CLOUD BASED MULTI-STATION DISTRIBUTION ARCHITECTURE FOR NETWORKED RADIO STATIONS

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ABSTRACT

The goal of the project was to build up a networked radio station architecture in a cloud environment. The main task was to interconnect and cascade virtual radio stations directly without separate distribution devices and interfaces. The use case for this was to allow utilization of central program feed on regional or affiliate stations with direct IP connectivity inside the cloud environment.

The results of the tests showed that the concept is feasible for networked broadcast production purposes. The Cloud-based installation offers clear benefits for radio network installations in the future.

The system offers not only the possibility of networked operation without any external codecs or controls. Cloud-based operation offers also media sharing directly from the same media asset management. The configuration can be made so that any station can act as a master to any stations in the network. This can be important for instance in sports and other activities.

INTRODUCTION

Networked radio stations possess one or more central hubs and several regional or affiliate stations. Typically, each station is a separate entity. Connectivity between the stations is done with separate distribution networks. The distribution networks are based on IP-based audio codecs or satellite feeds. The advent of cloud technology gives new possibilities to simplify the overall distribution radio network architecture and enables versatility and flexibility to the station network configurations.

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NETWORKED RADIO STATION

Networked radio stations have typically a network hub that is producing a main feed for the network. The network may have several sub-stations or affiliates that utilize the main programming as a part of their broadcast offering. The network feed may contain news, talk shows, and programs for the nights, etc. Typically, the network hub provides also ready-made programs that can be utilized on the affiliate or networked stations.

Typically, each of the sub-stations has its own separate and local radio automation systems. The program feed from the network hub is typically distributed to the sub-stations via satellite feed or codec connectivity.

Figure 1. Shows the target of this approach so that all the audio management is in the Cloud and all the stations can be controlled anywhere. The stations are networked so that the central hub can provide audio streams to the sub-stations for short or longer periods. The programming of the network can be done via browser-based user interfaces and the stations can share the audio material as they share the same database. The programming database supports multiple channels and program shares so that master channel programs do not need to be re-entered into the sub-station logs or daily schedules.

Feed from the cloud to the transmitter sites is via SRT streams so that they can tolerate some package losses in the network.

