

# A Blue Print of a Unified Communications and Integrated Collaborations System in the Health Sector of Developing Countries: A Case of Uganda

Excellence Favor, Bakari M. M. Mwinyiwiwa, Damian D. Haule, and Fakh H. Omar

**Abstract**—Access to information is the key to the empowerment of everybody despite where they are living. This research is to be carried out in respect of the people living in developing countries, considering their plight and complex geographical, demographic, social-economic conditions surrounding the areas they live, which hinder access to information and of professionals providing services such as medical workers, which has led to high death rates and development stagnation. Research on Unified Communications and Integrated Collaborations (UCIC) system in the health sector of developing countries comes in to create a possible solution of bridging the digital canyon among the communities. The aim is to deliver services in a seamless manner to assist health workers situated anywhere to be accessed easily and access information which will help in service delivery. The proposed UCIC provides the most immersive Telepresence experience for one-to-one or many-to-many meetings. Extending to locations anywhere in the world, the transformative platform delivers Ultra-low operating costs through the use of general purpose networks and using special lenses and track systems.

**Keywords**—Developing countries, Unified communications and integrated collaborations.

## I. INTRODUCTION

THE health sector Information and Communications Technology (ICT) infrastructure has to become an enabler for the medical strategy of growth, excellence and good performance by providing premier information services and contributing as a valued service provider for its citizens. Establishing a foundational infrastructure sets a platform on which higher level services can operate. Central to this platform system is the establishment of a Global Directory and Authentication Service. With these core services in place, attention and effort can be focused on other services that enhance medical business processes like email, data collaboration systems, Network Access Protection [1-3], Active Directory (AD) Rights Management Services [4] and System Central Management. Additionally, by simplifying and eliminating the duplicated effort of providing core platform services like network, directory and authentication [5], IT will be able to provide high quality and efficient services to the health sector.

Excellence Favor is a Ph.D. candidate while Bakari M. M. Mwinyiwiwa and Damian D. Haule are working with the University of Dar es Salaam, Dar es Salaam, Tanzania.

Fakh H. Omar is working with the Nelson Mandela Institute of Science and Technology, Arusha, Tanzania.

The health sector should be therefore able to deliver a robust infrastructure that caters for the following initiatives: Messaging – Email & Calendaring; Collaboration - Web Portal services [6], Intranet [7]; Unified Communication – Instant Messaging, Conferencing, Presence; System Management and Security [8-9]; Change management – Training & Process. UCIC is the integration of real-time communication services such as instant messaging (chat) [10], presence information [11], telephony (including IP based telephony) [12], video conferencing [13], data sharing (including web connected electronic whiteboards or Interactive white Boards) [14], call control [15] and speech recognition [16] with non-real-time communication services such as unified messaging (integrated voicemail, e-mail, SMS and fax). UCIC is not a single product, but a set of products that provides a consistent unified user interface and user experience across multiple devices and media types [17-18].

UCIC allows an individual to send a message on one medium and receive the same communication on another medium. For example, one can receive a voicemail message and choose to access it through e-mail or a cell phone. If the sender is online according to the presence information and currently accepts calls, the response can be sent immediately through text chat or video call. Otherwise, it may be sent as a non real-time message that can be accessed through a variety of media. TelePresence is a combination of cutting edge audio, video and network enterprise solutions, also hardware optimized environments and a software glue that holds the elements together to make the best high definition video presence available in industry today [19].

It is a very new, unique, innovated technology that creates in presence, high definition, virtual meeting possible. And also TelePresence makes these things work for your work, as well as for personal life over a health sector network. You know predominantly it's about productivity, getting people in front of others and in a very virtual environment, but creating that in presence experience is key [20]. Furthermore, TelePresence is about improved responsiveness for health workers to be able to respond to patients, to be in presence of patients, also for subject matters to get in front of the patients very easily and fast, so TelePresence enables that to happen. The aim of this research work is to develop an environment with seamless flow of information in the health sector by using UCIC system, thus enabling prompt medical services delivery in

the health sector which will reduce the death rate in the developing countries

## II. RESEARCH PROBLEM

The health sector lacks powerful connections to connect people both inside and outside the sector for high productivity and performance. In developing countries like Uganda, poor telecommunications infrastructures in health sector prevent the inhabitants from accessing and benefiting from the inexpensive and reliable health services and information. The lack of information contributes to inadequate health services hence resulting in high death rates [21]. There are no sufficient systems in place that reduces communication response time or delay in response which is essential in decision making and acting upon instructions. There is no seamless flow of information between the medical workers and the people they need to connect with to get work done—leading to a significant decrease in overall performance and high death rates [21]. There is a lot of time and money wasted by having separate e-mail, phone, audio and video conferencing, voice mail, and instant messaging systems.

