ISO/IEC JTC 1/SC 38/WG 4
Cloud Computing Interoperability and Portability (CCIP)
Convenorship:

Document type:	Contributions
Title:	Contribution from Hans-Dieter Kreft "Paradigm Of Cloud Computing"
Status:	For consideration at WG4 Face-to-Face in Santa Clara
Date of document:	2015-01-05
Expected action:	INFO
Email of secretary:	
Committee URL:	http://isotc.iso.org/livelink/livelink/open/jtc1sc38wg4

The paradigm of cloud computing.

A proposal and demonstration for SC 38 WG 4.

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Content

Introduction

This is a proposal of a new view (paradigm) on cloud computing.

It serves as a discussion templet to the members of the Working Group WG 4 which is a part of the international standardization body SC 38.The topic of WG 4 is:

“Cloud Computing Interoperability and Portability”.

Certain aspects of the proposed new view will be available for live demonstration at the face to face meeting of the WG 4 on January 20th – 21st, 2015 in Santa Clara, California, USA.

1 Scope of this document

The main scope of this document is identic to that of WG 4, which is laid out in ISO Working Draft WD 19941: „**Define terms and concepts for interoperability and portability in cloud computing**“. Discussion proposals are made to the following questions:

- How is the cloud computing to be defined to ensure broad acceptance within the society?
- What new technical requirements arise for the standardization of the new cloud computing paradigm?
- What requirements can be realized promptly and demonstrated at WG 4?

Other reference documents are: SC 38/WG 4 N 20; SC 38 N 824; SC 38 N 875. Whereby the Use Cases of WG 3 and the corresponding description in document SC 38/WG4 N 18 (starting at page 23) were helpful. The basic concepts and use cases for interoperability and portability are frequently used as they are clearly listed in document SC 38/WG4 N 21.

2 Summary of results

A cloud is defined by its global service presented at Ports of Cloud Services (POCS).

The fundamental features of Ports of Cloud Services (POCS) are explained by use of **Figure 1, Figure 2** on the following page.

Ports of Cloud Services (POCS) as symbolized in Figure 2 offer globally accessible cloud services via standardized software. These standards include interoperability, transportability, live search results in defined namespaces etc. The cloud service points are controlled through conventional web browsers. The implementation of the services through various IT equipment (PCs, mobile phones, tablets, servers, etc.) provides the basis for a global accessible cloud concept.

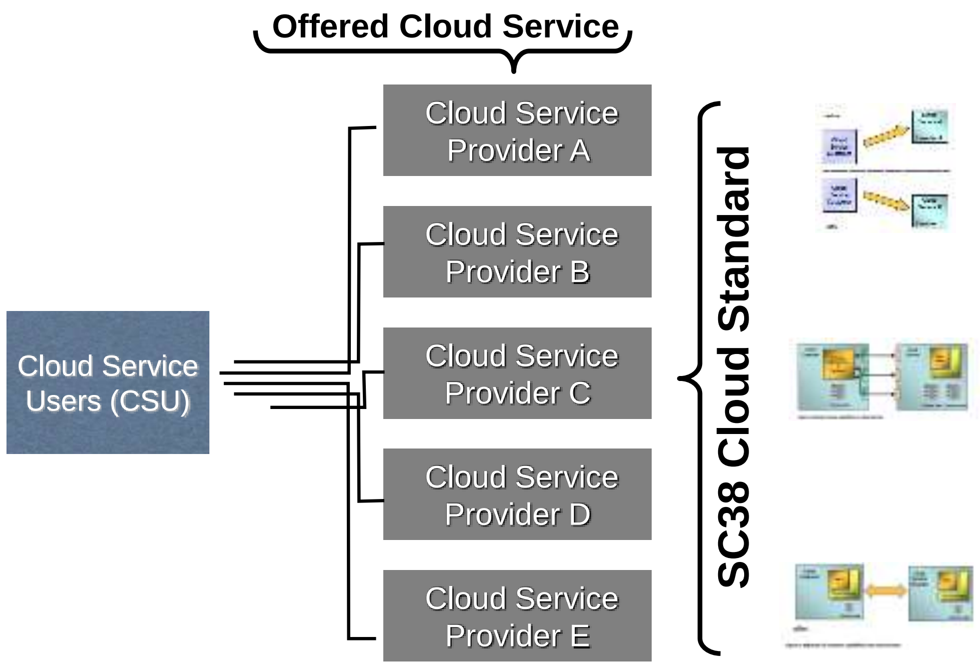

Figure 1. Indirect (second hand) usability of SC 38 Cloud Standard.