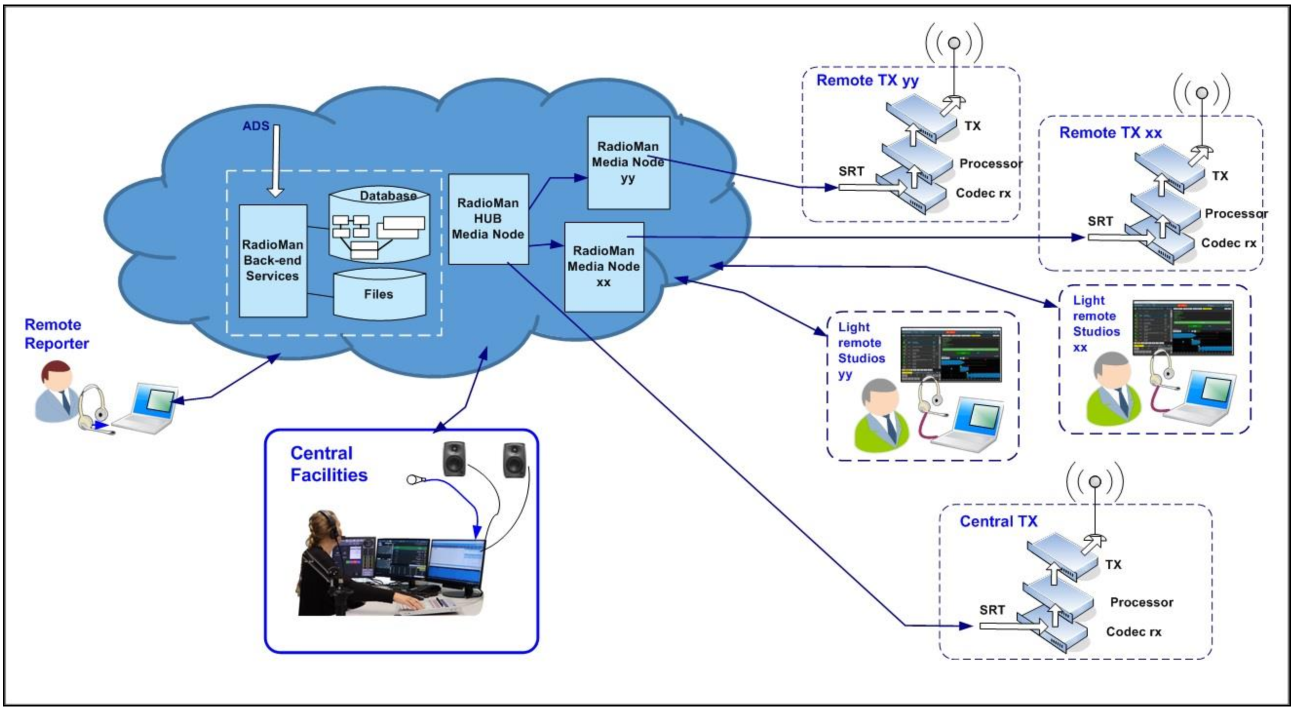

Figure 1 – Networked Radio Station in Cloud

CLOUD, IP CONNECTIVITY AND AUDIO DISTRIBUTION

Cloud environments like the AWS have certain benefits for the implementation of multiple radio/playout instances that need to be connected:

a) IP connectivity within the cloud is typically quite fast and does not suffer packet losses as much as the common Internet.

b) It is easy to manage, monitor, and control several instances in the cloud environment.

c) One can place all the instances in a single private subnet for security and reliability reasons

d) Cloud environments like AWS provide relatively stable clocks ‘Bhatia (1)’ for cloud instances and make synchronization needs lighter.

e) Cloud environment allows easy interfacing for web streaming and on-demand services.

IP AUDIO DISTRIBUTION AND DIFFERENT USE CASES

Networked IP audio is today based on the principles of AES67 ‘AES (2)’ and derivatives. In an audio recording studio environment, one needs to have a minimum delay to tolerate signals from multiple microphone lines coming from the same audio source. Clock errors may cause audio phase distortions in audio mixing. Another effect is the overrun or underrun of audio device buffers caused by clock drifts. This is why the AES67 and its derivatives need to use the PTPv2 clock synchronization.

Media distribution is completely changed by transmission over the public internet, which introduces delays, jitter, and packet loss. New standards and protocols have been introduced to cope with these needs by individual companies and organisations like SMPTE. One widely used low latency open-source streaming format is SRT ‘SRT (2)’, Secure Reliable Transport Protocol, by Haivision.

Radio broadcasters have used N/ACIP type of audio IP codecs for contribution and distribution purposes over common Internet for years. The difference to the AES67 world is that the open Internet has un-deterministic package delays and this causes a trade-off between delay and reliability. However, radio contribution and distribution use cases can tolerate much more delay than audio studio environments.

A networked radio station can tolerate moderate delays for contribution feeds. This has already been accomplished with WebRTC remote connectivity and explained in an earlier paper ‘Kivela (3)’. Moderate delays up to 200 ms can also be tolerated between the network hub and sub-stations. The delay from a station playout/audio mix to the transmitter is not critical and can be slightly larger.

ARCHITECTURE

The building blocks for this approach were RadioMan automation systems placed within the AWS cloud environment. The RadioMan virtual systems were already supporting virtual browser-based playout controls and WebRTC based audio contribution interfaces.

For Networked Radio Station operations, the RadioMan system needed added features:

- Ability to send the central audio feed to the substations
- The ability for the sub-station to receive the central feeds.
- Ability to control the routings via external messaging, with controls on the playlist items and also with manual controls on the On-Air screen.
- All the added features were made to the RadioMan Backend System and the RadioMan Media Node plugin architecture.

The actual playout units in RadioMan are called Media Nodes and they are versatile control and media processing units. The Media Nodes are based on a proprietary architecture called APAR and they can be placed in the Cloud or virtual or physical processing units. The plugin-based APAR architecture allows various digital tasks like audio playout, recording, transcoding, matrix controlling and other timed or live media operations. Figure 2. displays the Media Node architecture