The health sector has experienced multiple generations of growth and restructuring which has resulted in an infrastructure consisting of multiple technologies supporting similar functions across the various departments in the sector. The health sector has several mobile employees who access resources and network remotely, posing operational and security challenges. This complexity in the health sector infrastructure has resulted in the following challenges: *Operational Complexity* - the costs of administering and maintaining multiple infrastructures is significantly increased for the Health Sector, *active Directory and Global Applications* - the ability to deploy global applications is hampered due to the existence of multiple Active Directory Footprints that has resulted to a lack of common Security Group Policies (GPOs) and authoritative health sector Identity source, *messaging and Collaboration* - as initiatives seek cross-group collaboration, excessive time and energy is spent bridging the many independent departments making it costly for the health sector to execute on even the most basic collaborative services, *employee and Business Productivity/performance*—a key requirement by the health sector is user productivity/performance, *security* -mobile employees roam around the world with their PCs, using these PCs in hotel rooms, home, internet cafes etc and in the process could get the PCs infected, *management Agility* – growth and restructuring are part of normal operations for the health sector. The IT infrastructure needs to handle these events as a natural part of the IT ecosystem instead of as a major exception to the IT operations.

The effort in addressing the mentioned challenges has been at a minimal level so far in the sense that most of the systems are not fully integrated and they are merely isolated. As a result, the health sector seeks to use management tools to improve its operational efficiency. Unified Communications and Integrated Collaboration system is envisioned to help in this direction.

## III. OBJECTIVES OF THE RESEARCH WORK

The main objective of this research is to develop a system for deploying unified communications and integrated collaboration system in health sector of developing countries, taking Uganda as a case study. Specifically, this research will focus on the following areas:

- i. To assess the existing infrastructures of the health sector in terms of communication and collaboration aspects.
- ii. To identify the support needed in the proposed unified communication and integrated collaboration system in the health sector.
- iii. To model a system to support unified communication and integrated collaboration system (Telepresence, mobility and interoperability) in the health sector.

## IV. HYPOTHESES OF THE RESEARCH WORK

The hypothesis of this research is “ *A Unified Communications and Integrated Collaboration system will enable seamless flow of information between the workers and the people they need to connect with to get work done – leading to significant increase in overall productivity and performance to the health sector of developing countries.*”

According to the stipulated hypothesis the components and technologies employed in the infrastructure (such as QoS and IP Multicast) provide a secure, robust, reliable, and efficient foundation. Building on the infrastructure, the gateways and call-processing components perform the necessary conversion, integration, and control functions to enable efficient, streamlined communications. The applications augment the call processing to provide features of services (Presence, mobility and Interoperability) required by users. And the endpoints provide access to the network services and features—enabling users to make the most of their communications system and increase their productivity and performance

## V. RESEARCH METHODOLOGIES

This research will require a carefully developed methodology which will involve the combination of qualitative and quantitative methods. The location of the study will be in Uganda. The steps that will be taken in this approach will involve:

- i. Literature review
- ii. Feasibility study – establish user requirements
- iii. Data collection from organization such as World Health Organization (WHO), UNICEF, Hospitals, Standard Bureau’s of Statistics, Mobile Telephone Network companies, ISP’s, Communication Commissions, Rural Health centres/units, by visiting them on line or physically conducting interviews. To obtain data such as the level of ICT in hospitals and the rural health centres, the technologies that are already in place, the population density, Teledensity, number and spacing (distance) between the rural health centers using questionnaires.
- iv. Analysis of the health sector in terms of UCIC (SWOT analysis)

- v. Model the system using the OPNET tool. OPNET tools allow for the configuration of presence, instant messaging, virtual meetings and mobility.
- vi. The validity of the model will be analyzed using OMNET or a dynamic Real-time Network Simulator Platform (RealNeS) which enables the “hot” configuration of system parameters (portability, extensibility, Integration, management, remote access effectiveness – uptime/throughput, jitter, congestion, latency and delivery – speed, cost), simulation of any kind of packet-switched network in real-time and evaluation of performance of all types of IP-based multimedia services over different radio access networks in real-time. The investigation of all aspects of cross-layer optimization and its influence on Quality of Service will be done using the appropriate tools.

and inclusion of non-verbal cues which happen in a remote meeting). The successful implementation of this system will lead to three folds, i.e. socially, academically and technically

#### *Socially*

Socially it will lead to improved access to health services in the developing countries thus reducing the level and impact of poor health, underpinning public education campaigns to promote healthy behavior in critical areas such as Acquired Immune Deficiency Syndrome (AIDS), transferring diagnostic information to specialized centers strengthening the basis for decision making, enhancing the effectiveness of the health institutions, equitable distribution of health information and services, the establishment and stimulation of a strong progressive society and economy and improve the well being of people living in the developing countries.

