Wireless Primer: What are the Technologies and Benefits?

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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

Overview of Wireless Technology

Near Field Magnetic Induction

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

Bluetooth & Bluetooth Smart Languages
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.

### 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
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 | 6.790 MHz | Subject to local acceptance
26.957–27.203 MHz | 27.126 MHz | 27.130 MHz
40.66–40.70 MHz | 40.68 MHz | 40.681 MHz
432.05–434.79 MHz | 433.92 MHz | 433.92 MHz
902–928 MHz | 915 MHz | Region 2 only
2.400–2.483 GHz | 2.450 GHz | 2.450 GHz
5.725–6.875 GHz | 5.800 GHz | 5.800 GHz
61–61.5 GHz | 61.25 GHz | Subject to local acceptance
122–123 GHz | 122.5 GHz | Subject to local acceptance
244–245 GHz | 245 GHz | Subject to local acceptance

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**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 sync 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.

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

- ReSound Proprietary Language
- Bluetooth Smart
- Apple Audio Streaming

The Wireless Introduction: The First Generation

[Images of early wireless devices]
2.4 GHz wireless telephones: A technology breakthrough

Mobile telephones: It was soo big
Smart telephones: How did we live without them?

One system: The solution to all situations
Real Benefits: Personal Microphone

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
Wireless Personal Microphone: Increasing the SNR

Where Can a Personal Microphone be Used?
Real Benefits: Asymmetric Personal Mic

Personal Mic: Asymmetric Use

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

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.
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

Personal Mic: Asymmetric Use

Fig. 1. Mean signal-to-noise ratio for SRT (50% correct responses) obtained in the different hearing aid settings. Vertical bars represent standard deviation. W: wireless; M: hearing aid microphone.
Real Benefits: Unilateral Hearing Losses

CROS with Personal Mic
Real Benefits: Telephone & 2.4 GHz Accessory

Listening Conditions

- Acoustic Coupling
- Telecoil Coupling
- 2.4 Connection
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
Test Conditions

Unilateral Streaming

Bilateral Streaming

Audio Only

Audio & Visual

Benefit: Audio and visual information

Mean Percent Correct

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<thead>
<tr>
<th></th>
<th>Audio</th>
<th>Audiovisual</th>
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<td>48%</td>
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<td>71%</td>
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Audio

Audiovisual
Benefit: Bilateral streaming

Facetime: Speech Reading Opportunities
Real Benefits: Audio streaming for tinnitus

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
Real Benefits: Lost Hearing Aid

The Tale of the Lost Hearing Aid

June 1, 2015 — Enroute

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 led him directly to the exact location of the hearing aid.

Now I only could have one of these for my backs.
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

Smart App: Hearing aid personalization

Comfort in noise
Speech focus
Comfort in wind
Smart App: Tinnitus Features

[Images of smartphones and a smartwatch with various applications open, showing features for managing tinnitus.]
Stream sound in rich stereo quality

Proprietary Audio Streaming
Thank you.