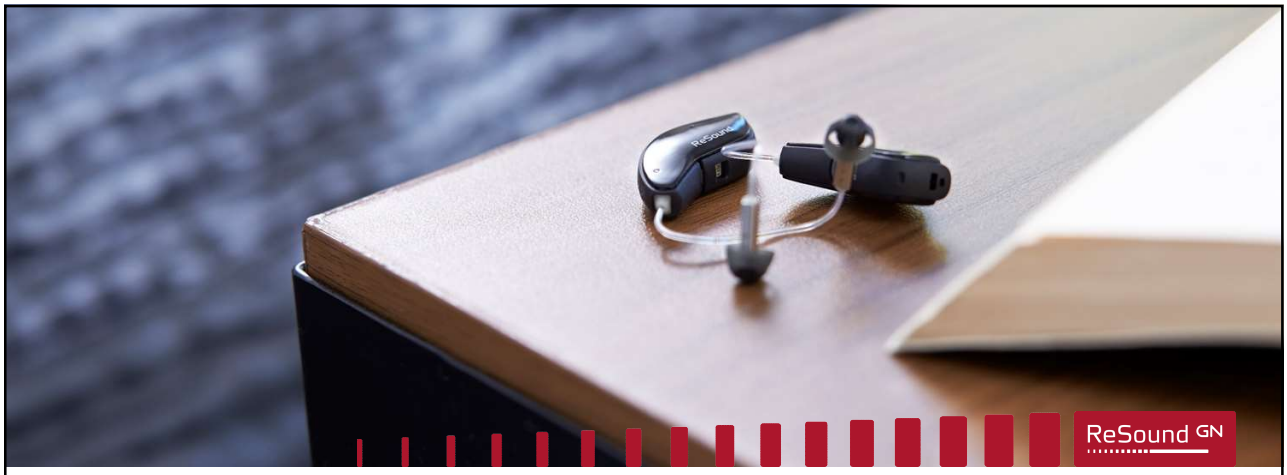

Wireless Primer: What are the Technologies and Benefits?

John A. Nelson, PhD

Vice President, Global Audiology Relations

Financial disclosure

John A. Nelson is employed as the Vice President of Global Audiology Relations at GN ReSound and has financial relationships in the products and services communicated, compared and evaluated in this presentation.

Learner objectives

As a result of this Continuing Education Activity, participants will be able to:

1. **Describe the differences between wireless technologies used with hearing instruments**
2. **Describe the benefits of wireless accessories in at least two communication situations**
3. **List the benefits direct communication with SMART devices in at least two situations**

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Overview of Wireless Technology

Near Field Magnetic Induction

FM Radio Transmission (2.4GHz, 900MHz, 866MHz)

Bluetooth & Bluetooth Smart Languages

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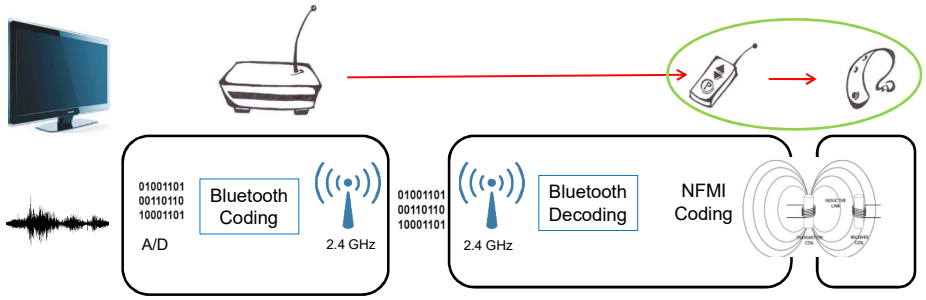
Near Field Magnetic Induction (NFMI)



Bluetooth radio frequency is used for communication between an accessory and a "Gateway device" and NFMI transmission is used from the "Gateway device" to the hearing instruments.

