Videoconferencing-as-a-Service for African NRENs

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Abstract

This paper describes recent developments in the capability of Videoconferencing and the associated opportunities for a shared videoconferencing offering for African NRENs. The improvements in inter-African network capacity, taken with the maturing of new approaches to videoconferencing open an opportunity for African NRENs to take advantage of an investment that TENET has made in its videoconferencing platform.

TENET, the South African NREN operator, has established infrastructure to support multi-party high quality videoconferencing that brings together room-based conferencing (including H.323/SIP conferencing) with the capability to participate from desktop and laptop computers and from mobile devices. Due to the efficient software based characteristics of the chosen platform (Vidyo), participants are able to enjoy up to HD quality conferencing and content sharing in multi-party conferences.

The backend of the Vidyo infrastructure is available as software appliances to run as virtual machines (VMWare). This allows for a geographic distribution of the Vidyo infrastructure that enables maximum efficiency in the use of the SANReN network within South Africa.
Following an approach from KENET, the Kenyan NREN organisation, TENET has been able to further leverage the flexibility of the Vidyo platform to enable KENET to offer the capabilities of Vidyo to its Higher Education and Research communities in Kenya
This paper and conference session will describe the details of this service and the key capabilities of the platform that allow for a distributed service. The paper and session will also outline the key economic, technological and organisational factors that make Videoconferencing-as-a-Service a compelling offering for African NRENs.

Keywords

Videoconferencing, cloud services, Vidyo, shared services

Introduction

This paper is a prospectus for a suggested shared service that will provide high quality videoconferencing capability for African NRENs at low cost. The suggested service is enabled by the opportunity to deploy videoconferencing infrastructure in a way that can be characterised as a Cloud type service (Armbrust et al. 2009), and builds on the investment

that TENET, the South African NREN operator, has made to support videoconferencing in South Africa.

Videoconferencing has long been a technology that has promised much (Unruh 2000) and often failed to deliver on its promises (Single Malt Cloud, 2104). Technical reasons for this include cost of proprietary room systems and back-end infrastructure, complexity, the need for better bandwidth conditions than is necessarily available in African countries, and the limiting of videoconferencing to meeting and board-rooms due to the lack of affordable and capable desktop and mobile client software. Videoconferencing use in education is subject to some novel challenges that may need thorough analysis and development of strategies to overcome them, if the technology is not become yet another while elephant. (Lawson & Comber 2014)

Recent advances in videoconferencing technology have enabled products to emerge that overcome many of these historic obstacles to the widespread adoption of videoconferencing. In the case of TENET's chosen platform, Vidyo (Vidyo, 2015), these advances include the wholly software nature of the stack (endpoints and infrastructure) intelligent matching of video and audio to the capabilities of endpoints in the meeting and scalability. This scalability refers not only to size of meeting but also to the availability of the software client on devices ranging from smartphones through desktop and laptop computers to full-blown telepresence type setups with multiple screens. Vidyo also allows existing videoconferencing endpoints using H.323 or SIP to join Vidyo meetings via a transcoding bridge. (Civanlar et al. 2009)

To enable collaboration and high quality meetings without the cost and trouble of travel for its customers in the universities and research council it supports, TENET invested in a Vidyo setup for South African higher education and research at the start of 2015. TENET put in place sufficient capacity to support these institutions in South Africa. Because Vidyo is a software-based system, TENET has been able to place infrastructure to support Vidyo meetings at key locations on the SANReN network in South Africa to ensure the most efficient use of network resources. Following discussions with KENET, the Kenyan NREN organisation, further infrastructure was placed in Nairobi to allow Kenyan universities and research organisations to use TENET's pool of licensing capacity (KENET 2015).

This paper will further expand on the points made in this introduction and will outline an offer of a shared service that will enable collaboration across and within African NRENs. It will explore the key characteristics that make Vidyo a good choice for academic videoconferencing, and which make sharing the service relatively straightforward.

