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A CONCEPT FOR MODERN VIRTUAL TELECOMMUNICATION ENGINEERING OFFICE

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High-performance modern Internet allows internal delivery and complement of attractive (mobile) services in the same way and QoS that are in the LANs. The world economics is widely characterized nowadays via the stable trends that the large and mid-range companies and authorities let in ever greater extent to outsource own engineering services via external smaller service providers. A concept for a modern virtual telecommunication engineering office under use of Service-Oriented Architectures and Cloud Computing technologies has been offered. Multiple use cases for virtual telecommunication engineering office have been discussed. As a significant example, the CANDY Framework and Online Platform have been examined. The important development trends for the CAD for network planning regarding to the tool integration and effective access optimization have been discussed. The CANDY system has been represented as an exhibit at CeBIT 2007, 2008, 2011 in Hannover.

Service-oriented Internet with Cloud Computing

Nowadays the network technologies have obtained large success regarding to data rate (WDM, 10GbE), mobility (HSDPA, LTE), universality and accessibility of computing services [1]. Actually a so called Internet of Services (IoS) became realistic and practically accessible for multiple users and appliances. IoS works on the basis of use of the applications and mobile apps, created with support of so called Service-Oriented Architectures (SOA).

High-performance modern Internet allows internal delivery and complement of attractive (mobile) services in the same way and Quality of Service (QoS) that are in the LANs. The discussed new information technology for serving of thin clients represented frequently via only low-performance appliances is called Cloud Computing (i.e. computing in the Clouds of Service-Oriented Internet) [2—6].

Among other things, the development of a modern virtual telecommunication engineering offices (VTEO) based on SOA and Clouds is one of the up-to-date tasks and very profitable business niches. We would like to deal with a mentioned VTEO concept and certain significant examples and use cases in the next sections of the given work.

A concept of virtual telecommunication office

The modern world economics is widely characterized via the stable trends that the large and mid-range companies let in ever greater extent to outsource own engineering services via external smaller service providers [7].

The discussed service providers are, as a rule, independent high-specialized engineering offices aging via high-performance networks (VTEO) with a relatively few employees. But the mentioned VTEOs can only survive in the long term if they provide their services at reasonable costs, at the shortest time and on the highest quality level.

Let us call the offered services as Virtual Project Processing. Examples of Virtualized Processes (VP) and the corresponding tasks circles can be formulated very largely. There are inter alia the following tasks and processes: electro-technical calculations; chip and electronic circuit design; judiciary documents preparation; statics computing for civil craft; tax return bill preparation etc.

Accordingly, the following specific requirements on such VTEOs have to be discussed in this section: per client order (performed project) can be obtained a relatively high profit, however, its processing time is usually limited; simultaneous processing of multiple projects in various steps of preparedness; cooperation (via discussions and document exchanges) with several groups of clients; delegation, if necessary, of the project steps (subtasks) to the partner agencies (i.e. subordinated VTEOs); participation of several specialists at each project; efficient project management; necessity of the exact project documentations at each processing step; permanent improvement of company.

Permanent improvement of company's know-how can be effected via: problem discussions; successful qualifications and renewal training of the staff; efficient knowledge storage; reuse of project results in the subsequent projects.

Nowadays the current situation in most usual engineering offices is contradictive and can be formulated as follows: qualified staff but very expensive staff trainings; use of modern CAD techniques (Computer-Aided Design) for individual engineering works (projects) but some inefficient cooperation of the participants; high time extensity and labor efforts for contacts to the client and partner companies.

It is, therefore, an important scientific-technical problem, to make the below discussed technologies (see next sections) available for VTEOs. Service-Oriented Architectures (Web Services) and Cloud Computing techniques (private and hybrid clouds) aimed to implementation of available services and providing access means are two indispensable components of the examined VTEO concept. The most acceptable models of interoperability VTEO-2-Clouds are as follows: Software as a Service (SaaS) with interface supporting to service-oriented Web applications or mobile apps, which provide access to the Cloud (frontend); Platform as a Service (PaaS) with the use for offering an integrated project environment for development and testbeds.