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Wireless systems based on Near Field Magnetic Induction

Advantages

Ease of implementation due to existing Radio Frequency (RF) chips

Longer battery life due to low current drain on hearing instruments

Transmit through almost everything

Drawbacks

Short transmission distance (1 meter)

Need to wear "Gateway device" around the neck

Sound quality can be affected by orientation of the gateway device and HA receiver coil and any delay introduced by relay between components

May encounter interference with magnetic sources

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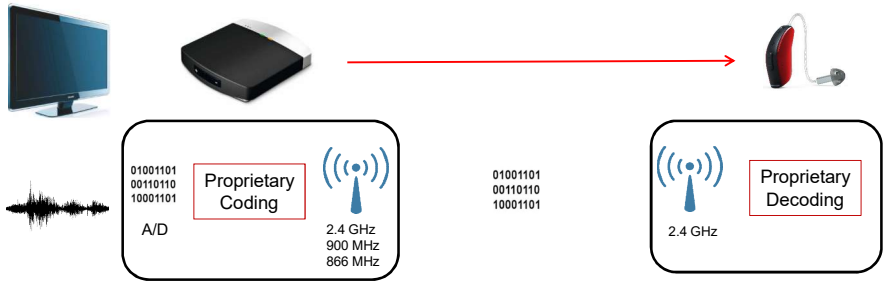
Proprietary Radio Frequency Systems



Proprietary radio frequency: 900 & 868 MHz

Advantages

- **Does not require a "Gateway device"**
- **Long distance signal transmission**
- **Relatively low power consumption (approx 5mA)**
- **Low latency (processing delay) from source to listener**
- **No echo problems and no lip synchronization issues when watching TV**

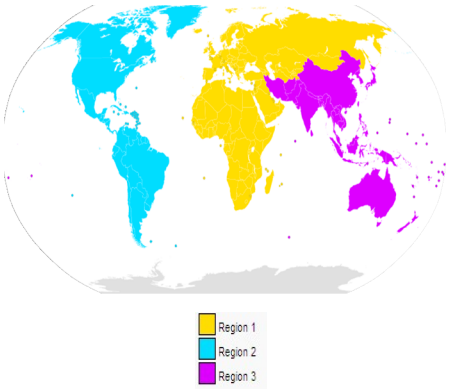
Drawbacks

- **Requires a specially designed antenna**
- **Requires a streaming device for Bluetooth audio**
- **Power is from the hearing aid battery**
- **900 MHz ISM band is limited to use in certain areas including US, Greenland, and some eastern Pacific Islands**
- **868 MHz ISM band is limited to use in EU.**
- **Japan isn't covered**

ISM Bandwidths

Regulatory Group:
International Telecommunications Union for radio communication

Frequency range [Hz]	Center frequency [Hz]	Availability
6.765–6.795 MHz	6.780 MHz	Subject to local acceptance
13.553–13.567 MHz	13.560 MHz	
26.957–27.283 MHz	27.120 MHz	
40.66–40.70 MHz	40.68 MHz	
433.05–434.79 MHz	433.92 MHz	
902–928 MHz	915 MHz	Region 2 only
2.400–2.500 GHz	2.450 GHz	
5.725–5.875 GHz	5.800 GHz	
24–24.25 GHz	24.125 GHz	
61–61.5 GHz	61.25 GHz	Subject to local acceptance
122–123 GHz	122.5 GHz	Subject to local acceptance
244–246 GHz	245 GHz	Subject to local acceptance



Proprietary radio frequency: 2.4 GHz

Advantages

Does not require a 'Gateway Device'

Long distance signal transmission

Robust and reliable connections (small information packages and spread-spectrum frequency hopping which minimizes interference)

High transmitted data capacity: bandwidth, stereo, low distortion

Low latency (delay) so no echo problems and no lip synchronization

World wide applicable

Drawbacks

Requires a specially designed antenna

Requires a streaming device for Bluetooth audio

Power is from the hearing aid battery

Bluetooth & Bluetooth Smart

Latency for Bluetooth protocol exceeds 40ms and is often up to 125ms depending on the audio compression technique used