Videoconferencing - the case for an NREN Service

The question may well be asked as to why an NREN organisation should be in the business of running a videoconferencing service at all. Many NRENs offer or aspire to offer a videoconferencing service, some, based on traditional centrally provisioned MCU (Multiple Control Unit) model while others have been exploring routes beyond this type of service. TENET's view is that while some of the better endowed universities in South Africa might well be able to provision the required infrastructure and support to meet their own needs for videoconferencing, many others would be challenged to make such provision, and that there was a real danger of fragmentation in the availability of solutions with consequent issues around interoperability.

One of the key challenges for South African higher education and research is to address the huge disparity between the very best institutions in the country and the rest. One key driver for TENET's establishment of a videoconferencing service was to provide a level playing field where academic discourse and collaboration both between the universities and research organisations and with external stakeholders could take place. TENET's judgement was that there were considerable benefits in both financial and operational terms in the provision of a central managed service for videoconferencing rather than allowing a free-for-all where institutions might end up with islands of incompatible systems. These factors combined with significant cost savings accruing from the ability to share the service among the approximately 50 institutions that TENET supports, made the case for a central service.

Why video and not web conferencing?

TENET makes a clear distinction between web and videoconferencing. While there are many overlaps in terms of functionality, the affordances of the two approaches to collaboration have a number of distinctive characteristics (Stephenson & Downing 2012).

Web conferencing, which encompasses applications such as Adobe Connect[1], Big Blue Button[2], Blackboard Collaborate[3] or Cisco WebEx[4] are typically suited to one to many or instructional type scenarios, where the added functionally of being able to run quizzes and take feedback asynchronously is a determining factor. Typically web conferencing platforms default to a emphasis on the content being shared while the video and audio does not get the same emphasis. This can lead to less than optimal meeting experiences; with remote participants being displayed in any thumbnail views and audio feeds being bedevilled by poor quality and echo.

Videoconferencing (which includes Vidyo) emphasises the video and audio quality first and foremost, and is therefore more suitable for meetings involving conversation and the cut and thrust of argument and debate, and where it is useful to stretch beyond the desktop to room based conferencing setups, or a mix of room and personal device endpoints. Most videoconferencing platforms offer content sharing (this includes Vidyo) and in addition Vidyo has a "Presenter" mode which brings it closer to the web conferencing paradigm outlined above. Historically, videoconferencing was something confined to expensively equipped and inflexible boardroom settings, but the advent of the software based videoconferencing platforms like Vidyo means that it is now possible to provide client software to run on personal devices and a web client for guest use.

The point should be made at this point that some issues pertain to any type of video or web conferencing. For example, a poor quality camera, a backlit participant, a noisy room, bad lighting or lack of echo cancellation on the audio feed and poor meeting etiquette will degrade the quality of the virtual meeting, whatever technology is being deployed.

TENET's Offering for South African HE and Research

[1] Adobe Connect - *http://www.adobe.com/products/adobeconnect.html*
[2] Big Blue Button - *http://bigbluebutton.org*
[3] Blackboard Collaborate - *http://www.blackboard.com/online-collaborative-learning/*
[4] Cisco WebEx - *http://www.webex.com*

Like many NRENs, TENET saw a couple of years ago that a videoconferencing service for South African higher education and research was something that was both needed and demanded by its customers. TENET explored the market, and for a while offered a Polycom hosted VMR (Virtual Meeting Room) service to interested parties. This service saw patchy take up - a couple of institutions made use of it, but most failed to find use cases that might justify the cost of the service. Some of the characteristics of the hosted VMR service that made it less than useful were that the VMRs were fixed and allocated - so institution X had a five port VMR, but those ports could not be shared with institution Y or Z when X did not need them. As these were Polycom VMRs, and other H.323/SIP endpoints could join, there was no cost effective desktop or mobile client software that people could use if an H.323/SIP equipped meeting room was not available.