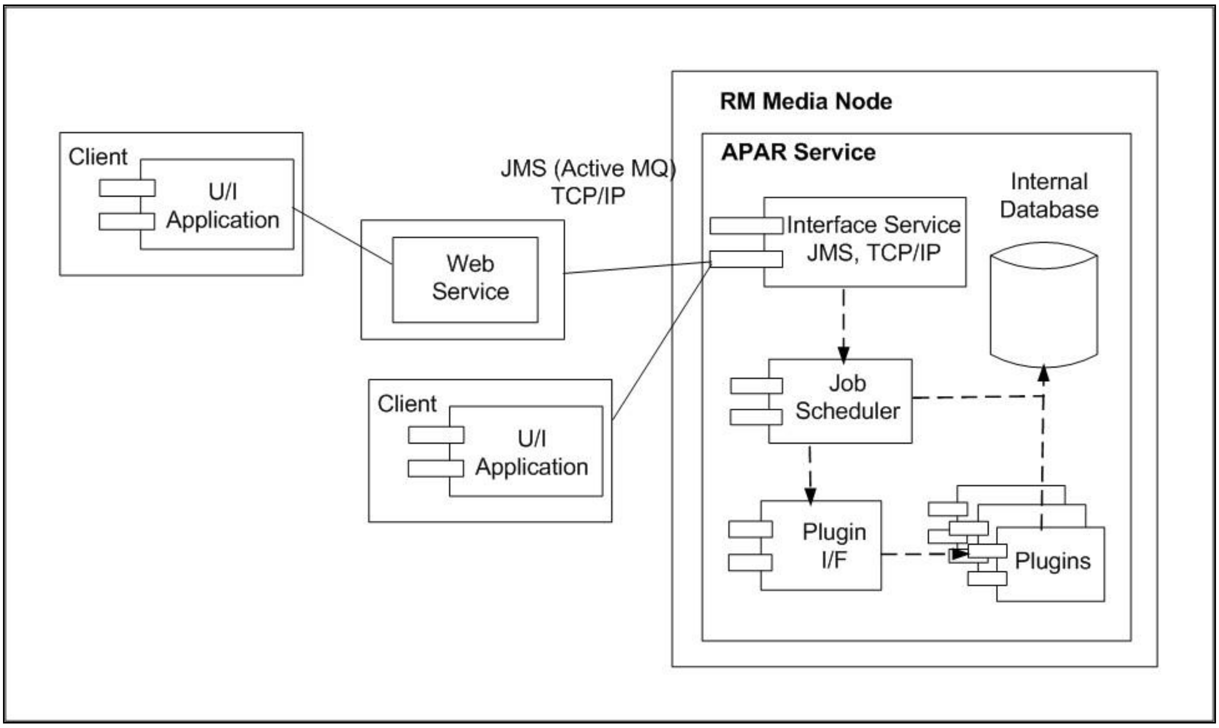

Figure 2 – The RM Media Node Architecture

The Audio Player plugin supports for instance following functions:

- Playlist instances
- CartWall instances
- Playing “Silent” playlist items (e.g. Script rows)
- WebRTC Streaming (OnAir Live)
- New for Networked Stations: Streaming Inputs (External Sources and Passthru)
- Streaming Outputs, New Feature: SRT support
- IP Audio with Virtual and physical Sound Cards
- Playout Reporting (playout history)
- Playout Level Reporting over ActiveMQ

Audio processing in the Media Node is done in loop mode that handles audio frames/packages. The incoming buffer for the substation is dependent on the package delays and delay jitter of the network. Another criterion for the buffer is to allow some level of possible clock drift that is then managed by sampling rate conversion adaptation in the receiving Media Node. The incoming stream can be WebRTC, RTP, or SRT. The audio processing is kept as light as possible in order to keep the processor loads and cloud costs low. The audio process is shown in Figure 3.

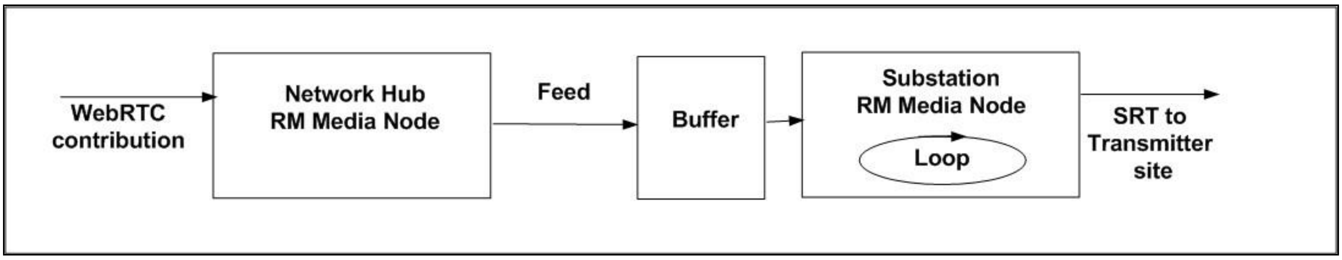

Figure 3 – Audio feeds in Networked Radio

The Output streaming from the Media node can be RTP stream, SRT, or Icecast. The Media Node supports also control of the audio source. Networked Radio Stations need also external control of the external feeds and these were added to the control architecture. The external feed control can be either on the playlist items (play audio files, news scripts, and external feeds), from Active MQ messaging, or from the user interface.