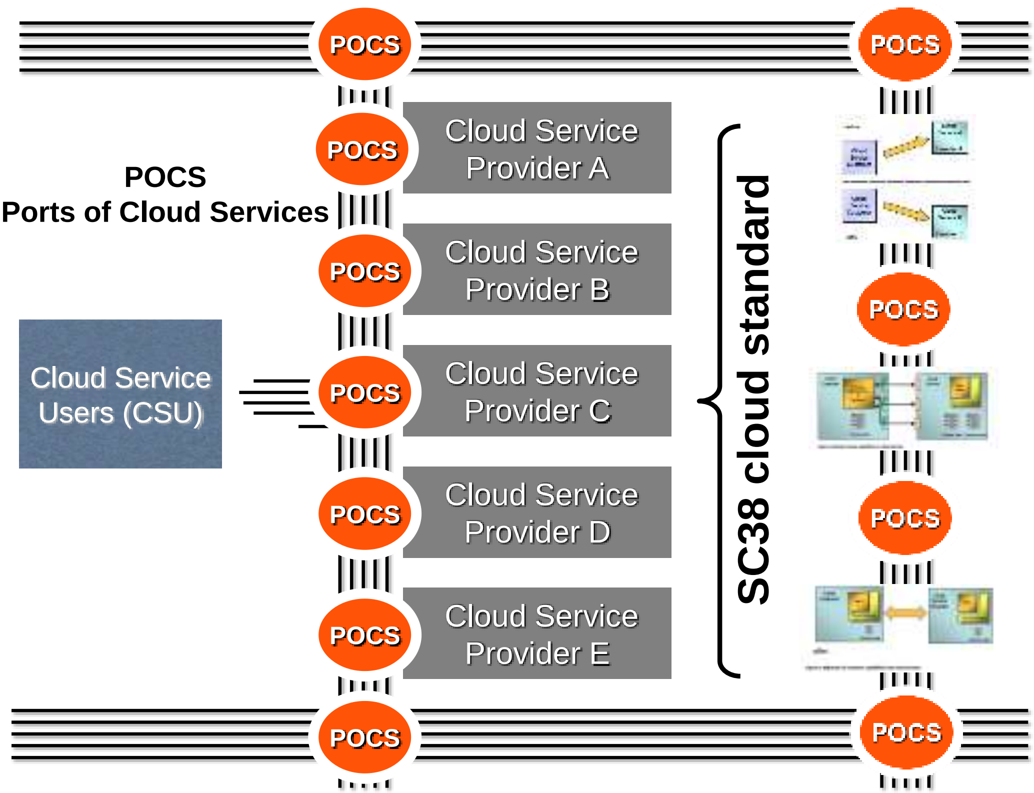

Figure 2. Direct (first hand) usability of SC 38 Cloud Standard.

2.1 Advantages at a glance

The analysis of the comparison of **Figure 1** and **Figure 2** (both page 3) illustrates how Ports of Cloud Services (POCS) elevate conventional cloud services to a new level.

- **Figure 1** presumes that a completely formulated „SC 38 Cloud Standard" exists.

The "SC38 Cloud Standard" is applied to all use cases formulated by WG 3. This is symbolized by the application example on the far right hand side of **Figure 1**. They are taken from document SC38/WG4 N 20. For example, if services are offered on mobile phones, PCs, tablets, etc. they shall be standardized services.

Figure 1 depicts many cloud service users (CSU) as indicated by the blue box on the left. For the use of a specific cloud service they are directly connected to the cloud provider who offers the specific service.

- An important characteristic of this concept is that the advantages of standardization for cloud service users (on the left hand side of **Figure 1)** is ensured through the adherence to „SC 38 Cloud Standard" by the cloud service providers (right hand side).

- With that, the advantages of standardized clouds to the user are indirectly provided through the special usability of the individual cloud service provider (second hand effect).

Figure 2 shows the fundamental structure of **Figure 1.** The Ports of Cloud Services (POCS) are added in red. They offer global accessible cloud services via standardized software. The global accessibility is symbolized by a matrix of connected lines, which work much like a data bus for transmitting data and usually adhere to the standards of the internet.

- In **Figure 2** it is assumed that there exists a completely formulated „SC 38 Cloud Standard with Ports of Cloud Services (POCS)".

Many Cloud services like interoperability, transportability, live search in a defined name space must be globally accessible and should be made available through the POCS via standardized software.

- Cloud service users access global cloud services through the POCS in standardized form (left hand side of **Figure 2**) because all cloud service providers must meet the implemented standard of the POCS software.

- All POCSs are connected and communicate via the internet. More particularly, no matter on which POCS a service is requested or accessed, all POCSs respond to the users as a uniform global accessible cloud system.

- The SC 38 cloud standard, as previously defined by the experts of the WGs remains as a standardization requirement (right hand side of **Figure 2**). The focus here lies on the standardization for the exchange of cloud services between cloud service providers.

- The exchange of services between cloud service providers may be achieved through the standardized POCSs. (POCSs between the specific applications of the cloud service providers).

3 The new paradigm for Cloud Computing.

This section explains why the present paradigm for cloud computing has to be revised.

A paradigm[1] is here understood in the sense of a Kuhn paradigm. It is a framework of concepts, results, and procedures within which subsequent work is structured. Normal science proceeds within such a framework. A paradigm does not impose a rigid or mechanical approach, but can be taken more or less creatively and flexibly (Text from Wikipedia).