First, the VTEO must choose which kind of engineering services can be offered for the respective types of the projects and define for each an exact workflow (WF) of the project steps with the subordinated tasks and the associated qualification requirements (specialist roles).

At least one qualified employee has to be dedicated for each role. For the individual works, the high-quality CAD tools are to be provided, as well as a powerful project management system additionally for the project organization aims.

It is permanently to provide, that all project documents are currently available for all the participants (specialists, partners, clients) and they can efficiently communicate inter alia. Furthermore, the retrieving and on-demand offering the inter-operability of the most important project documents is to be supported. This requires specific document formats for each step of a project that can be processed in the subsequent steps without any further manual transformation.

The discussed concept of a VTEO is very helpful to meet the above mentioned requirements [8—11].

The resource requirements for such virtual engineering office move in the acceptable middle ranges (quantity of project employees; amount of retrieved project data). For general communication means, the classical services can be used (Email, SSH, Skype, videoconferencing etc.). The document management must be completely centralized and Web-driven. For the access WWW-techniques have to be used preferably (document preparation and supply per standard formats like HTML, PDF etc.). For any special project data, the appropriate XML-based professional problem-oriented languages are to be additionally developed with the associated XSD/XSL (XML Schema Definition/ eXtensible Stylesheet Language).

The project workflow management is the most important part of the discussed virtual engineering offices. But the majority of the commercially available systems are anyway too complex for direct use. Leaner solutions are therefore preferable. Such WF management solutions are usually based on Gantt diagrams (Fig. 1).

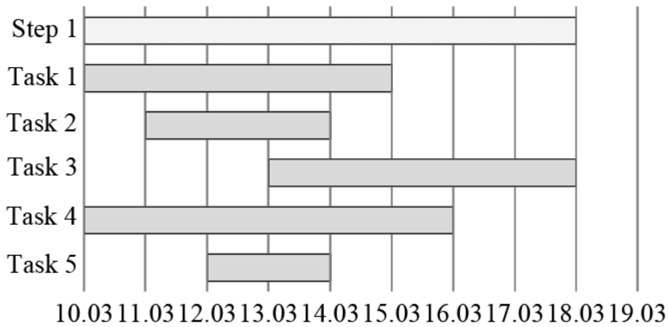

Fig. 1. A typical representation of a workflow via Gantt diagram: project step 1, tasks 1—5, execution period 10.03—19.03.2012.

For each WF step in a project, there are the different process types. Over and above that, the following classification of process types for a VTEO can be deployed: Automated, with a simple communication scheme (without human assistance and e.g. under support of sparing stateless protocol REST); Half-automated with use of complex stateful protocols with commits, under participation of specialists and dedicated personal as well as under support of classical stateful SOAP over HTTP or SMTP); Completely manual (expensive and very complex).

Purely human works (like e.g. granting of permission) have to be organized via WWW (Web Services, mobile Web Apps). Use of the WF management system is to provide the necessary download-functionality for input documents and, correspondingly, after completion of the works (execution of business process logic) the necessary upload-functionality of the required resulting documents by the responsible project employee to the centralized document management system.

The works with the CAD tools, like e.g. ArchiCAD, are to understand, as defined above, as the purely manual works.

It is particularly efficient if the VTEO can offer a processing support also via a central platform. This can be realized especially efficient on AJAX based techniques. The user activities are executed within the standard WWW-browsers, the business logic processing follows at the server site, e.g. via activation of certain specialized scripts. The resulting documents will be stored automatically and project-specific at the server site [7—11].

The specific WF Centric Management for a VTEO must be defined under use of the following principles and requirements to the process elements and their synchronization (Fig. 1): a Workflow is combined from a sequence of design steps; each step consists of one process (task) or multiple parallel processes; each process possesses a status, e.g. (ready [y/n], result [+/-]); each process uses and/or produce input/output documents; a process is either an atomic process or a Workflow itself.

The next important aspect is a type of billing and a payment method (accounting in a VTEO). There are different possible systems: between the simplest blanket (all-in-one) accounting of delivered services to differentiated complexes prices depending on data amounts, manual efforts, tasks dimensions and computational complexity. With the simple VTEO accounting forms SSL method or, alternatively, XML security find favor. SET method can be recommended for differentiated complexes prices schemes.