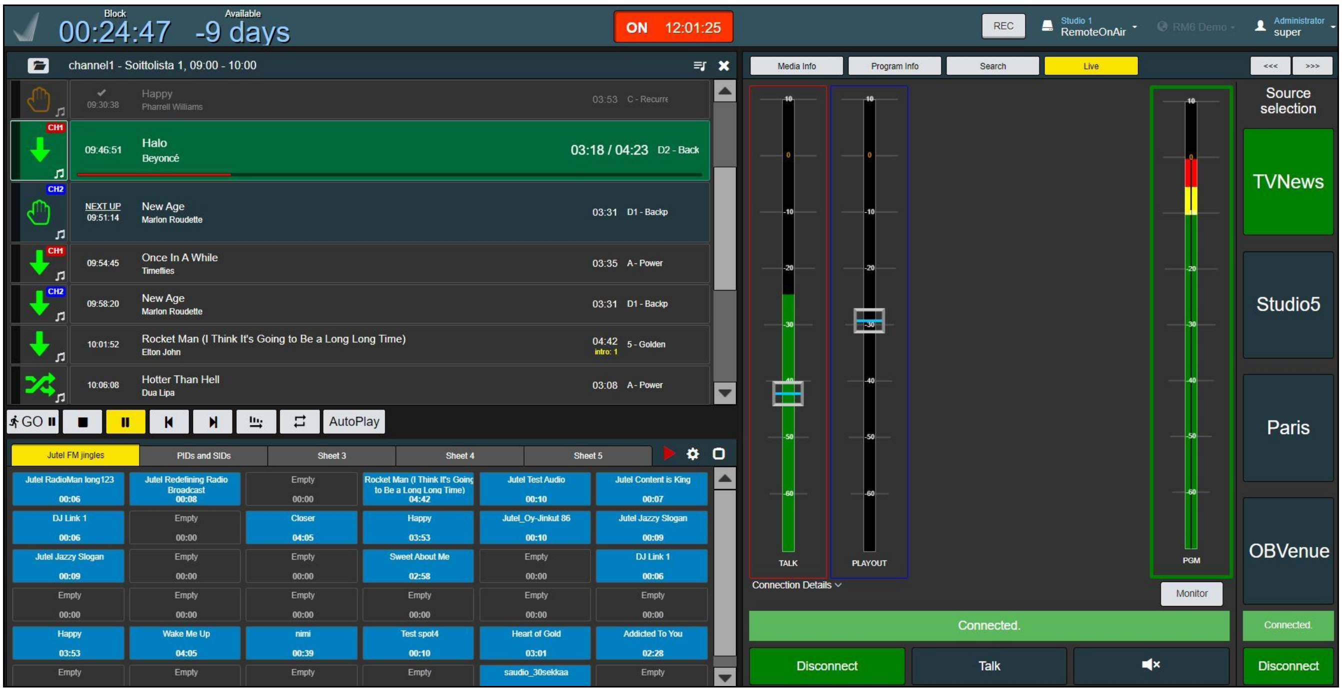

Figure 4 – External feed Source Selection controls on On-Air Screen

Figure 4 shows the browser-based ON-Air user interface with external feed controls. The same external feed selections can also be on playlist items on the playlist.

Figure 5 shows the External Source definitions on device control U/I of the system.