3.1 The paradigm for cloud computing as referenced in WG-4

Terminology for the use in understanding the concepts of interoperability and portability for WG 4 is specified in document SC38/WG 4 N 20. Paragraph 5.1 row 10 and onwards of this document defines cloud computing as follows: (text underlined by author)

„*Cloud computing is defined as a paradigm for enabling network access to a scalable and elastic pool of shareable physical or virtual resources with self-service provisioning and administration on–demand, and many of these components are also the benefits from an interoperable system or interoperability.*"

Row 29 and onwards further defines the concept:

„Cloud computing has the potential to support commercial and other activity to an even greater extent than the Internet. The economic and social benefits that could flow from this are truly enormous. But this potential will not be realized without portability and interoperability. They are important – some would say vital – because of their ability to enable this technology-based revolution.

Interoperability has become a key requirement within the ICT industry as most customers use heterogeneous ICT systems, which often have to be integrated together to enable business processes. Cloud services are expected to interoperate just like traditional ICT systems, since customers are likely to be using different cloud based services from a variety of vendors and these services will have to work together."

These texts and other documents (z. B. N8, N11, N12, N18, N21) show the global aspects behind any cloud concept:

- That there is a paradigm for enabling network access for shareable resources.
- That there is a potential of even greater extent than the Internet.
- Customer heterogeneous ICT use (PCs, Phones, Tablets, Browser etc.).

The here listed points and many others require a relevant new frame of explanation that must define how the intelligence in technical systems is made globally available for the use by human intelligence. At least the global accessible technical intelligence should help humans to master the requirements of an ever increasing complex and globally interconnected world.

- In this sense the standardization of cloud computing should be in accordance with the always present scientific and global social aspects.

[1] http://en.wikipedia.org/wiki/Paradigm

One of the starting points of the ongoing scientific debate is the article of Mark Weiser "The computer for the 21the century[2]". In the scientific world the symbiosis of human and technical intelligence are named like "Ubiquitous Computing" or "Ambient Intelligence[3] [4]".

3.2 A renewed paradigm for cloud computing

This section proposes a renewed paradigm for cloud computing and serves as a basis for discussion for WG 4.

In light of the new formulation of cloud computing, it is important to highlight the symbiosis of human and technical intelligence. This offers significant advantages for the standardization of cloud computing. The following formulation is therefore proposed as the new paradigm:

- **Cloud computing has to meet the requirements of an increasingly complex world through the symbiosis of individual human and global technical intelligence.**

In biology, symbiosis exists between two forms of life where each organism complements the other with their specific characteristics to the advantage of both organisms. More specifically, to create a new form of survival in a changing environment. This is precisely what the paradigm for cloud computing expresses. In a world of limited resources and increasing human population, forms of survival have to be adapted. An open, critical and global society recognizes and discusses these broad constraints. It is the duty of the professionals involved in the standardization process to recognize these constraints in order to minimize or eliminate them.

3.3 The symbiosis of individual human and global technical intelligence.

By aid of **Figure 3**, Page 7, this section illustrates how important conclusions for cloud computing can be drawn from the interaction of human and technical intelligence.

Figure 3 compares the functionality of human intelligence (left) with technical intelligence of clouds (right)

On the left hand side of the illustration, two humans (A and B) capture analog data of an object. It is, in this case, the moon, which is presented to their senses (eye). The signals of the senses are stored in the human brain. There the "moon" is stored as a "Local Analogous Signal Representation A". Human brains cannot directly transfer data (content) from one brain to another. For transfer of content, the brains attach additional Information (meaning) to the content.

We can extract some specific points of human intelligence from the left side of the illustration:

[2] http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html

[3] http://de.wikipedia.org/wiki/Ambient_Intelligence

[4] http://www.mva.me/educational/hci/read/ubiquitous_computing.pdf

- Human intelligence does not directly transfer information (data, content).
- The human intelligence sender of information adds descriptive information about the content which the receiving individual than has to decipher and interpret.
- Content and its importance or meaning are thus inextricably intertwined by natural intelligence.
- The data content of brains is not globally accessible.