Combinations of the streamed sound with amplified sound or direct sound of this magnitude are perceptible as echoes and even lip synch issues when watching television

Even small delays, though not consciously perceived, will cause a mismatch between audio and visual signals has a significant negative impact on the television viewing experience (Reeves & Voelker, 1993)

Bluetooth Smart eliminated the 'audio' channel to allow for fast and efficient transmission of data

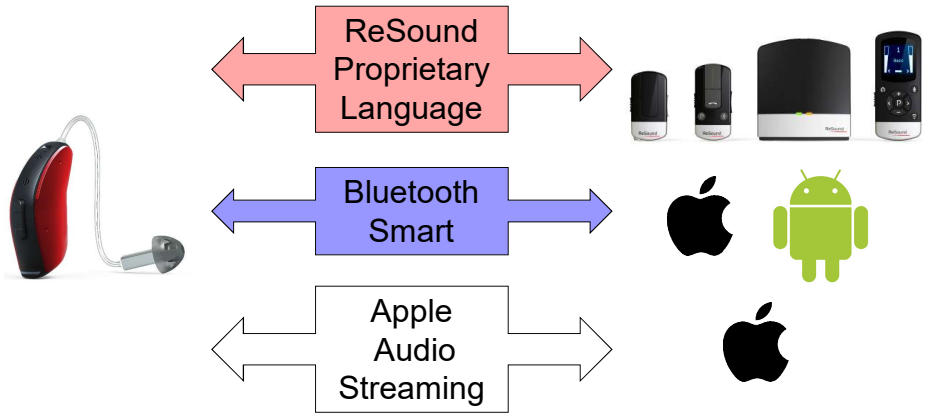
Bluetooth® SMART

The 2.4GHz Wireless Revolution

Apple collaborating with hearing aid industry to connect devices directly

2.4 GHz technology is the only way to connect for real benefits

Some 2.4GHz Languages



The Wireless Introduction: The First Generation

2.4 GHz wireless telephones: A technology breakthrough

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Mobile telephones: It was soo big

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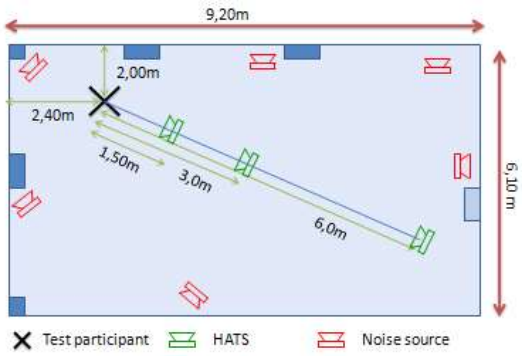
Smart telephones: How did we live without them?

One system: The solution to all situations

Real Benefits: Personal Microphone

ReSound GN

Personal Mic Study: Test Setup



Methods: Test setup
HATS with an artificial mouth
Dantale II test sentences

HATS was placed in front of the test participant representing a hearing instrument user.

Mini Microphone was around the neck of HATS.

HATS was placed at 3 positions: 1.5, 3.0 and 6.0 meters

A diffuse noise field was generated by 6 identical loudspeakers.