#### *Academically*

Academically it will lead to promoting information exchange among researchers in the health sector, gain more knowledge on ICT technologies and advancement of career. There will be improvement in design skills after coming up with a model of UCIC deployment system in the health sector.

#### *Technically*

The central contribution of UCIC technology is integration. The system brings together all available communication modalities and makes them available on a robust multimedia interface, thus easy collaboration, communication, access, business process integration and presence. This will lead to Maximization of the existing infrastructure, building on a future-ready foundation, streamlining end-user communications, increased efficiency and reduced costs and deployment of powerful speech-enabled self-service applications. VoIP as there is a single identity system and it helps secure all communications. One system, one password for all communications i.e. with unified communications technologies, the user can move smoothly from phone to e-mail to a videoconference. Therefore the user can focus on communicating instead of how he/she is going to get in touch.

## VI. BENEFITS OF THE PROPOSED UCIC

This study is going to lay platform on how the Unified Communications and Integrated Collaboration system will be taken to the health sector and how it will improve the information flow, save time and money. Once UCIC has reached the health sector and has been exploited properly, then the well being of the people in the developing countries will be improved because health information and services will be easily accessible. The presence of UCIC in the health sector will bridge the big gap that exists between the quality of services of urban and rural areas, thus fairly equitable distribution of health services and information. This will create a strong link between urban and rural services and generally to the globe.

UCIC provides a seamless flow between the work users do and the people they need to connect to get that work done—leading to a significant increase in overall productivity and performance. With UCIC time and money is saved [22] by replacing separate e-mail, phone, audio and video conferencing, voice mail, and instant messaging systems with an integrated, Windows-based platform and built-in, enterprise-grade protection by find and communicate with the right person—anytime, anywhere, on any device with a single user interface for Instant Messaging (IM), email, presence, voice, video, and application sharing; protects the IT ecosystem with the spam and virus-fighting capabilities of Exchange; simplifies management and scalability while maximizing IT resources and extending investments; increases IT control and visibility to meet changing business requirements.

UCIC technology aims to minimize delays, by focusing on the integration of the following: telecommunication voice systems and services: data communication networks, IT systems, mobile telecommunications services, videoconferencing technology and Telepresence services. UCIC provides the most immersive Telepresence experience for one-to-one or one to many or many-to-many meetings. Extending to locations anywhere in the world, the transformative platform delivers Ultra-low operating costs through the use of general purpose networks and using special lenses and track systems in order to produce vectoring (the technology that makes realistic eye contact

## VII. PROPOSED DESIGN FOR DEPLOYMENT OF UCIC SYSTEM TO THE HEALTH SECTOR

The best choice of the right telecommunication technology will determine the success of the implementation of the system. The deployment and exploitation of this system will not only depend on the telecommunication infrastructure, but also on other factors like electrical power, existing telephone and TV infrastructure, environmental conditions and databases. For the proposed system the technologies and methods that have been highlighted to be used are via Satellite, WIMAX and WI-FI considering their advantages to the location where these health sector services are located and the UCIC links to the right players or resources at the right time like: Microsoft, Cisco, Avaya, Intertel, Miltel, NEC, Nortel, Siemens and Shoretel considering the applications they are supporting.

A UCIC solution is a unique distributed platform that provides the system's core communications capabilities. Purpose-built for IP, this open, highly reliable platform which is compatible with the existing infrastructure, works seamlessly with the business applications and processes, and makes integrated business communication easy to deploy and manage as shown in Fig. 1. The UCIC system scales easily and is ideal for multi-site organisations because it behaves and appears as a single, unified system with full PBX, voicemail, and automated attendant functions.