The discussed issues are illustrated sufficiently in the next sections of the given work on the example of a VTEO (a fictive service provider) for a design of combined network structures.

Important issues of SOA technology

SOA based on Web Services (Fig. 2) possess the following profitable advantages: Web Services offer spread platform intendancy for Enterprise Application Integration (EAI) and Business-to-Business (B2B) solutions; Web Services use open standards and protocols, their expressiveness is recently simplified due to XML deployment; Use of HTTP 1.1 and advanced interaction models AJAX, COMET facilitates B2B intercommunication through the company firewalls [1, 2].

Nevertheless as the disadvantages correspondingly the recent problems act as follows:

1. The mostly important complication by deployment of SOA on Web Services relies to security aspects. The transport of Web Services into the intranet area has to be definitively authenticated and encrypted. The HTTPS vs. XML signature and XML encryption can be as possible options discussed.

2. The next one is the performance that is considerable and negatively affected via significant overhead contained in multiple XML descriptions, as well as via parsing long XML documents.

3. The further problem is management of available Web Services with specified QoS and gain of required programming know-how for SOA deployment (e.g. DOM-XML processing).

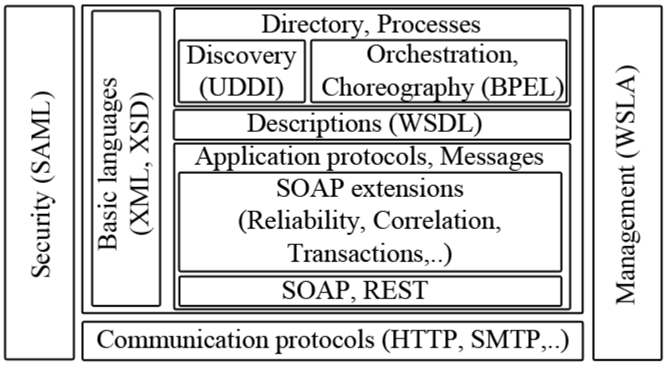

Fig. 2. SOA/Web Services Basis Architecture.

The outlined problems can be solved via the newly elaborated extensions of Web Services, so called RESTful WS and WS-*. The extended WS-* use the basic components (Fig. 2) and allow creation of efficient service-oriented applications on classical Web, Semantic Web and Web 2.0 due to the use of the following integrated technologies [4—6]:

1. Reliability via WS-Addressing, WS-Reliability, WS-Message Delivery.

2. Messaging via WS-Eventing, WS-Notification.

3. Security via WS-Security, WS-Trust, WS-Privacy, WS-Federation, SAML (Security Assertion Markup Language).

4. Transaction, Co-ordination, Context via WS-Transactions, WS-CAF (Composite Application Framework).

5. Semantic Features via OWL-S (Web Ontology Language for Web Services).

The extensions are depicted in Fig. 3.

Based on the REST model (Fig. 4) performance can be recently increased. RESTful Web Services are based on REST, Representational State Transfer [5]. RESTful Web Services act in some measure as an antagonism regarding to SOAP and XML-RPC.

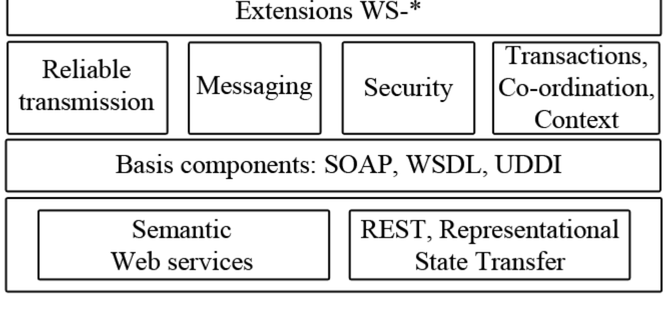

Fig. 3. Extensions WS-* and alternatives.