The test environment was a carpeted room with a sound treated ceiling

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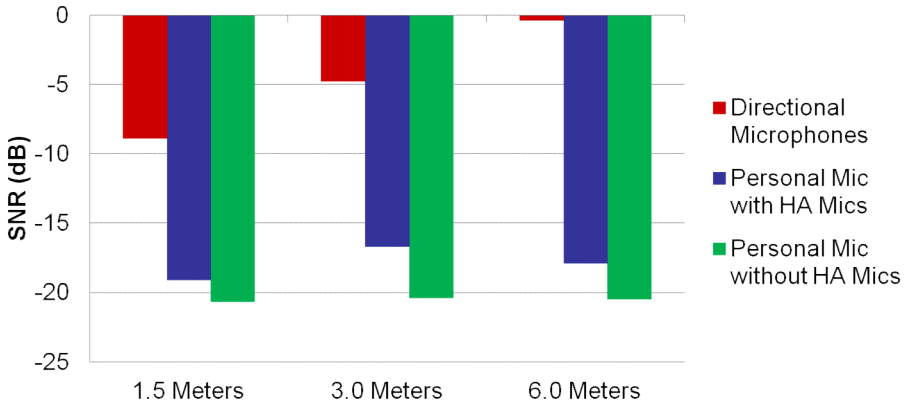
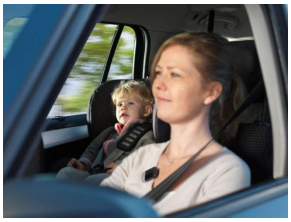
Wireless Personal Microphone: Increasing the SNR



Where Can a Personal Microphpone be Used?



Real Benefits: Asymmetric Personal Mic

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Personal Mic: Asymmetric Use

Quantitative enhancement of speech in noise through a wireless equipped hearing aid.

(Ciorba A, Zattara S, Loroni G, & Prosser S. *Acta Otorhinolaryngol Ital*, 2014:34(1):50–53)

SNR benefit for wireless streaming with different test conditions using 2.4 GHz wireless devices

Devices were programmed with 16 dB flat gain, omnidirectional response and with noise reduction off

Speech signal from the front speaker and split to the streamer

Party and traffic noise presented through 4 surround speakers placed at the sides/back of the test subjects

Nine normal-hearing subjects participated in the study.

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Personal Mic: Asymmetric Setup

Unaided

Aided Conditions

1. Hearing Aid Mic ON / Personal Mic OFF (bilateral)
2. Hearing Aid Mic OFF / Personal Mic ON (bilateral)
3. Hearing Aid Mic ON / Personal Mic ON (bilateral
4. Asymmetric: Hearing Aid Mic OFF & Personal Mic ON | Hearing Aid Mic ON & Personal Mic OFF

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Personal Mic: Asymmetric Use

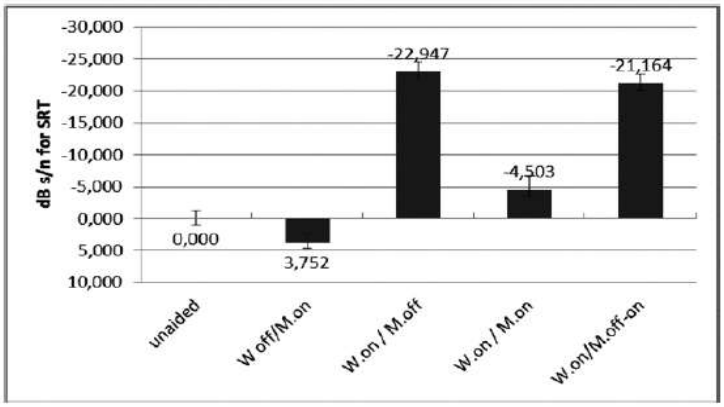

Fig. 1. Mean s/n ratios for SRT (50% correct responses) obtained in the different hearing aid settings. Vertical bars represent standard deviation.
W: wireless; M: hearing aid microphone.