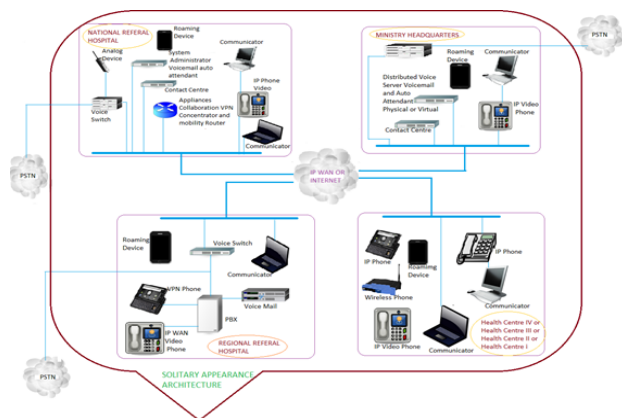


Fig. 1 The proposed architecture model for Deployment of Unified Communications and Integrated Collaboration system

A distributed communications solution - the UCIC platform integrates multiple facets of communications into a single distributed architecture to provide a range of rich capabilities. Call Control is the foundation of the platform and the flagship of the UCIC architecture. Embedded in the highly reliable UCIC Voice Switches, UCIC call control is provided as a true distributed application. Each voice switch hosts the application, services all of its associated users and network interfaces, and works with all other voice switches to create the complete solution. Applications including unified messaging, account codes, and others, are integrated into the core platform and deployed at either a central location or distributed to all sites. A UCIC built-in distributed workgroups feature provides basic Automatic Call Distribution (ACD) functionality that is ideal for informal call centers. Simple call routing, overflows, announcements, historical reports and real time alerts are built into the core platform.

Audio and web conferencing as well as Instant Messaging are services fully managed and deployed through the UCIC System. Features on the UCIC platform are easily accessed through UCIC IP Phones and the UCIC Communicator application suite, which includes full mobility capabilities. Since the platform is based on open standards, additional popular solutions, including Microsoft Outlook email, interactive voice response systems, voicemail-to-text and leading CRM solutions easily integrate to meet any business requirement.

Distributed call control – the UCIC distributed software architecture deploys core voice communications capabilities at each site. This architecture means a single system can serve multiple locations while providing for stand-alone

reliability at every site in the event of a wide area network (WAN) failure. The result is a single-image system that scales easily, distributes to all geographical sites/locations, delivers feature transparency to all users and delivers rock solid reliability. Distributed voice applications Voice applications, including voicemail, auto-attendant, and basic ACD are similarly distributed through the enterprise as integral components of the UCIC platform.

The UCIC platform unified messaging features can be either centralized at the Headquarters location or distributed across a network on standard servers or inside Voice Switches. As a stand-alone system, UCIC provides a feature-rich voicemail solution for all enterprises as well as advanced call routing rules that let workers customize how their callers are handled. When combined with desktop and mobile user interfaces, users can take advantage of easy-to-use visual voicemail, can integrate their voicemail and can easily direct their calls based on their calendar.

The UCIC platform includes an embedded auto-attendant that provides 24-hour automated call answering and routing to improve service and brand image. Outgoing prompts can be customized and linked to the time of the day and/or day of the week. Individual groups have their own menus with unique greetings and options. UCIC's basic ACD or "workgroup" solution provides basic call center functionality to enhance customer experience and report on agent or customer behaviors. The integrated experience through the UCIC Communicator boosts agent and supervisor productivity and allows them to monitor real-time queue or agent activity.

Distributed workgroup functionality further enhances the customer experience by ensuring that agents in remote sites or branches are available independent of any network outages. The UCIC platform also includes an integrated Call Detail Reporting (CDR) and call accounting system. With CDR, the system tracks the calls for users, trunks, and workgroups. The integrated call accounting system goes further in helping you manage communications costs by associating customer or project accounts to all calls or by enabling password access to advanced calling permissions.

UCIC Voice Switches and Appliances - UCIC Voice Switches host UCIC distributed call control software and support UCIC IP Phones, SIP devices or combinations of analog devices. They are available in a range of sizes for health sector headquarters, regional offices, rural health centres and small to midsize private health centres. UCIC Voice Switches also provide network interfaces to bridge your communications beyond the enterprise by supporting SIP, analog, and ISDN trunking. UCIC Voice Switches feature an embedded voicemail and auto-attendant functionality providing distributed and survivable service attendant features at a remote office or site.

UCIC Virtual Private Network (VPN) Concentrator and InGate SIParator are key components of the UCIC platform that provide a secure solution for connecting to end-user telephones or service providers over the IP network. The UCIC VPN Concentrator enables secure and remote deployment of UCIC IP Phones in the user's house, health centre locations, customer's location, or in the enterprise's smaller locations. The InGate SIParator provides secure

connectivity to network based service providers for both inbound and outbound calling. Leading technology independent rankings, UCIC consistently earns top marks for superior IP telephony technology. UCIC's technology leadership in dynamic echo cancellation, jitter buffering, lost packet handling, and wideband audio codecs result in exceptional voice quality that satisfies the most demanding business user. Designed for power efficiency, Voice Switches also help lower energy consumption.