TENET terminated that service in 2014 and looked for an alternative. From consultation with the videoconferencing support teams in the institutions, TENET knew that it needed a service that was scalable, would work with existing H.323/SIP installations, would add support for desktop and mobile connections, would offer easy guest access and that would allow for streaming and recording. A further essential characteristic was that the service needed to be hosted within or connected directly to the SANReN network and have good in-country support from suppliers or developers.

TENET selected Vidyo as a product that best matched these criteria. Vidyo is one of the new breed of videoconferencing platforms that are appearing as alternatives to the traditional H.323/SIP offerings that have dominated the market up to now (Karcher 2013). Vidyo has a number of key characteristics that make it very suitable as the platform through which an NREN can offer a videoconferencing service. These include:

- **Use of the SVC extension to the H.264 standard**: Vidyo uses SVC to transmit video streams between participants. Vidyo's own way of implementing SVC means that the video image stays robust even in fluctuating or less than ideal network conditions;
- **Entirely software based stack**: Vidyo's entire offering is available as software that runs on non-proprietary hardware and OSs. This includes the room system capability, the desktop and mobile clients and the backend infrastructure;
- **No transcoding or re-encoding needed**: Vidyo calls are intelligently managed by the VidyoRouter infrastructure component that does no transcoding; it simply routes traffic in the most efficient manner possible. The means that a single hardware VidyoRouter or its virtualised equivalent can handle up to 100 concurrent connections. Vidyo uses the processing power of the endpoints to do the coding and decoding work;
- **Very high quality video**: On suitable hardware Vidyo will transmit at up to 1080p and can display up to 5K images. This makes Vidyo a good option for medical or engineering applications, as well as allowing for the best possible meeting experience for more routine activities;
- **High quality audio**: Vidyo has its own built in software echo-cancellation and will intelligently use hardware echo-cancellation if the audio device in use has that available;
- **Very low latency**: Unlike conventional MCU based system, Vidyo introduces very little latency into the meeting experience, and manages the lip syncing so that the audio stays in sync with the video;

- **Allowing existing H.323/SIP Endpoints to participate**: Vidyo offers a VidyoGateway device (as a virtual machine if required) that allows organisations' exiting investments in Polycom, LifeSize or Cisco to join Vidyo meetings. The VidyoGateway can also be used as a virtualised MCU for pure H.323/SIP calls is required;
- **Web client for guest users**: Guest users are sent a web link that once clicked, downloads a small plugin to the browser (no restart needed) which then joins the meeting. Registered users can invite potentially unlimited guests to their meetings. From early next year the requirement to download a plugin will be replaced by support for WebRTC;
- **High quality content sharing**: In a Vidyo meeting all participants can share content from any open window on their computer or their entire desktop. Each participant can choose which share to view (or none);
- **Distributed deployment options**: Vidyo supports a robust but flexible distribution of infrastructure that allows organisations to establish VidyoRouters and VidyoGateways in locations that allow users' traffic to make efficient use of the available network capacity. This distributed infrastructure can draw on a common pool of licensing and support;
- **Multiple organisations can share same installation**: Vidyo allows the creation of multiple "Tenants" on the same installation. This allows TENET to offer each institution its own VidyoPortal and ability to connect that to institutional authentication systems;
- **Flexible Cloud style licensing options**: Vidyo's "Hosted Lines" licensing model is based on a licence of a number of concurrent connections to the service. This pool of concurrency can be shared between multiple users, and between multiple tenants;
- **Recording, Replay and Streaming**: The VidyoReplay (available as a virtualised appliance allows for multiple concurrent recordings, streaming and replay or downloading of recordings at a later date.

This graphic illustrates the parts of the Vidyo system. The way in which TENET has put these components together will be described below.