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Real Benefits: Unilateral Hearing Losses

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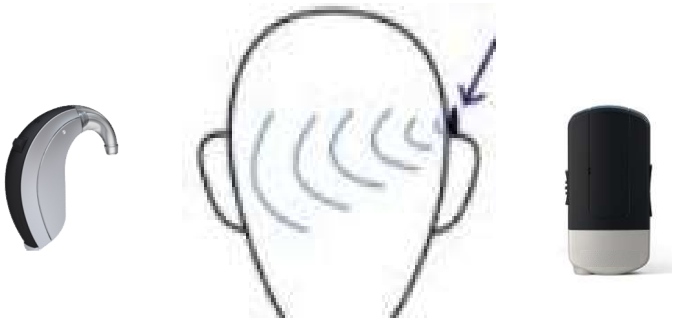
CROS with Personal Mic



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Real Benefits: Telephone & 2.4 GHz Accessory

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Listening Conditions

Acoustic Coupling

Telecoil Coupling

2.4 Connection

GN Making Life Sound Better

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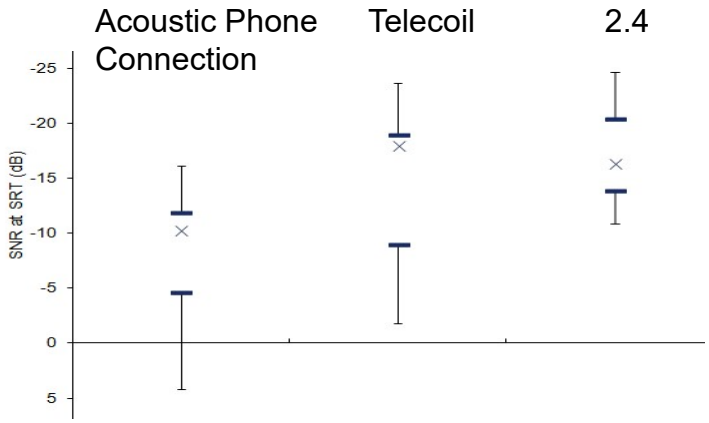
Results: Average SRT scores



X is the median with 95% confidence intervals, horizontal bars mark the interquartile ranges, error bars represent the maximum and minimum scores for each condition.

Real Benefits: Audio & Video Information

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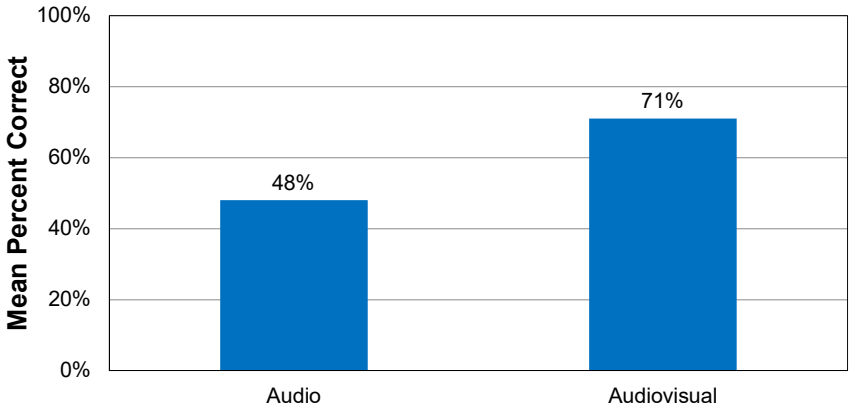
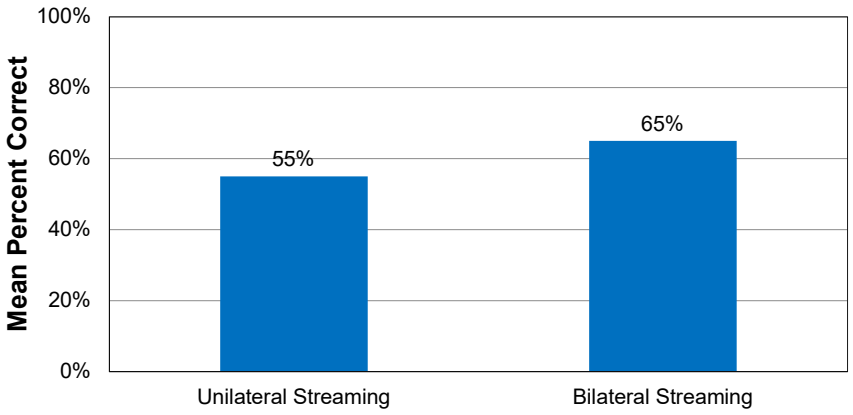
Test Conditions

