

HIGH QUALITY AUDIO RECORDING IN NOKIA LUMIA SMARTPHONES

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This white paper describes the Nokia Rich Recording technology and introduces the next evolutionary step in Nokia Rich Recording technology.

It also provides background of how Nokia Rich Recording has evolved from Nokia 808 PureView to Lumia 1020, and introduces the latest generation of the Nokia Rich Recording technology with its four microphone directional stereo recording capability in Lumia 1520.

BACKGROUND

Sound quality is an essential element in high-quality video recording. The Nokia 808 PureView camera phone, announced in 2012, introduced the most advanced audio recording solution for smartphones. With its Nokia Rich Recording technology, Nokia 808 PureView was not only noticed for its exceptional video quality, but the sound captured in the videos was something more than people would have expected to hear from a smartphone. The sound was captured in high-quality stereo with full audio bandwidth, but what really set Nokia Rich Recording apart from the rest was its capability to record even the loudest live music concerts without audible distortion.

The feedback from Nokia Rich Recording was by far great. Suddenly there was a smartphone capable of capturing the sound with a quality that even got the sound professionals excited about the possibilities a smartphone can offer.

Rich Recording technology

Nokia Rich Recording technology was made possible by developing an entirely new digital microphone technology to handle high sound pressure levels. The new microphone technology was called High Amplitude Audio Capture (HAAC) microphone and it was able to handle more than six times the sound pressure level compared to conventional smartphone microphone technologies. However, achieving high recording quality required much more than just a microphone. Nokia's long history in voice and multimedia audio digital signal processing made it possible to develop sophisticated signal

processing methods running in 32-bit arithmetics for high-quality microphone signal conditioning. The result was a truly exceptional specification for a smartphone: Omni-directional stereo recording, ca. 20Hz-20kHz bandwidth covering the hearing range and ability to handle up to 140dB sound pressure levels without audible distortion.

Second generation

Later, the HAAC microphone technology was made available for selected Lumia devices delivering distortion-free audio recording capability, but it was not until Lumia 1020 when the full featured Nokia Rich Recording was introduced to Lumia smartphones with the Nokia Pro Camera application.

In Lumia 1020, based on the feedback from Nokia 808 PureView, the audio bass management filter setting was exposed to users for controlling the low frequency cut-off in the recording. This setting allowed more advanced users to optimize the audio recording quality for different recording conditions.

Next challenge

Rich Recording was a revolution in the smartphone audio recording capabilities as it provided audio quality available before only in dedicated audio and video recording devices. In addition to significant quality improvements overall, Rich Recording provided a solution for recording loud sounds and events with smartphones in a good audio quality; something that had been a challenge for a long time.

The success from Nokia 808 PureView and Lumia 1020 challenged us in the Nokia Lumia audio team to further improve the audio recording quality and capture the moments even better. This led us to the new development path towards directional recording.

DIRECTIONAL RECORDING

Microphone's directivity also known as polar pattern indicates how sensitive a microphone is to sounds coming from different directions. A microphone is called "Omni-directional" when it picks the sound equally well from all directions around the microphone. When a microphone is more sensitive to sounds coming from one direction than others it is called as "Directional" microphone.

Directional recording microphones are often preferred in demanding professional and video production applications for their ability to record the subjects clearly and accurately in presence of distracting sounds and ambient noise.

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Both Nokia 808 Pureview and Lumia 1020 capture the sound in omni-directional fashion. While the sound quality does not leave much to complain about, the sound is picked equally from all directions limiting the capabilities to emphasize the preferred subject in presence of distracting ambient sounds.

Capture what you see

While the directional microphones are mainly used for professional applications, they also bring clear benefits for smartphones. People capture moments everywhere, like family events at home, friends at the coffee place, concerts in the park and skate-boarding tricks on the street. The places and subjects vary, but one thing is common - people want to capture what they see and hear.

Four microphones

The microphone components used in Nokia Rich Recording devices are inherently omni-directional. That is, each component picks the sound equally from all directions without the ability to focus in the direction of video capture.

In Lumia 1520, a different approach was taken. We included four second generation, omni-directional, low-noise HAAC microphones to form two identical microphone pairs, one for each audio channel. The signals from each microphone pair are then processed with Nokia capture processing algorithms in 32-bit

arithmetics. The processing, combined with suitable acoustics implementation of the microphone pairs, outputs a directional, cardioid type, stereo recording pattern.

With the unique combination of Rich Recording and four microphones, Lumia 1520 is capable of recording sounds in front of the camera, while attenuating the sounds from other directions. The sensitivity difference between the sounds in the front of the camera compared to the sounds in back of the camera can be up to 10dB in free-field conditions. In other words, the sounds in front of the camera can be recorded even twice as loud compared to the sounds in the back.

Benefits

Lumia 1520 audio recording solution provides several benefits

- Improved sound clarity for the subjects in front of the camera.
- Improved accuracy and resolution of the stereo image.
- Improved localization of the sounds around the camera resulting in greater sense of depth and immersiveness.
- Reduced "room effect" in echoic spaces.
- Distortion-free, full bandwidth stereo recording.

Best of both worlds

Microphones with different polar patterns do not compete. For some applications it is more beneficial to capture sound equally from all directions, while in some applications it is an advantage to attenuate sound from certain directions and focus more in one direction.

In Nokia Camera application, we have taken this into account and included an option to switch between omni-directional and directional recording in video settings. With the default option of directional recording you can just point and shoot and feel confident that what you see and hear gets recorded in the best possible way.

UNIQUE COMBINATION

In Lumia 1520, the same four high-performance microphones that are used for capturing high-quality video recordings are also used for advanced microphone noise reduction of your standard and wide-band audio calls. Combined with intelligent Nokia voice processing the call experience will be both robust and enjoyable.

One can say that the Nokia Lumia 1520 smartphone delivers a unique combination of the latest audio technologies in multimedia audio recording and high-quality voice. Nokia Rich Recording with four microphones is again one step closer to a perfect recording.

CREDITS

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DIRECTIONAL RECORDING CONCEPT