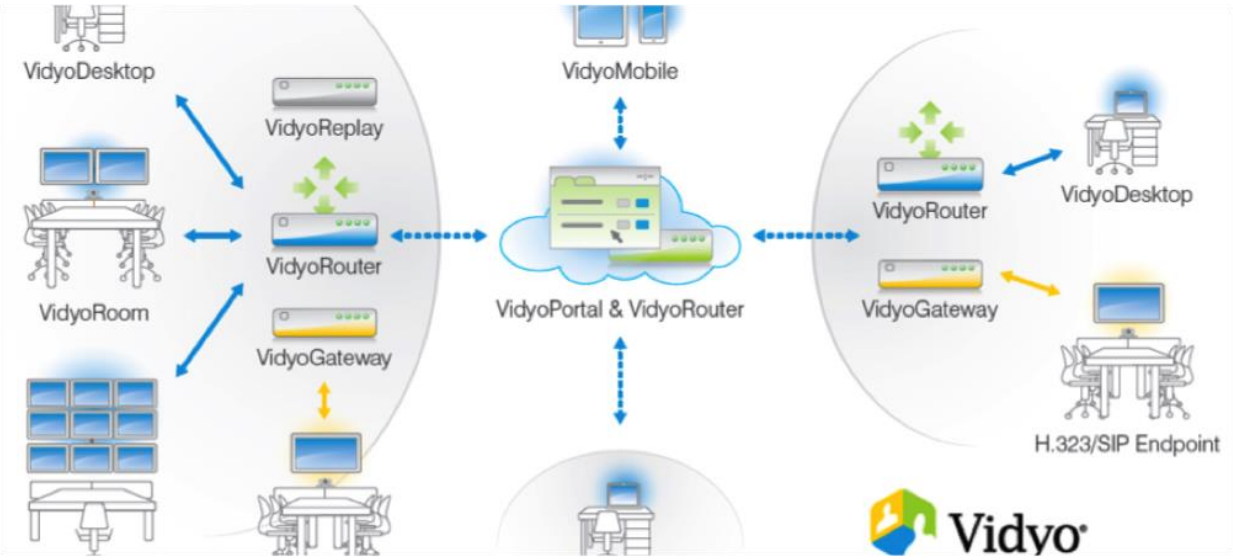


Figure: 1 Components of the Vidyo suite of the products (Source: Vidyo)

In researching the market for videoconferencing systems, it was discovered that Vidyo is the system in use by the European Organisation for Nuclear Research (CERN) and by a number of other NRENs around the world, as well as the other big science project represented in South Africa: The Square Kilometre Array (SKA). The example of CERN was of particular interest as the installation there accommodates 40,000 users, at times up to nearly 1,000 concurrent users and regular meetings of 20, 30 or 40 participants (CERN 2015). This showed that Vidyo was a platform that could easily scale to accommodate the foreseeable needs of South African higher education and research

Another notable user in Africa is AIMS (the African Institute for Mathematical Studies) based in Muizenberg in the Western Cape, South Africa, but with regional centres in many other African countries. AIMS uses TENET Vidyo infrastructure to link with universities in South Africa and also with its regional centres, as well as funders and partners in Canada and Germany.

In addition to these high profile use cases for Vidyo, it was noted that a number of NRENs in Europe are rolling out videoconferencing services based on Vidyo, the most mature one of which is Vscene (Jisc 2015), which is offered by the UK NREN organisation, Jisc, and is used in a shared service arrangement by the Irish NREN, HEAnet (HEAnet 2015). There are also indications that CERN will be looking to offer Vidyo as a service to NRENs who are part of Géant[5] in the near future.

TENET's Vidyo Infrastructure

To realise the ambition to provide top class collaboration opportunities for its users, TENET has set up a Vidyo infrastructure with nodes in Cape Town, Johannesburg and Durban, these being the three major centres on the SANReN network (TENET, 2015). There is a VidyoPortal that looks after user accounts and system management tasks, and there are three VidyoRouters each capable of handling up to 100 concurrent connections as well as a cluster of VidyoGateways with a combined capacity of 12 concurrent up-to HD quality for connections from H.323/SIP endpoints. There are also five telephone lines running over SIP into the VidyoGateway cluster that allow participants to join by voice only. All these components run as virtual machines under VMWare. Users in different parts of the country are assigned different Location Tags that determine which VidyoRouter they access. This ensures the shortest network path to the Vidyo infrastructure from the endpoints and saves on network bandwidth between the parts of the infrastructure.