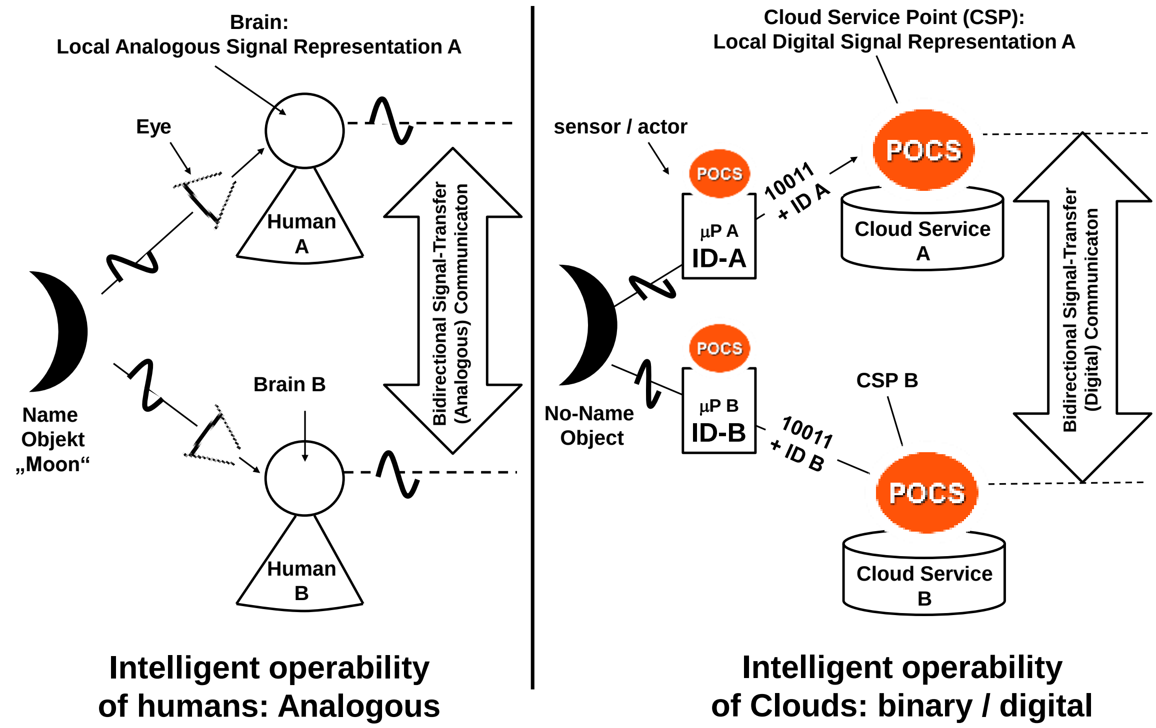

Figure 3: Comparison between human and technical intelligence.

The right hand side of **Figure 3** illustrates analogous to the left side the corresponding process of receiving and transmitting data (from the moon) for technical systems. We can identify the **cloud service point (POCS)** as the “Local Digital Signal Representation”. Therefore the POCS represents the brain of the digital world; it assumes the function of the human brain in the analogous realm. Both are in their own realm the service points for interoperable communication.

The POCS, depicted in red in **Figure 3** (see also **Figure 2**, Page 3), is in essence a locatable computer system as part of a more complex technical system. It may, for instance, be a “server”, “notebook”, “tablet”, “mobile phone” etc. A POCS thus includes a CPU, memory management, bus, ports and a standardized software kernel (Called: Web Operation Kernel (**WOK)**.

Similarly, the sensors and / or actuators (ID-A, ID-B) in the right hand side of **Figure 3** are comparable to the moveable eyes on the left side of the illustration and may contain parts of the software of the POCS. It could be implemented in a microcontroller which utilizes the specific parts of the WOK which are necessary for its local function.

The fundamental functionality of such a POCS (implemented in a server) will be presented at WG 4 in Santa Clara.

3.3.1 The global aspect

From our human experience we know that human brains operate under the assumption that any other brain functions the same way. This is the global aspect of human operability. This is adapted by the POCS in similar ways.

- The interoperable (global) function of POCSs is guaranteed by its identical standardized software.

If the new view should fulfill the successful symbiosis between human and technical intelligence to function in an increasingly complex world, it follows that cloud standardization has to adapt a similar intelligence structure. For example, when we humans add descriptive information (meta data) for transmitting content we rely on the fact that the receiving brain will extract the added information in a way that presents the original content. The cloud service point POCS on the right hand side of **Figure 3** has to fulfill this requirement. A simple fact for cloud concepts follows:

- Cloud Service Points have to present to humans global accessible meta data for describing (explaining) content.

The extended analysis of **Figure 3** reveals some important aspects, which are analyzed in the following chapters:

- A global extended matrix instead of a central intelligence.
- Standardized meta data instead of content exchange.
- Name Spaces
- Semantic communication
- Sensors and actuators.
- Monetization.

3.3.2 A matrix instead of a central intelligence.

With human intelligence, there is no central instance governing communication between two individuals. Universally, the overall human intelligence is not governed by a central instance. It is performed by identically functioning and distributed brains. Communication between individuals is direct and live. With an increasing number of individuals, this system soon approaches its limits.

The standardized global function of POCSs establishes a distributed digital intelligence. The advantage of a symbiosis between human and digital intelligence arises from the fact that much more POCSs could be coordinated than it is possible for human brains. If, for example, POCSs present meta data for describing web content, humans can, by aid of POCSs "walk" through a nearly unlimited space of meta data which describes web content.

This advantage is a typical effect of symbiosis: Each part complements the other with its specific characteristics to the advantage of both.

