities.

Finally, the report offers a set of recommendations on the way forward. The analysis shows that cloud standardization is much more focused than anticipated and that standards are maturing in some areas.

5.8 ZED

Social Games

- **Keywords:** Social; Facebook; Casual Games; Games; Puzzle; Zynga; iPhone, King.com; iOS; Android; Jobs
- **Review period:** Weekly
- **Hyperlinks:** <http://www.insidesocialgames.com/>
- **Summary:** Inside Social Games is the first site dedicated to tracking the convergence of games and social platforms.

Android

- **Keywords:** Android; Smartphones; Games; App; Tablets; Wearables; Deals
- **Review period:** Weekly
- **Hyperlinks:** <http://www.androidpolice.com/topics/applications-games//>
- **Summary:** We cover Android news, apps and games, phones and tablets. Sometimes we rant.

iOS

- **Keywords:** iOS; iPhone; iPad; Apps; Games; Review; news
- **Review period:** Weekly
- **Hyperlinks:** <http://www.imore.com/games>
- **Summary:** The center of the iPhone Universe - featuring news, reviews, help & tips, buyer guides, forums and accessories.

Videogames

- **Keywords:** Game development, game developer, game programming, game programmer, videogame, artificial intelligence, 3D animation, game design, 3D modeling, game business, game jobs, game directory, game development software, game technology, 3D technology, game producer, game audio, game animation, virtual reality, digital entertainment, PC game, Xbox game, game news, new game, arcade development, Nintendo development, Playstation development, Playstation 2, PS2, Dreamcast development, Game Developer magazine, Computer Game Developers Conference, Game Developers Conference, Independent Game Developers Conference, CMP Game Media Group, game industry research, online game development, digital assets, free textures, free 3D models, free shaders, Gamasutra Exchange, 3D Studio Max textures
- **Review period:** Weekly
- **Hyperlinks:** <http://www.gamasutra.com>
- **Summary:** Selected news, features, and analysis from Gamasutra, a leading site dealing with the art and business of video games.

iOS Games

- **Keywords:** iPhone, iPhone apps, iPhone applications, iPhone games, iPhone news, iPhone reviews, iPhone videos, iPod touch, iPod touch apps
- **Review period:** Weekly
- **Hyperlinks:** <http://www.appspy.com/>

- **Summary:** AppSpy gives you the latest news and reviews on iPhone, iPod games and apps, including reviews, videos, news, price changes, and more.

iOS Games

- **Keywords:** iphone, iphone apps, iphone applications, iphone games, iphone news, iphone reviews, iphone videos, ipod touch, ipod touch apps
- **Review period:** Weekly
- **Hyperlinks:** <http://www.148apps.com>
- **Summary:** The best gosh-darn iPhone app reviews and news site this side of Mars!

Games

- **Keywords:** assassin's creed unity, assassin's creed unity - dead kings, playstation now, survivalcraft, warhammer quest, naruto shippuden: ultimate ninja storm 4, final fantasy xv, night cry, halo 5: guardians, captain toad: treasure tracker, d4: dark dreams don't die, worms battlegrounds, littlebigplanet 3, the order: 1886, angry birds, final fantasy, halo, league of legends, minecraft, pacman, plants vs. zombies, sonic the hedgehog, super mario bros., the sims, world of warcraft.
- **Review period:** Weekly
- **Hyperlinks:** <http://www.videogamesblogger.com/>
- **Summary:** We blog and tweet about videogames. Game on!