The SKA (Square Kilometre Array) South Africa[6] had a considerable Polycom estate already in place, but were looking for ways to make that set up more flexible, They make use of the TENET VidyoPortal and VidyoRouter but have deployed their own VidyoGateway internally to allow them to have guaranteed access to the H.323/SIP bridging capacity that they need. This is an example of a hybrid cloud arrangement, as the SKA can also drawn the pool of H.323/SIP bridging in the wider TENET setup.

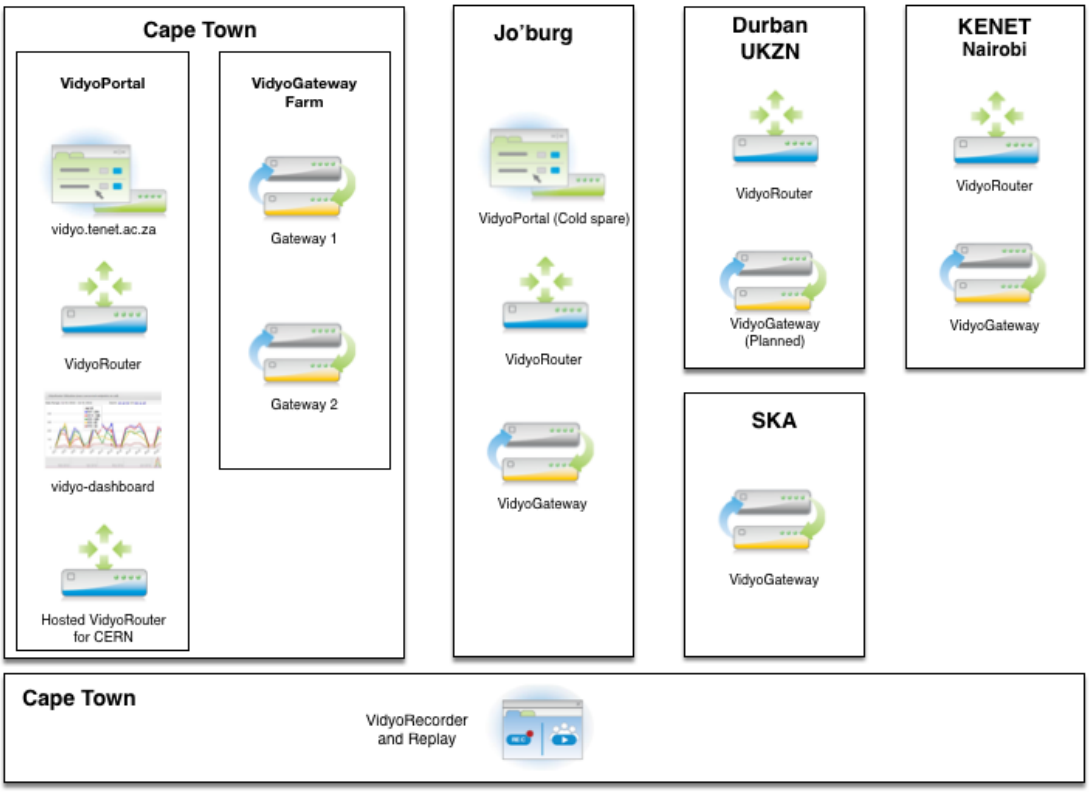
In addition to the deployment outlined above, TENET has worked with KENET, the Kenyan NREN organisation to setup a VidyoRouter and VidyoGateway on KENET's VM platform in

[5] Géant - *http://www.geant.org*
[6] SKA South Africa - *http://www.ska.ac.za*

Nairobi. This has enabled Kenyan users to make use of the Vidyo infrastructure (including TENET"s pool of licences) while keeping the video and audio traffic between endpoints within Kenya when speaking to other sites across the country.