Such Web Services themselves and based on them further applications can be described accordingly to the mentioned architecture style only via URIs and HTTP v1.1. The distinguishing features are as follows: asynchronous, temporary character, no RPC, direct requests on resources and documents (URI), use of a generic interface, standard semantics, and stateless communication protocol.

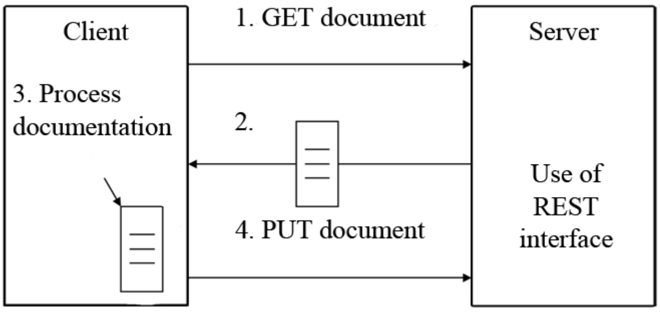

Fig. 4. Representational State Transfer Method.

The RESTful Web Services are stateless too, contain necessary context themselves and are operated only via simple {GET, PUT, POST, DELETE} functionality. Such sparingness [5, 6] lets more consistency by use of established W3C standards; the SOA performance is increased but nevertheless for account of flexibility decreasing.

Contemporary SOA concepts are mostly focused on EAI and B2B surround. However, mapping of business processes (respectively for VTEO) as well as services orchestration and composition (e. g. via BPEL4WS) is still inelastic and associated with higher developer-site complexity. Therefore, elaboration of new concepts is an imperative. The concepts have to include not only new marketable ideas, e.g. like VTEO, but also the analysis of costs and benefits [12].

Clouds as a new information technology

Abstract access to the network resources is performed with aid of primitive Web Services (WSDL, UDDI, SOAP, REST) [1, 2, 4—6], refer to Fig. 2. The general models of Cloud Computing are used. Software as a Service (SaaS) is the simplest model with interface supporting to service-oriented Web-applications or mobile apps, which provide access to the Cloud (Frontend). Platform as a Service (PaaS) is used for offering to an end-user of an integrated environment for development and/or testing for (Web-) applications and mobile apps (Testbeds). The model Infrastructure as a Service (IaaS) is applied for offering virtualized services in internal computing and networking structures (inter alia due to use of the remote servers, Storage-Area Networks/ Network Attached Storages, Virtual Machines operated per SNMP etc.).

The functions of Clouds provide offering the services for thin client access to the virtualized resources with non-transparent internal structure aimed to performance of certain routines, resources and time-consuming tasks, to consolidation and/or partition of available physical resources, as well as for integration of applications and mobile apps for enterprise informational systems EAI (Enterprise Application Integration) [1, 2, 4—6].

Load balancing and function distribution between Cloud Computing and conventional IT are depicted in Table 1.

Table 1. Load balancing and functionality distribution between Cloud Computing and conventional IT.

Conventional IT	IaaS	PaaS	SaaS
Applications	+	+	Applications*
Data	+	+	Data*
Runtime	+	Runtime*	Runtime*
Middleware	+	Middleware*	Middleware*
Web Services	+	Web Services*	Web Services*
OS	OS*	OS*	OS*
Virtual Resources	Virtual Resources*	Virtual Resources*	Virtual Resources*
Server	Server*	Server*	Server*
Storage	Storage*	Storage*	Storage*
Network	Network*	Network*	Network*
+	for self-responsibility		
*	delivered from the cloud		

The providers of Internet of Services offer to their end-users multiple attractive services on different hierarchical levels. Purposed to creation and maintenance of different service-oriented applications and mobile apps the providers of Internet of Services offer frequently corresponding easy-treatment standardized APIs (Application Programming Interfaces) for multiple target platforms.

A context between Cloud Components and Cloud Services is represented in Fig. 5. The most famous Cloud Computing providers (IoS providers) world-wide are as follows: Amazon EC2; Sun/ Oracle Cloud; MS Windows Azure; OnLive Games etc.

Especially in Ukraine and Russian Federation the Cloud Computing functionality is rather limited per IaaS (i.e. classical DPC, Data Processing Centres). The oldest and largest DPC of Ukraine are ColoCall and Hosting.ua (even deployed in 2000).