Games

- **Keywords:** Playstation, Sony, Nintendo, Xbox, Microsoft, Games, PS3, Ps4, Xbox 360, Xbox One, Wii, Wii U, Nintendo 3DS, iOS, Android, iPhone, iPad,
- **Review period:** Weekly
- **Hyperlinks:** <http://www.ign.com/>
- **Summary:** IGN is your site for Xbox 360, PS3, Wii, PC, 3DS, PS Vita & iPhone games with expert reviews, news, previews, trailers, cheat codes, wiki guides & walkthroughs

Smartphones Games

- **Keywords:** Apple iPhone, iPad, iPod touch, Android, Windows Phone, Windows 8, PS Vita, Sony PSP, Nintendo 3DS, DSi, DS, Xperia Play, BlackBerry, Java, Kindle, OnLive, game, video Games, mobile, mobile phones, mobile games, wireless, cellphone, UK, pocket gaming, nokia, sony, ericsson, samsung, motorola, Sharp, siemens, java, free game, europe, reviews, previews, news, handset reviews, how to, practical guides, release calendar, features
- **Review period:** Weekly
- **Hyperlinks:** <http://www.pocketgamer.co.uk/>
- **Summary:** Pocket Gamer is the world's leading destination for games on Apple iPhone, iPad, iPod touch, Android, Windows Phone, Windows 8, PS Vita, Sony PSP, Nintendo 3DS, DSi, DS, Xperia Play, BlackBerry, Java, Kindle, OnLive. Get news, previews, reviews, tips, features and practical guides for: Apple iPhone, iPad, iPod touch, Android, Windows Phone, Windows 8, PS Vita, Sony PSP, Nintendo 3DS, DSi, DS, Xperia Play, BlackBerry, Java, Kindle, OnLive.

Smartphones Games

- **Keywords:** Apple, iPhone, iPad, iPod Touch, Android, Games, App, Applications, Tablets, App, Game, King.com.
- **Review period:** Weekly

- **Hyperlinks:** <http://www.theappside.com/blog/games/>
- **Summary:** The Appside is a business intelligence service. Our aim is to make sense of the apps space for brands, agencies and entertainment companies.

Video Games

- **Keywords:** Reviews, Previews, Videogames, Europe, Nintendo, Sony, Microsoft, PS4, Playstation, PS3, Xbox, Xbox 360, Xbox One, Wii, Wii U, Nintendo 3DS, iOS, Android, iPhone, iPad, Tablet,
- **Review period:** Weekly
- **Hyperlinks:** <http://www.eurogamer.net/>
- **Summary:** Eurogamer is the largest independent gaming website in Europe, providing news, reviews, previews, and more

Video Games

- **Keywords:** Crappy bird, flappy bird, crappier bird, code, development, remake, demake,code,crappier bird,demake,development,flappy bird,remake,news,mafia 2, mafia 3, mafia iii, rick pasqualone, 2k, take-two, take 2, 2k czech, hanger 13, ,2k,2k czech,hanger 13,mafia 3,mafia iii,rick pasqualone,take 2,take two,xbox one, xbox 360, ps3, ps4, psvita, 3ds, wii,3ds,ps3,ps4,psvita,wii,xbox 360,call of duty, advanced warfare, activision, captain america, zombies, china,activision,advanced warfare,bannerpost,captain america,china,zombies,assassin\'s creed, assassin\'s creed: unity, unity, acu, ubisoft, playstation 4, xbox one, dead kings, dlc,acu,assassin\'s creed unity,assassin\'s creed: unity - dead kings,dead kings,dlc,playstation 4,ubisoft,unity,pc games, retro games, dos games, wolfenstein, jazz jackrabbit,browser games,retro games,nes, mario, mega man,mario,mega man,ffxv, final fantasy xv, square, pc, port, release, listing, steam, mini-game, online,final fantasy xv,listing,mini-game,online,pc,port,release,square,steam,far cry, mad max, jurassic park, vampires, red dead, far cry 4, far cry 5,far cry 4,far cry 5,jurassic park,mad max,red dead,vampires,bad box art, custom box art, the elder scrolls, oblivion, gamestop,box art,fan art,parody,the elder scrolls iv: oblivion
- **Review period:** Weekly
- **Hyperlinks:** <http://www.nowgamer.com>
- **Summary:** The game that launched 1000 clones, now written in under 20 lines of code Over at KTbyte, some enterprising developers have managed to make 2014\'s most talked-about mobile game run, programming it with less than 20 lines of code. The game, inventively named Crappy Bird, riffs on the iOS sensation that rose to infamy last Summer. The de-made game runs just as well as the original release, sans Mario-based assets. Hence, it\'s actually a better game. You can play it here

Android games

- **Keywords:** Andorid, App, Juegos, Games, Galaxy, Samsung, Xperia, Sony, HTC, Aplicaciones, Analisis, Reviews,
- **Review period:** Weekly
- **Hyperlinks:** <http://www.xatakandroid.com/>
- **Summary:** Google\'s Android news and information: Android Market, apps, smartphones, tablets and more.