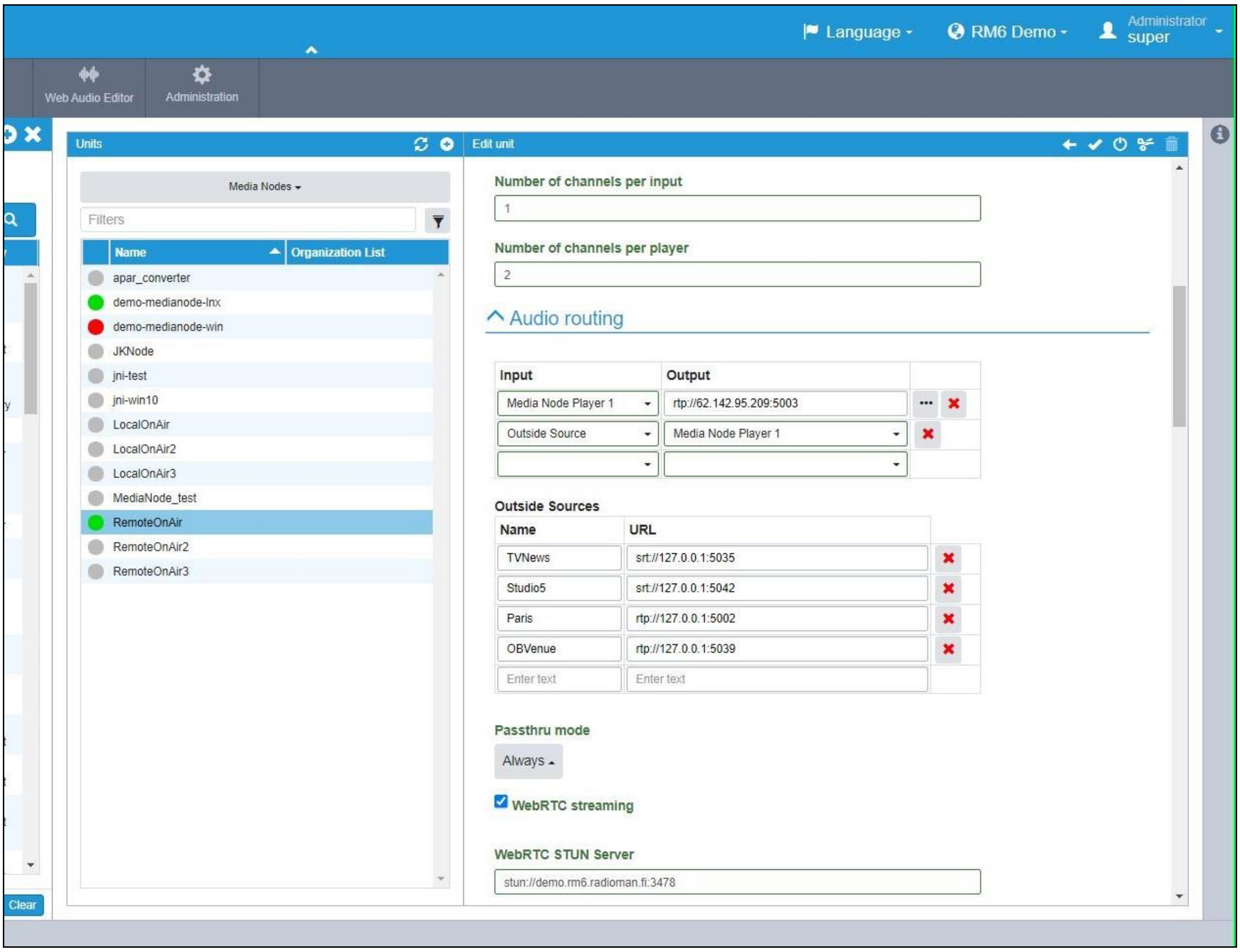

Figure 5 – Live Source Definitions

RESULTS

The system was built as an extension to the existing Cloud-based RadioMan installation. Tests on the connectivity between media nodes in a cloud environment showed that within a cloud one can utilize basic RTP streaming between the nodes without the need for special measures for packet losses.

The architecture has been used for various use cases in daily radio operations:

- Central station feed to the sub-station
- Localization of advertisement for sub-stations
- External news (TV News audio) feed integration to the broadcast schedule
- External contribution via WebRTC to the live show.

One part of the project was to ad SRT support to both the incoming and outgoing streams of the Media Node. Outgoing SRT stream is mostly used as a feed to a transmitter or satellite site. SRT streaming has also been tested between the central hub and the sub-stations but this is not necessary for an all-cloud environment.

SRT can be necessary for connections between stations in networked configurations if some of the stations are implemented with physical on-premise Media Nodes for large studio integrations. Physical Media Nodes can be on Windows or Linux boxes or virtual machines in virtual server environments.

One part of the system tests was done also with a third-party virtual multi-channel codec facility that was installed in the same sub-cloud as a container installation. This kind of installation can be used if the number of sub-stations or affiliates becomes large. These tests also proved the cross-compatibility of the SRT streams with a hardware-based SRT codec on the transmitter end.

One part of the study was the possibility of FM audio processing in the cloud. This was not yet implemented as virtual installation FM processors are still in an experimental phase and the overall cost of cloud-based processing may exceed the price of a hardware-based processor. The processing capacity needed for the processor is still quite high and thus the monthly running costs must be taken into account.

CONCLUSION

The results of the tests showed that the concept is feasible for networked broadcast production purposes. The cloud-based installation offers clear benefits for radio network installations in the future.

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