The greater the number of individuals relying on added information for solving complex problems, the more important it is to rely on a global accessible cloud matrix that provides these added information.

The POCS-Matrix interconnects it services through the internet and their functions are controlled through conventional internet browsers.

- POCSs thus add a communication layer (matrix) to the web. This layer describes what is happening on the web, live and up to date (see for some technical details part 4: "Demonstrable technical effects to WG 4 for clouds with POCSs. Page 13")

3.3.3 Standardized meta data for actual search results.

A unique feature to human intelligence is to describe content by added information. It is necessary that the symbiosis of human and technical intelligence establishes a comparable form of added information.

Added information is termed "meta-data". Only by the use of meta-data is it ensured that a symbiosis in the use of data between human and technical intelligence will become successful. This point is of particular importance as it relates to search results.

The lack of a meta data reveals that conventional search engines do not meet the requirements of a symbiosis between human and technical intelligence. If, for instance, a new document is stored within the cloud, or new content is added to a website, the corresponding metadata must immediately be available throughout the global cloud.

- It is insufficient for humans when search engines compile time delayed data about content in the cloud.

- Individuals want to know what others have to share with them regarding content, activities, services etc. in the cloud now and live.

- The question: "What is the content telling me?" dominates the question: "What is available in the web?"

We can identify these essential elements of meta data for describing content:

1. Title
2. Description
3. Keywords
4. Addresses (of content, pictures, documents, videos etc.)

POCSs enable humans to assign meta data to content. If, for instance, meta data are stored via any connected POCS, this information is made available immediately to all other connected POCSs. This is illustrated in **Figure 2** by the parallel lines. They symbolize an information matrix which serves for global and actual data transfer (see also part 4"Demonstrable technical effects to WG 4 for clouds with POCSs.at page 13).

3.3.4 Name spaces

The object name “moon” in Figure 3, Page 7 is indicative of how humans assign names to objects. The right hand side of the illustration initially lacks equivalent meaning of the object. Names are learned by natural intelligence. This naming of objects by human intelligence has to date not been considered essential for technical intelligence.

However, the importance of meta data in communication, as previously established, also makes the use of names practical in the realm of technical intelligence.

- A global accessible repository (table) for names must be established interpretable by humans.
- Each name (featured in a dictionary as a noun) is assigned a unique, internationally accepted digital signature.
- The data of the repository become usable if a name, its description or unique code is entered into software.

3.3.5 Categorial classification.

Since humans communicate through metadata, they communicate within the realm of meaning (semantics). The successful inclusion of semantic abilities in a cloud system is still vague. Much is in flux since science cannot yet offer clear principles on how content is assigned meaning automatically. Since meaning, in the realm of natural intelligence, is reliant on tangible human experiences and their environment, it may take some time before science offers results in this matter.

Regardless of this concern, we can do a first step in the right direction:

- We can introduce specific keywords as categories for classifying content. .

For example, the following meta data are classified by their category:

A. Title: Moon; Descripiton: A natural astronomic object; Keywords: moon; Category: Astronomy

B. Title: Moon; Descripiton: A poem; Keywords: moon; Category: Poems.

Since humans determine how categories classify content, a search engine searching for the category “Poem” will not present the content related to the meta data of A.

Since only humans can classify data by categories, the previous example further exemplifies the symbiosis of human and technical intelligence.

3.3.6 Sensors and actuators.

Human intelligence relies on senses (left hand side of Figure 3 „eye") and can control the senses. The eye can fix an object (moon). From a technical standpoint, sensors and actuators are present in the realm of natural intelligence.

Natural intelligence transports and uses analog signals (left hand side of Figure 3), the cloud uses digital signals (right hand side of Figure 3).

- With the advancing reliance on a symbiosis, it is necessary to detect human analog signals as digital signals. This is depicted in Figure 3, Page 7 on the right hand side of the illustration. Intelligent Sensor ID-A contains a microprocessor to convert analog information to digital signals which are made available to the cloud.

- The conversion from analog to digital signals can be achieved at the source of human senses (intelligent glasses, hearing aids, medical aids, etc.).

- More particularly, society has anticipated the symbiotic view with the "internet of things". It is thus necessary to include that as part of the new paradigm in the development of cloud technology.

It should be noted that a binary code namespace has to be established for sensors and actuators too. More particularly, every sensor and actuator is assigned a unique digital code. Additionally, similarly to the repository for named objects, the specific data of each sensor shall be stored in a listed form.

3.3.7 Monetization

Monetization in cloud computing is an important aspect. It can be made an integral and standardized part of the POCS-matrix. Existing formats of advertising and transaction features for advertising can be adapted in the new system.

A possible form of monetization is illustrated in **Figure 5**, **Figure 6** (Page 12).