These two examples demonstrate the way that the Vidyo infrastructure can be designed to enable best use of bandwidth and a hybrid type environment mixing external with internal capacity.

Figure: 2 This graphic shows the schematic for TENET's Vidyo platform:



The UbuntuNet Alliance and wider African NREN Connectivity Opportunity

With improvements in intra-African connectivity, NRENs in Africa are now able to start to look beyond their own networks and identify and exploit collaboration opportunities, as is illustrated by one of the major themes of this conference. The promise of AfricaConnect2 (AfricaConnect2 2015) is that the opportunities will increase for African NRENs to realise the benefit of Cloud and other shared service initiatives such as the one being proposed in this paper.

The offer

Given the existence of the TENET Vidyo infrastructure and the ability of that infrastructure to scale and support a distributed cloud based model of provisioning, along with the

improvements in intra-African network links, and the requirements that universities and researchers have for high quality video and audio collaboration tools, TENET would like to offer other African NRENs the opportunity to bring into play capabilities for videoconferencing in a cost-effective manner.

One possible model is that TENET will procure and manage the core Vidyo infrastructure and will supply support and training. NRENs wishing to benefit from this service will provide a suitable VM platform to enable provision of a VidyoRouter and, if needed, a VidyoGateway local to their network. TENET will connect these infrastructure components into its Vidyo "cloud" and will configure this set up to ensure that traffic from to and from users in a particular country stays in that country, while enabling collaboration across borders when that is required. Due to the flexible way in which Vidyo can be deployed, there is scope to add further components to the local setup, such as additional VidyoRouters, Gateways and even VidyoRecorders/Replays. Further elaborations of this core model can be made in due course as the service develops.

Benefits

For African NRENs the benefits of taking up this offer is that it will enable a cost effective improvement in the ability of their users to collaborate using high quality video, audio and content sharing, while having very few management or technical overheads beyond the provision and maintenance of a small VMWare setup.

The benefits for the users of the system will come from the access to high quality collaboration via video and the ability reach out beyond the walls of their institution to gain access to resources and expertise that is not available locally. To given an example from South African experience, the mathematics and statistics community in South Africa is exploring the use of TENET's Vidyo service to enable better collaboration between mathematics and statistics faculty across South Africa, which will include initially, opportunities for improving access to supervisors for students at Masters and Doctoral level and in time to develop a networked Masters programme with teaching being delivered from departments across the country and also from overseas.

Next steps

As was stated in the introduction to this paper, this is really a prospectus. TENET is very open to further discussions with interested parties to design a robust business model for a shared service for videoconferencing. Costs of bringing high quality videoconferencing to universities and research organisations across the continent are very modest, especially when placed against the maintenance costs of existing H.323 endpoints and MCUs.

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Biographies

Rob Bristow is currently working as a Visiting NREN Fellow at TENET (the South African NREN Operator). He is on a secondment from Jisc, the UK NREN organisation. He has an extensive background in the deployment and support of various sorts of videoconferencing platforms and has been responsible for research that explored the financial and environmental benefits of videoconferencing in for higher education and research. He currently lives in Cape Town, and is enjoying exploring as much of Africa as possible before his return to the United Kingdom at the end of next year

Geoff Hoy qualified as a zoologist and initially lectured at the University of Cape Town (UCT) , before changing careers and qualifying in electronics and working in electronics for a number of years. This naturally lead to an interest in computing and he then managed some of the networks before managing UCT's. In 1998 he moved to the UCT Libraries as deputy director so as to facilitate the libraries implementation of move to electronic resources. In 2006 he moved to TENET (Tertiary Education and Research Network of South Africa) where he is responsible for service management (acting), project management, & capacity development. He is now involved in the Rural Campus Connectivity Project Phase II, connecting rural campuses to the SANREN Network. He is excited and passionate at the potential that video conferencing has for teaching and learning and the time that can be saved instead of traveling.