Videogames

- **Keywords:** PS3, PS4, Sony, Microsoft, Jeux video, Games, videogames, Xbox One, Xbox 360, Nintendo, Wii, Wii U, Nintendo 3Ds, PS Vita, iOS, Android, iPhone, iPad, Ipad Touch, Tablet, Smartphone
- **Review period:** Weekly
- **Hyperlinks:** <http://www.gamekult.com/>
- **Summary:** News about video games, tests, previews, images and videos including solutions and tricks as well as several blogs about Gamekult.

iOS

- **Keywords:** iphone, iphone 6, iphone 6 plus, iphone 5s, iphone 5c, iphone 4s, iphone 4, apple, app, cellulare, appstore, applicazioni, cydia, app store, 3g, jailbreak, accessori, italia, melafonino, ipod, telefonino, recensioni, news, mela, recensioni, accessori, italia, icloud, itunes
- **Review period:** Weekly
- **Hyperlinks:** <http://www.iphoneitalia.com>
- **Summary:** iPhone Italia is the Italian blog about iPhone 6 and iPhone 6 Plus, iPhone 5S (and previous) with news, guides for jailbreak, apps reviews in the App Store and accessories, tutorials for iOS, iTunes or iCloud, contest, information about Siri and iMessage, support forum among other things.

Videogames

- **Keywords:** gamer blog, gaming blog, playstation 3 blog, iphone blog, ipad blog, apple blog
- **Review period:** Weekly
- **Hyperlinks:** <http://www.konsolengamer.com/>
- **Summary:** Gaming blog with Reviews of Playstation3-, PC- iPhone- and iPad Games, as well as game techniques of several types.

Android games

- **Keywords:** Android apps, free and in-app purchase, smartphone, tablet
- **Review period:** Weekly
- **Hyperlinks:** <http://www.androidpit.de/android-apps>
- **Summary:** Only the best Android-Apps in the world: games and professional tools (for smartphone and tablets)

iOS

- **Keywords:** iphone, iphone apps, iphone applications, iphone games, iphone news, iphone reviews, iphone videos, ipod touch, ipod touch apps
- **Review period:** Weekly
- **Hyperlinks:** <http://www.iphone-news.org/>
- **Summary:** News every day about iPhone, iPad and iPod Touch.

Videogames

- **Keywords:** Games, latest information, PlayStation 3, PS3, PSP, PSVita, Nintendo 3DS, Wii, Reviews, Release Date
- **Review period:** Weekly
- **Hyperlinks:** <http://www.famitsu.com/>
- **Summary:** Game information site. Information about anime and smartphones in addition to games, free comics and enhance content.

Videogames

- **Keywords:** Games, online games, MMORPG, PC games, PlayStation, PlayStation 3, PS3, Wii, PSP, Nintendo DS, Xbox 360, iPhone
- **Review period:** Weekly
- **Hyperlinks:** <http://www.4gamer.net/>
- **Summary:** It is Japan's largest comprehensive gaming sites. Online game from the consumer game, until Hatewa hardware information. I will deliver the latest game news around the world. Also enhance Reviews information, such as user review.