	Unilateral Streaming	Bilateral Streaming
Audio Only		
Audio & Visual		

Benefit: Audio and visual information



Benefit: Bilateral streaming



Facetime: Speech Reading Opportunities

Real Benefits:
Audio streaming for tinnitus

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Tinnitus & Streaming

Multi Mic, Micro Mic, and MFi allows wirelessly streaming unlimited sound signals

User choice of sound signals that are most beneficial and therapeutic for them

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Real Benefits: Lost Hearing Aid

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Broadmead hearing clinic Oak Bay hearing clinic

HEARING CARE

- Home
- What is an Audiologist
- Tinnitus Retraining Therapy
- Dr. Wright's Blog
- 'How To' Information
- Custom Ear Plugs
- Healthy Hearing Expo
- House Calls
- Testimonials
- Contact Us
- Request an Appointment
- Our Locations
- Upcoming Events

PHONE NUMBERS

Call today for your free in-office demonstration.

The Tale of the Lost Hearing Aid

June 1, 2015 -- Erin Wright

Tom Croft is an Oak Bay City Councillor who got his hearing aids from Oak Bay Hearing Clinic for the first time last month.

He loves them and never misses a day using them. However, one sunny Saturday in Victoria Tom was with his 3 year old granddaughter, who he had lifted onto his shoulders to take her home from an afternoon of playing in the local school playground. When he got home, he realized his hearing aid was missing.

Tom quickly grabbed his iPhone and opened up the Resound Smart App and was able to locate the exact location of his hearing aid. The GPS on the phone told Tom that the hearing aid was in the school playground. This was great, but Tom feared hours of looking through the grass of the large playground. When he got there, the finder bars on the app lead him directly to the exact location of the hearing aid.

Now if only I could have one of these for my socks.

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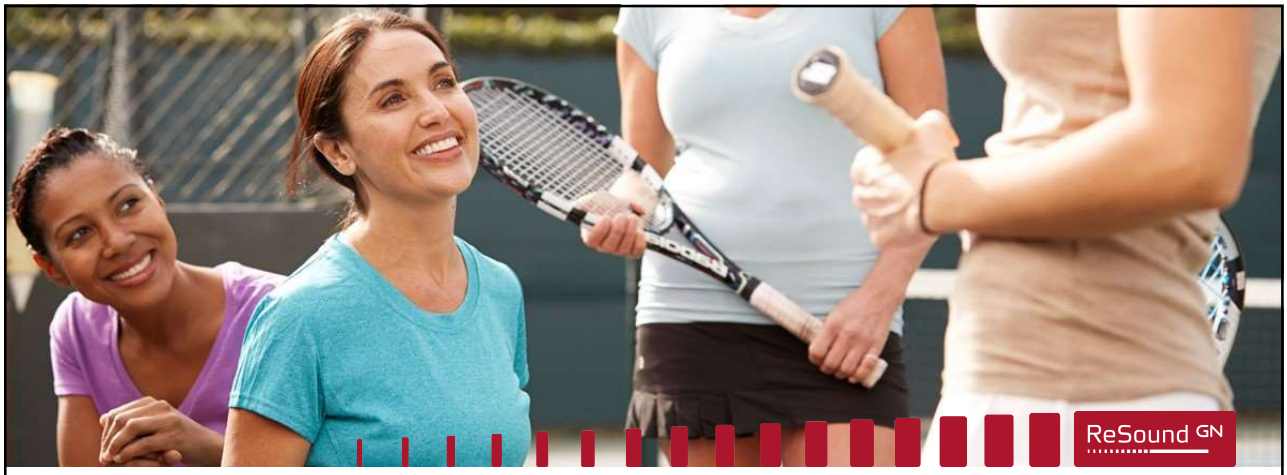