The most famous DPC providers in Russia are: Selectel, Stack Group, ISG, WideXS, Telehouse Caravan, IBS DataFort, KiaeHouse, DataDome, Filanco, Data-

Line, SVS-Comm, StoreData, KROK, PTKOMM (Rostelecomm).

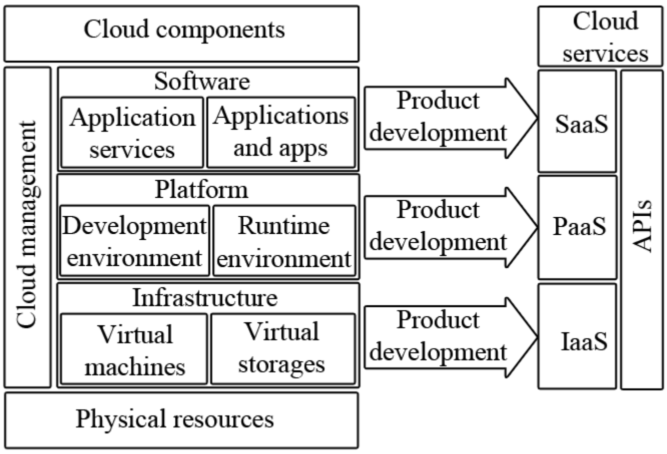

Fig. 5. Context between Cloud Components and Cloud Services.

Frequently the internal structure of the Clouds stays non-transparent for their end-users [1—3]. The users are enforced to outcrop from the full-trust position to their own Cloud provider or even to multiple Cloud providers. It brings sometimes the complicated SLA-handlings (Service Level Agreements) and responsibility principles of interested sites [1, 2, 4—6] because in the general case the Cloud providers have to operate on international level. In fact, they underlay to different legislatures in different countries. Moreover, they can be furthermore hierarchically organized and be dependent from further international providers.

Therefore by careful creation, deployment and maintenance of Cloud Services a lot of problems of multilateral data security unfortunately remain unsettled. This factor limits in certain kind of way the advancement of the discussed new IT and IoS.

CANDY as integrated CAD for combined networks

A computer-aided design (CAD) toolset for combined office communication and building automation networks (Fig. 6) is presented. It especially focuses on the combination of wired (IEEE 802.3-LAN) and wireless (IEEE 802.11-WLAN, 802.16-WiMAX) as well as wireless sensor networks using 802.15.4/ EnOcean.

CANDY Framework [7—15] supports an integrated design methodology providing a complete design workflow. The design requirements on these networks are often contradictive and often have to consider such factors as performance, energy and cost efficiency for a network solution altogether.

The system provides the following features: integrated workflow management; dedicated network description via NDML (Network Design Mark-up Language); structured cabling by EN 50173 support; frontend to CAD conformity; IP infrastructure analysis; access services to a high-performance computer cluster; as well as parallelized design routines realization [16].

Dedicated network language

The framework uses the dedicated NDML, a XML-based notation. NDML supports a uniform way of representing all major active and passive network elements (including switches, routers, gateways, patch fields, cross panels, base stations, sensors, access points as well as automation nodes), their detailed technical properties as well as their interconnections and related configuration issues.

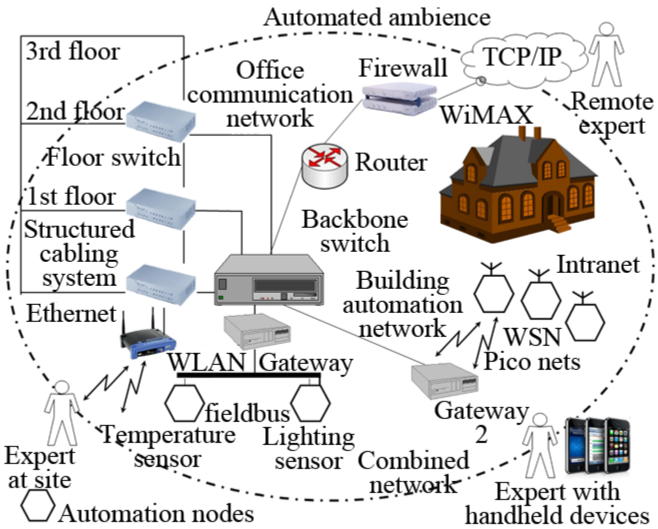

Fig. 6. A combined office communication and building automation network.