Figure 5, **Figure 6** illustrate the advantages of search results with meta data. **Figure 5** shows the presentation of meta data A to D as portrayed by a search engine. The gray area in the center represents the primary meta data as described above. Here, the question is answered: "What is the data telling me about its content?" The orange areas left and right of the meta data are affixed to the corresponding meta data and may be utilized as advertising space (standardized form)

Figure 6 presents the search results of **Figure 5** in a new, re-arranged order. Data in **Figure 6** were rearranged and sorted by date. It is apparent that the advertising space attached to the meta data was also rearranged accordingly.

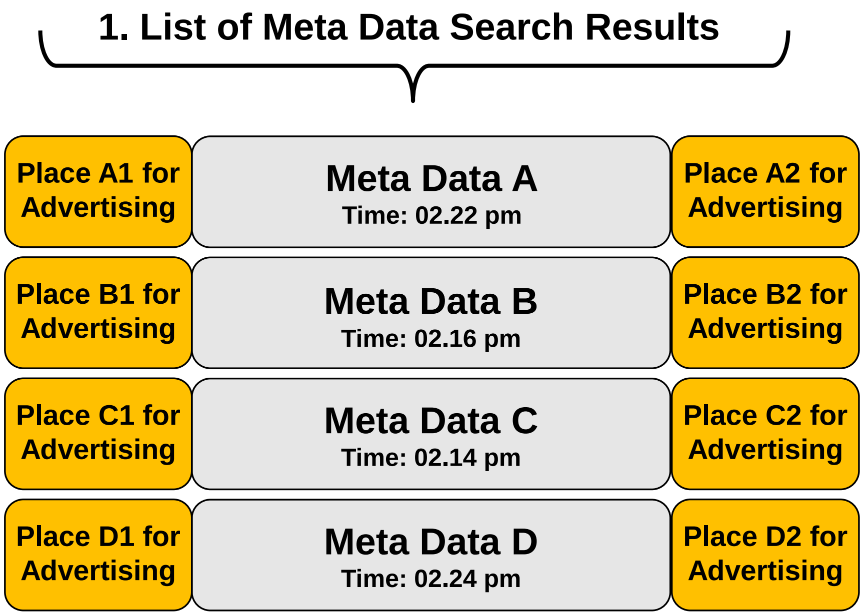

Figure 4: Search results not sorted by date.

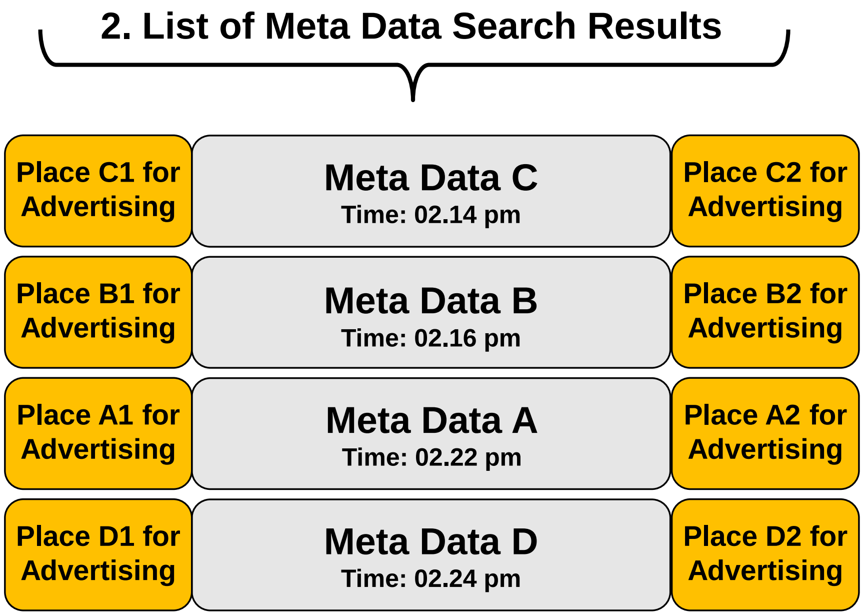

Figure 5: Search results rearranged and sorted by date.

The principle of connecting pre-defined and standardized advertising space with meta data yields several advantages:

- Advertising spaces are universally standardized to insure uniformity of use (e.g. advertising spaces can be automatically updated by software).
- Advertisements are directly connected to factual information and thus immensely valuable to advertisers.

- Sorting functions can be applied to search results even with paid advertisements since the ad-space is attached and “moves” with the primary meta data. Conventional search engines lack sorting functions since re-arranging search results lists would conflict with the paid ranking system.
- Those who don’t want advertisements attached to their meta data can leave those ad-spaces blank through standardized POCS functions. The meta data with all their advantages remain.
- Advertisements are limited to a standardized size and do not interfere.
- A combined list of search results from the POCS-matrix as well as search results from conventional search engines can be presented. (This will be demonstrated to WG4 members in Santa Carla.)

Conclusively: paid advertisements do not have to dictate the ranking of search results.

4 Demonstrable technical effects to WG 4 for clouds with POCSs.

A network of POCSs consisting of some servers will be prepared for demonstration to WG 4 members at the session in Santa Clara.