Software is hosted on embedded UCIC voice switch appliances to extend the overall system's reliability. UCIC Voice Switches exceed today's most stringent enterprise IT requirements, delivering 99.9% availability with: N+1 redundancy that helps ensure that if a UCIC Voice Switch fails or is isolated by a network fault, the phones supported by that switch automatically are transferred to another voice switch – either at that site or a shared resource at the Headquarters location.

UCIC processors do not require or use mechanical disk drives, eliminating the single most common point of system failure. An embedded, real-time operating system and unique call control architecture, enabling them to communicate with each other and distribute call processing in the network. Additional UCIC reliability is proved by the following powerful capabilities: PSTN failover: If the WAN is down or over-utilized for voice traffic or if bandwidth limits extension-to-extension calls between sites, calls can automatically route over the PSTN, ensuring seamless communication. Ethernet port failover: UCIC Voice Switches feature redundant network uplinks. If the upstream network device fails, UCIC voice switches automatically fail over to the redundant link, helping to ensure continuous operation. Power failover: Every UCIC Voice Switch features power fail transfer. If a complete power outage exceeds reserve power duration, one analog trunk on the UCIC Voice Switch automatically connects to one analog telephone, providing emergency dial tone.

Integrated collaboration Conferencing and Instant Messaging make conferencing universally accessible – well beyond traditional users. It empowers all users with real-time collaboration tools, including those who have only occasional need for them. Dial-in, high-definition conferencing: Whether it's a one-time conference or an always-on conference, users can invite their colleagues, partners, or patients to dial into the audio conference services in a single step. Because participants can be dialed in directly, the dead-time associated with waiting for them to join the conference is eliminated.

Conferencing offers support for wideband codecs, providing a higher level of listening comfort, making everyone – regardless of their location – feel more immersed in, and closer to, the conversation. Zero-touch web conferencing: Users on both PCs and Macs can share their desktops to collaborate on documents with their team. They can manage their documents in their own personal libraries or using the public one. Participation for attendees is simplified, as well: with a simple click on web link – and no download – attendees can see the shared desktop within seconds.

Self-service scheduling: Without IT supervision or assistance, users can schedule or create spontaneous conferencing, or even reservation-less conferences using an intuitive Web interface. For Outlook users, scheduling a conference has never been simpler: simply pressing the "Conference" button in the Outlook ribbon automatically associates a UCIC Conference with the meeting, including all information required for the host and participants to join. Instant recording: The Instant Recording feature gives users more options for the storage and distribution of the recording of the conference and its accompanying Web presentation, including keeping an archive of the event or enabling the distribution of the information to a broad audience.

Development of Management and Security Services - Management infrastructure centered on Security solutions such as Firewalls, Forefront client security, Active Directory Rights Management Services (AD RMS) and potentially Network Access Protection (NAP) embedded in the routers and switches.

UCIC is built around simplifying user experience and giving users what they want. Thus, a diagrammed depiction of UCIC rightly places the user in the center shown in Fig. 2. With UCIC the user can easily access many services (conferencing, collaboration, unified messaging, etc.) via devices, web portals, desktop applications and special applications.



Fig. 2 Conceptual Diagram of UCIC Places User in the Middle

The Health sector IT optimization should begin with infrastructural and foundational elements such as Directory, Identity and Authentication services. The services will lay the foundation for an evolution towards a high-value IT service structure, followed by such services as Microsoft Unified Collaboration including Messaging and Unified communications, firewalls, endpoint (Forefront) security, Microsoft office applications, Active Directory Rights Management Services (AD RMS), Network Access Protection (NAP), Management infrastructure, legacy clean-up and optimization, and then on to a state of other expanded well-tuned services.

## VIII. CONCLUSION

Unified communications and integrated collaborations system can help the requirements of the health sector by

reducing communication complexity, integrating disparate applications, and tying communications services directly to specific activity process to reduce human latency. UCIC creates a healthcare environment with highly regulated; data and information resources which meet strict requirements for privacy and protection.

UCIC offers noticeable and measurable benefits for health sector establishments looking to improve operational effectiveness. Through the deployment of UCIC, health sector organizations can advance customer services, maximize resource effectiveness, meet compliance requirements, and create new income opportunities. Therefore, the health sector organizations should develop explicit business cases for the use of UCIC technologies within their particular environment, paying close attention to situations that reduce latency, leading to tangible gain from speedy and comfortable interactions.

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