In contrast to existing vendor-specific notations, NDML is based on open standards and enables interoperability and portability of network design tools and projects.

Development history and trends

CANDY is an open framework with a large set of design tools and functionalities. These include design editors, consistency checks, transformation tools, specific wireless network design tools, and integration of existing simulation environments. NDML serves as common “glue” for these tools.

Java technologies facilitate the tool development including among others Application Server and Middleware (Apache, Tomcat with JSP, Java Server Pages, and EJB, Enterprise Java Beans), ERCP (Eclipse Rich Client Platform), as well as Web Services (Apache Axis 2). A flexible tool access is provided via available Java desktop applications and Android apps for smartphones/ tablet PCs.

The CANDY Tools survived the following development history:

1. Conception/ Implementation of a prototype (CANDY Prototype): Conception of NDML with prototype for network editor; prevalent implementation basis: Java-Servlets, Java-Applets, EJB.

2. Realization of dedicated planning tools (CANDY Framework), inter alia, tools for: for structured cabling system, called CANDY Trace Router; for optimized design of radio networks, called CANDY Site Finder; prevalent implementation basis: Eclipse Rich Client Platform; further development of NDML (XSD instead of DTD, achievements in advancing so called viewpoints and language elements); realization of an extensible framework (CANDY Framework) with mostly important planning steps and frontends to encapsulated external tools.

3. Further realization of a universal design platform (CANDY Framework with CANDY Online Platform): Workflow and documentation management („WF-centric"); support of all design steps; loose embedding encapsulated external tools via Web Services; prevalent implementation basis: HTML5, AJAX, Web Services; multimodal access via mobile users with smartphones/ tablet PCs (Fig. 7).

CANDY highlights

The system possesses the following highlights [7—15].

1. Accurate planning is the precondition to decisive advantage under competition pressure. In view of networks complexity, the task can be solved by efficient software tools like CANDY Framework and Online Platform.

2. The engineers have to optimize large-scaled objectives within complex contexts. CANDY system represents integrated design for 802.3/802.11/802.16/802.15.4 nets under use of own as important integration component.

3. The implemented CANDY Online Platform provides possibility to running complex parallelized propagation algorithms for wireless nets as well as multivariant TCP/IP simulation processes via CANDY Web Services on the high-performance computing environment MARS (ZIH@TUD).

4. The realized framework and access services offer to the specialists and students a rare possibility to start their ambitious CAD jobs, obtain the results in few minutes, support real measure data acquisition and their comparison with modeled results [10, 11].

A CANDY specific workflow for network design and WF Centric Management are built under use of the following principles: a CANDY workflow is combined from a sequence of design steps; each step consists of one process (task) or multiple parallel processes; each process possesses a status, e.g. (ready [y/n], result [+/-]); each process uses and/or produce input/output documents; a process is either an atomic process or a workflow itself (refer to Fig. 1).

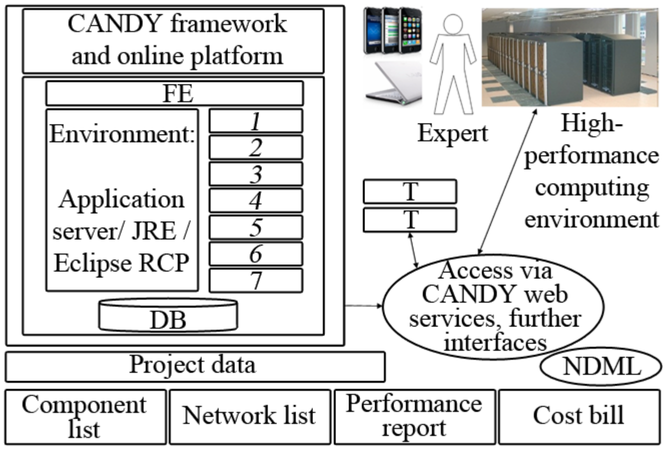

Fig. 7. Design tool integration and access with the following modules: (*1*) project manager; (*2*) network editor; (*3*) component browser; (*4*) SCS trace router; (*5*) wireless site finder; (*6*) workload analyzer; (*7*) bill reporter; (FE) front-end via XML; (T) loose-coupled and 3rd party tools, like, for instance, NS-2; (DB) component repository.