Figure 6 shows how a network of POCSs (POCS-Matrix) works to present live, up to date, metadata.

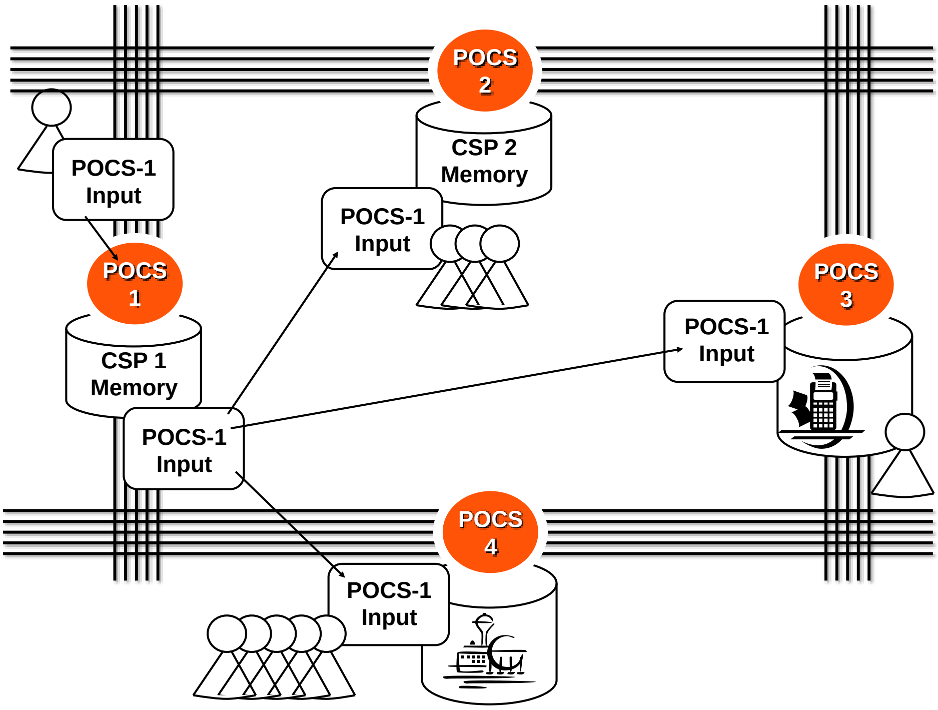

Figure 6: Up to date meta data in a POCS-matrix.

Figure 6 depicts four Ports of Cloud Services (POCS). Each POCS hosts the above mentioned standardized WOK software (WOK: Web Operation Kernel) and fulfills all mentioned hardware requirements. POCS 1 and 2 represent servers. POCS 3 represents a mobile phone and POCS 4 is a technical device in a remote university hospital. Such a system can be scaled and contain thousands or more POCSs. They are all connected by the POCS-Matrix. The following question arises:

- How can meta-information inputted through POCS 1 be made available to all other connected POCSs live and in a timely manner?

In **Figure 6** the meta-information may be entered through POCS 1's in a standardized form. It includes, for instance, a title, description, keywords (from a name space), location of content, images, categories etc.

One solution is that, for example, the user at POCS 3 sends a search request pertaining to their search term to all other POCSs. The results would have to be returned within of 300 milliseconds. This short response time is dictated by conventional search engines where data is stored in repositories and thus returned almost immediately. The downside being, is of course, that these results of search engines are not live and thus useless for time sensitive content searches of, for example, medical data, available last minute ticket offers, data from live sensors etc. However, as indicated above, time sensitivity of search results must be given in a symbiosis of human and technical intelligence.

The solution is as follows: A new POCS 1's input is immediately transmitted to all other POCSs within the network and stored locally in a repository on each POCS. If, for instance, the mobile phone user enters his search term or keywords, he will immediately receive the results since the metadata are stored on POCS 3 (hosted in this example by the network provider, see therefore **Figure 2**, page 3). Since metadata consist of a maximum of 1 kB of data, a wealth of metadata of many terabyte can be stored on each POCS system.

- With this method the actual meta information of the complete cloud is stored locally.
- If the user connected to POCS 3 asked for a specific meta information he gets the answer immediately from his local POCS 3 repository.

5 Greater social aspects of cloud computing.

The following bullets are not contributions to the standardization process. They can be viewed in reference to more fundamental documentation (e.g. SC 38 representations). It illustrates what socially relevant aspects may motivate the standardization process.

5.1 Historical background.

The internet provided the physical basis to combine high performance hardware and software to make them available centrally for a global audience. This view is strengthened by the success of locally accessible and globally functioning search engines (Google) and globally usable commercial applications (Amazon, eBay) but also global services such as Wikipedia and many more.

- An alternative view emerges if we view cloud computing as an inevitable result of human intellectual evolution.