iOS

- **Keywords:** iPhone6, iPhone5, iPhone5s, iPhone4, iPhone4S, iPad2, iPad3, New iPad, iPhone, iPhone Chinese network, iPhone 3G, iPhone 3GS, iPad, iPhone mobile phone, China Unicom iPhone, iPhone Girl, itunes, iPhone simulator, iPhone price, iPhone Forum beginner's Guide, tutorial, iPhone hack, surrounding, iPhone firmware, iPhone Internet, iPhone software, iPhone games, movies, themes, wallpapers, ringtones, downloads, Wei Feng original software, iPhone, Apple, Palm Pre, Gphone
- **Review period:** Weekly
- **Hyperlinks:** <http://www.feng.com/>
- **Summary:** Wei Feng network was born January 10, 2007, with the US Apple (Apple Inc.) announced the iPhone on the same day, is the first to establish a special website on the iPhone, Wei Feng Network Forum has been the most popular Chinese iPhone, iPad, MAC community, is the world's largest online community discussion about the iPhone, Wei Feng network produced its first original iPhone Chinese software now offers iPhone software evaluation websites, music, movies, ringtones, downloads and other service.

Videogames

- **Keywords:** files, game files, gaming files, game patches, counterstrike patches, counter-strike patches, counter-strike, half-life, game demos, demos, game upgrades, gaming files, free demos, online gaming, australian gaming, computer gaming, australian computer gaming, free downloads, free demos, free files,
- **Review period:** Weekly
- **Hyperlinks:** <http://www.ausgamers.com/>
- **Summary:** AusGamers - Australia's largest online gaming resource! All the latest news, demos and files, as well as an active community and plenty of free services!

Videogames

- **Keywords:** Games, videogames, nintendo, Sony, microsoft, Ps3, ps4, Xbox One, Xbox 360, Wii, Wii U, eSports, PC, Smartphones
- **Review period:** Weekly
- **Hyperlinks:** <http://www.lazygamer.net/>
- **Summary:** The Latest Gaming News, Lazygamer, The Worlds Best Video Game

5.9 TUB

Network Function Virtualization

- **Keywords:** ETSI, Cloud, Standards
- **Review period:** Monthly
- **Hyperlinks:** <http://www.etsi.org/technologies-clusters/technologies/nfv>

- **Summary:** Working Group at ETSI for providing specification about virtualization of Network Functions.

OpenStack Community

- **Keywords:** Cloud
- **Review period:** Monthly
- **Hyperlinks:** <http://www.openstack.org/community/>
- **Summary:** One of the biggest community working on the opensource OpenStack platform

Service Function Chaining

- **Keywords:** Service Function Chaining
- **Review period:** Monthly
- **Hyperlinks:** <https://datatracker.ietf.org/wg/sfc/documents/>
- **Summary:** IETF standardization group providing a specification about Service Function Chaining

5.10 TI

Computer vision/AR enabler Platform

- **Keywords:** Computer vision
- **Review period:** Monthly
- **Hyperlinks:** <https://www.khronos.org/openvx/>
- **Summary:** OpenVX is an open, royalty-free standard for cross platform acceleration of computer vision applications. OpenVX enables performance and power-optimized computer vision processing, especially important in embedded and real-time uses cases such as face, body and gesture tracking, smart video surveillance, advanced driver assistance systems (ADAS), object and scene reconstruction, augmented reality, visual inspection, robotics and more.

Computer vision/AR enabler Platform

- **Keywords:** Computer vision
- **Review period:** Monthly
- **Hyperlinks:** <http://simplecv.org/>
- **Summary:** SimpleCV is an open source framework for building computer vision applications. With it, you get access to several high-powered computer vision libraries such as OpenCV – without having to first learn about bit depths, file formats, color spaces, buffer management, eigenvalues, or matrix versus bitmap storage.

A flexible cross-platform WebRTC client framework based on GStreamer

- **Keywords:** WebRTC, crossplatform, GStreamer
- **Review period:** Monthly
- **Hyperlinks:** <http://www.openwebrtc.io/>
- **Summary:** OpenWebRTC is built on the belief that the WebRTC standard would transcend the pure browser environment and that native apps, implementing the same protocols and API's, would become an important part of the WebRTC ecosystem. This is especially true on mobile platforms where native app distribution is often preferred over pure web apps. Native OpenWebRTC apps can either talk to other native apps or browsers that support WebRTC. OpenWebRTC can also provide the WebRTC-backend to web

browsers. One such example browser is Bowser. As you can see here, Bowser is in fact a very thin layer of UI code on top of OpenWebRTC.