Simulation and validation

The design results for WLAN IEEE 802.11 are not satisfying accurate generally. Correspondingly, the site survey functionality with design correcting is necessary. An advanced method to planning radio networks leans on prognosis of received power und comparison of measure values aimed to their further optimization. The method is called Measurement-based prediction (MbP methodology). The reference components of the MbP methodology are shown in Fig. 8.

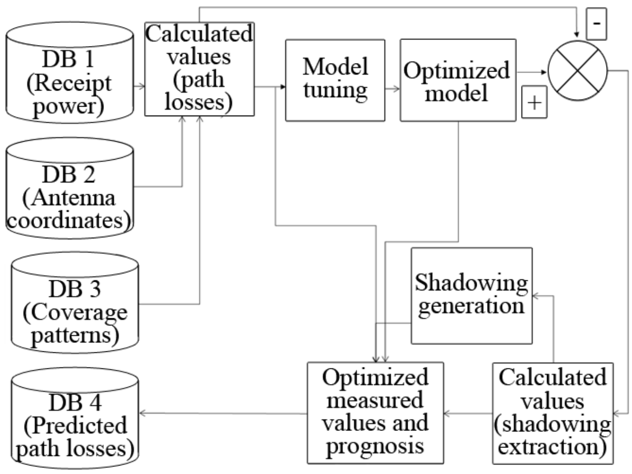

Fig. 8. Measurement prediction methodology for planning of radio networks

By deployment of the MbP methodology, advanced measure devices and hardware solutions of [1, 2, 17] can be used. The data bases contain all necessary reference values (covering samples, antenna coordinates etc.). The used empirical radio propagation model is valuated and via inset of the MbP methodology is adapted to real receipt power [17]. The following validation tools are developed within the CANDY project.

The access to the simulation und acquisition measure data (ubiquitous design) follows multimodal via a Windows notebook or an Android smartphone/ tablet PC (under use of mobile apps).

The important functionalities are depicted in Fig. 9: download of planning data from CANDY server; measurements of relevant parameters, preliminary data retrieving; comparison with planning data; upload of measure tuples to CANDY validation server.

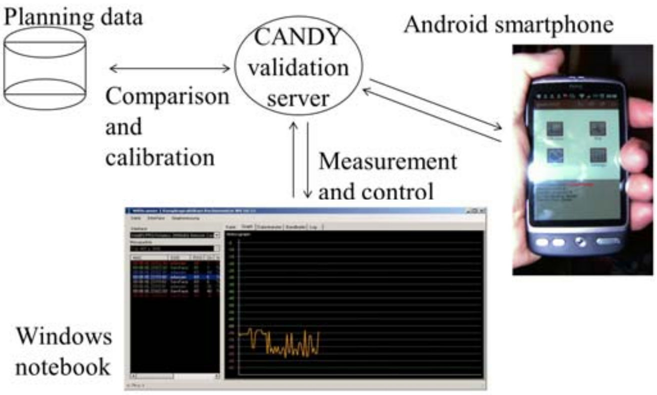

Fig. 9. Simulation and validation within CANDY.

Conclusion

High-performance modern Internet allows internal delivery and complement of attractive (mobile) services in the same way and QoS that in the LANs. The world economics is widely characterized nowadays via the stable trends that the large and mid-range companies and authorities let in ever greater extent to outsource own engineering services via external smaller service providers. A concept for a modern virtual telecommunication engineering office under use of Service-Oriented Architectures and Cloud Computing technologies has been offered. Multiple use cases for virtual telecommunication engineering office have been discussed.

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