If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

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Hearing Aid Technology - Industry Roundtable

Moderator: Catherine Palmer, PhD
University of Pittsburgh

- Technical Assistance: 800-753-2160
- CEU Total Access members can earn credit for this course
  - Must complete outcome measure with passing score (within 7 days for live webinar; within 30 days of registration for recorded/text/podcast formats)
- Questions? Call 800-753-2160 or use Contact link on AudiologyOnline.com
### Hearing Aid Month

- Advances in Implantable Amplification Devices (#24716)
  Brad A. Stach, PhD

- Hearing Aid Solutions for the Speech-in-Noise Problem (#24702)
  Joshua M. Alexander, PhD

- Vanderbilt Audiology’s Journal Club (#24207)
  Todd A. Ricketts, PhD

- An Evidence-Based Approach to Reporting Hearing Aid Benefit (#24714)
  Ron Leavitt, AuD

- Hearing Aid Technology Industry Roundtable (#24717)
  moderated by Catherine Palmer, PhD

---

![Audiology Online](image-url)
Tinnitus Solutions

UNIQUENESS OF WIDEX ZEN THERAPY

- Patented choice of fractal music (Zen) as stimulus
  - Relaxation properties of music
  - Semi-random for maximum effectiveness
- Structured WZT rehabilitation program
  - Holistic approach
- Over 5 years of proven effectiveness
Tinnitus Solutions

ZEN STIMULUS OPTIONS

- Zen is in most Widex hearing aid models (combination unit)
- 5 Zen tones – difference in pitch, tempo, dynamic range
- Zen noise (white noise)
- Zen noise-shaped (configurable narrow band noise)
- Adjustment of pitch, tempo and loudness
- Sleep timer
- Flexible Combinations:
  - One to five Zen programs
  - With or without amplification
  - Zen alone
  - Broadband Noise alone
  - Zen Noise Shaped alone
  - Noise plus Zen

WIDEX ZEN THERAPY MATERIALS

Counseling, Relaxation, Sleep

- Comprehensive Manual
- Checklist for patient chart
- Counseling Flipbook
- Information materials for patient
- Counseling DVDs
- Relaxation CDs
- Cognitive Behavioral Intervention
  - Flipbook
  - Take home worksheets
- Pre/Post Verification materials
Tinnitus Solutions

EVIDENCE ON ZEN EFFECTIVENESS

- Kuk and Peeters (HR, 2008) showed Zen tones relaxed patients
- Sweetow and Henderson-Sabes (JAAA 2010) showed significant tinnitus reduction on THI
- Kuk et al (HR 2010) reported tinnitus reduction in all survey respondents
- Herzfeld, M. (HR, 2011). Showed a very high (over 90%) success rate using Zen as a sound therapy tool
- Sekiya et al. (AO, 2013). Shows fractal music as effective in TRT treatment
- Boboshko et al. (Russian ENT magazine, 2014): Zen decreased the burden of tinnitus in 90% of the cases.
- Herzfeld (HR 2014 Nov) High success rate of using the WZT protocol
- And at least 5 on-going studies

Latest!!!
Herzfeld et al (2014, Nov Hear Rev)

- Thirty subjects with at least one year history of tinnitus
- Followed WZT protocol
- Seen at 2, 4 (optional), 6 months post fitting
- Evaluated on TFI and THI
- Highly effective on >80% on subjects
Cochrane Systematic Review (Hobson et al, 2010)

- Six trials (553 participants) were included in this review
- When compared to other interventions, sound therapy was found to be equally effective in reducing the loudness of tinnitus or the overall severity of tinnitus
  - (patient education, 'relaxation techniques', 'tinnitus coping strategies', counseling, 'tinnitus retraining' and exposure to environmental sounds)

Basheikh (2012)

- Critical Review: Does the evidence indicate which therapy is more effective in the reduction of tinnitus-related distress?
  - Limited evidence was available to support one specific therapy over another
  - The benefits of combined approaches incorporating both sound therapy and counseling are apparent
What’s sound therapy?