At some point of evolution the exchange of information through a written language was discovered. As a result, knowledge could be reproduced and transferred from generation to generation on clay and papyrus. Later on, data processing with computers was discovered and made available to everyone through the personal computer for a vast variety of applications. Enormous increases in computing power and modelling of complex processes now go hand in hand to bring about a massive transformation of our world; from the first moon landing to computer caused stock market crashes. The global networking of computer power (cloud computing) resulted and now offers local access to globally available data, weather models, television, etc.

In addition, the rationalization of production processes yields societies the time to learn, therefore, broaden their knowledge base which in turn fosters the advance of intellectual capacity. In short: the process of intellectual advancement accelerates itself.

In light of this historical background we can formulate the following hypothesis:

- Each evolutionary developing biological intelligence reaches the threshold at which it creates technical intelligence to aid in expanding their own intellectual abilities itself.

It becomes evident how we utilize technical intelligence as a tool to expand our own human intellectual abilities.

- With cloud computing we take the step towards making globally distributed technical intelligence locally accessible and usable.

- In this light, cloud computing would not be viewed as a singular technical development but as a major new advancement.

This advancement is understood as a symbiosis of human and technical intelligence and could be viewed as the vision for better understanding cloud computing. Because of its technical aspects it is ready for standardization processes.

5.2 The primacy of the human.

The new view on cloud computing assumes a symbiosis of two forms of intelligence. An important claim will be the primacy of the human intelligence versus the technical intelligence.

The question of why human intelligence must dominate technical intelligence is quickly concluded in our human favour. After all, we can cut the power of machines (we pull the plug), and thereby terminate their working intelligence and thus demonstrating its dependence on us. If, on the other hand, we cut down the power to all the global working computers our lives dramatically change for the worse for us humans. There is no health care, no traffic, no energy for heat etc. In this type of symbiosis between human and technical intelligence, it requires a more thorough argument to grant human intelligence primacy.

- The human primacy argument holds true because, human conditions, needs and values are, at least for the foreseeable future, <u>not accessible by technical intelligence</u>.

This is best illustrated by a simple and practical example: the meaning of data, or web content, is not clarified or revealed by automatic extraction or aggregation of data or content by machines, especially as it applies to big data mining. Rather, humans must contribute information to automatically presented data in order to assign relevant meaning.

The question

"What does the data a search engine returned tell me?"

cannot be answered if millions of search results are presented by machine intelligence. Section 3.3 illustrates (and it is demonstrated at the next WG 4 session) how this requirement is to be solved.

5.2.1 Personal data security

Human primacy for the two forms of intelligence is already particularly important today when it comes to the protection of personal data. It becomes more prominent when sensor data and the operation of actuators are integrated into the symbiosis of the two forms of intelligence. Neither should medical devices (from hearing aids to life support machines) nor purely technical devices, such as heat control sensors, be subject to the primacy of machine intelligence. Human needs, in light of the symbiosis of the two forms of intelligence, are thus a priori determinative and may need to be legally regulated. Only thus can the misconception that technology is in conflict to human needs be countered.

5.2.2 Security of flow data and storage data

The international debate on the issue of personal data protection does not adequately distinguish between flow data and storage data. Flow data moves through the various data transmission channels of the internet. For technical reasons (e.g. wireless data transmission) as well as for legal reasons (data transfer across regions with different legislature) private organizations or individuals are unable to securely protect flow data. Public debate has to focus on the protection of data from unauthorized eavesdropping across states and legal boundaries. This issue is uniformly resolved for traditional data transport systems (i.e. postmen delivering mail). The so called Snowden documents are a result of taps on flow data.

The storing of data, on the other hand, falls within private law. If, for instance, a bank employee passes customer data to a third party, they will be in violation and breach of contract with their employer bank and are thus liable for the ensuing damage. It is important to establish in what legal jurisdiction the data has been stored and who is liable under this jurisdiction. Conventional cloud computing concepts do not satisfy this requirement as it is at best ambiguous what private law and jurisdiction is applicable when data is stored remotely. It is thus also ambiguous how a data security violation or misuse of data is dealt with.

5.3 Functional cooperation instead of local concentration

The new view on Cloud Computing neither binds human intelligence nor machine intelligence to a geographic location.

With traditional cloud computing concepts a super imposed computer intelligence hardware is concentrated, geographically disconnected from the human user. Conventionally, the remote cloud would technically and independently provide benefits to organizations, individuals and institutions. However, the geographic separation does not apply to the presented symbiosis of human and machine intelligence since it is not reliant on local concentration of intelligence. Human intelligence is associated with permanently changing geographic locations and computer intelligence is bound by hardware and its applications (computer, tablet, mobile phone, etc.) which also does not necessitate a stationary location.

5.4 Software comes to the data

From a purely technical perspective the conventional cloud computing concept is reversed in the new frame: local data must not be transferred to where the central software and hardware are located but standardized software is instead transferred to where the data is located.

Just like a hearing aid which must not be controlled by a centralized computer intelligence the same concept applies to sensor data of a remote heating system. In both cases, computer software can autonomously work on site. And, of course, the latest excel or gaming software does not have to be centrally available but can be distributed and accessible across many computers.