A personalized hearing experience

End-user app portfolio

Enhances the user experience of the hearing aids

Empower users to take control and personalize their hearing experience

Complete hearing aid portfolio connected to apps

ReSound Smart App

Download on the App Store

ANDROID APP ON Google play

Direct control with Android™

GN Making Life Sound Better

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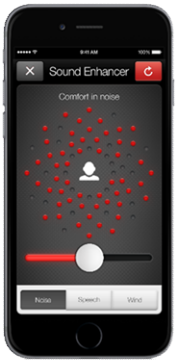
Smart App: Hearing aid personalization



Comfort in noise

Speech focus

Comfort in wind

GN Making Life Sound Better

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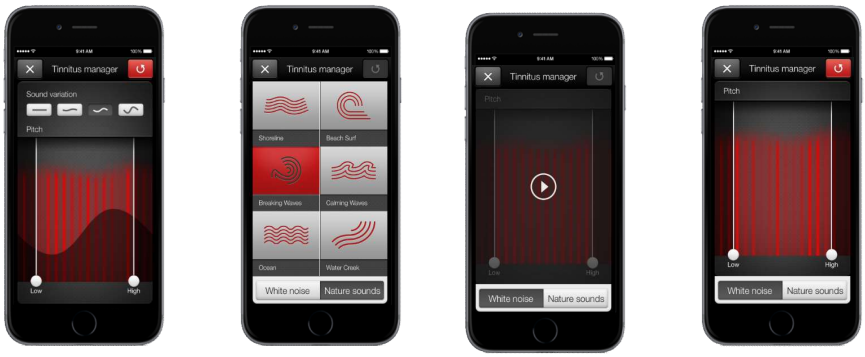
Smart App: Tinnitus Features



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Stream sound in rich stereo quality

Proprietary Audio Streaming

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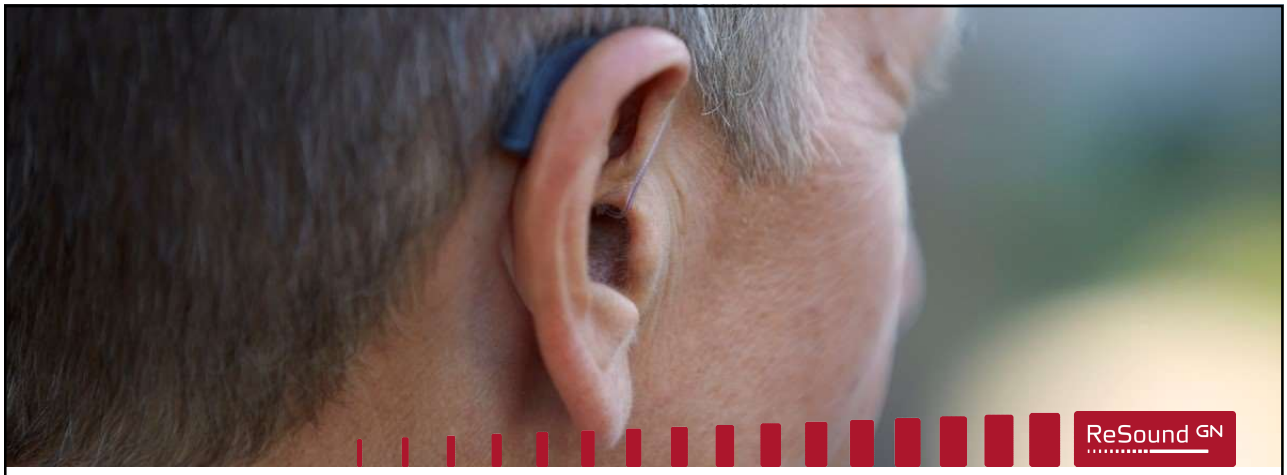

Thank you.