• The use of any sound for the purpose of tinnitus management
  • widely accepted as one treatment for tinnitus
• Sound therapy may be provided by hearing aids, noise generators (or “tinnitus maskers”), or combination instruments that provide both amplification and generate a sound stimulus
Tinnitus Solutions

Starkey Hearing Technologies

• Product Highlights
  – Amplification
  – Sound Therapy
  – Personalization
  – Education
  – *Proven Results*

Multiflex Tinnitus Technology

• Amplification
  – Up to 70-dB gain receivers
  – 12 Bands for Frequency Response Shaping
  – Independent Speech Optimization
  – Invision Directionality
  – Voice iQ²
  – Spectral iQ
  – Hydroshield²
Tinnitus Solutions

Multiflex Tinnitus Technology

• Sound Therapy
• Novel, complex, stimulus
  – White noise shapeable via 16 independent bands
  – Amplitude and frequency modulation with adjustable modulation rates
  – Audiogram-dependent “Best Fit” of the sound therapy stimulus

Tinnitus Solutions

Multiflex Tinnitus Technology

• Personalization
  – Customizable on a per-memory basis
  – SoundPoint Tinnitus allows for patient-driven customization of the Multiflex Tinnitus stimulus
Tinnitus Solutions

Multiflex Tinnitus Technology

• Education
  – StarkeyPro.com
  – TinnitusHearing.com
  – Audiology Online
  – Tinnitus Handbook

Tinnitus Solutions

Multiflex Tinnitus Technology

• Technical Papers at Starkey Evidence
Tinnitus Solutions

Multiflex Tinnitus Technology

• Proven Results
  – 2 Internal Studies
  – 5 External Beta Sites
  – 1 Independent Research Facility

MULTIFLEX TINNITUS TECHNOLOGY

Coming Soon in WIRELESS!
But did you know…

Halo can also be a tinnitus therapy device

Select your favorite sound generator app…

1. White Noise
2. Nature Sounds
3. Filtered Noise or Music
But did you also know…

Any wireless product can be a tinnitus therapy device when paired with SurfLink Mobile and used with your smartphone…

Tinnitus control feature

Custom-tailored sound therapy
- Programmable option in BTE, RIC, and custom instruments
- Choice between hearing instrument or therapy signal, or both at the same time
- Wearers can adjust volume in accordance to their individual preferences
## Tinnitus Therapy Signals

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### Accessories

- Miniature housing
- Weighs less than 2 ounces
- True stereo streaming
- Rechargeable battery
- Additional connectivity to:
  - FM
  - Induction loop systems
  - Other Bluetooth-enabled devices
  - Line-in (iPod, mP3 player, etc.)
Tinnitus Wrap-Up
Directional Microphone Technology

Walter Reed Directionality Studies:

Directionality helpful? Yes, please
Directionality not helpful? Omni, please

When is Directionality useful?
• Speech in front, nearby
• Noise present, back & sides
• Reverberation not excessive
Directional Microphone Technology

Clean Speech

Busy Room Noise

Which one provides the better S/N?

Directional Microphone Technology

Percentage of Total Time

- Full
- Split
- Surround

<40 | 40-50 | 50-60 | 60-70 | 70-80 | >80

CONTINUED
Directional Microphone Technology

What is binaural hearing advantage?

- Listening with two ears

- Main advantage is to:
  - **Exploit** the location of the better placed ear
  - **Extract** information from the differences between the signals

Binaural hearing aid processing: Directionality

By having two ears, humans as well as all mammals, are able to **use binaural directionality to concentrate** on the effective source right in front of the listener while subconsciously **blocking out** irrelevant noise signals around them.

By using two ears, the human auditory system is **optimized for effective sources from the front** (Hawley et al., 1999).
Binaural hearing aid processing: Directionality

With a bilateral fitting, the directional microphones of both hearing aids are designed in order to provide directionality (fixed or adaptively) towards the front.

Phonak UltraZoom
(2) Microphone directional system (monoaural dir)
Adaptive null noise cancellation system

Directional Microphone Technology

Binaural hearing aid processing: Beamforming

With a binaural fitting, the directional microphones of both hearing aids are wirelessly connected to each other in order to provide an extreme directionality towards the front.
Directional Microphone Technology

Binaural directionality approaches

Exchange of control signals

Exchange of audio signals

- Ipsilateral
- Contralateral

Data streaming

Binaural hearing aid processing: Beamforming

With a binaural fitting, the directional microphones of both hearing aids are \textit{wirelessly connected} to each other in order to provide an \textit{extreme directionality} towards the front.

Phonak StereoZoom

(4) Microphone directional system

Fixed null noise cancellation system
Directional Microphone Technology

Binaural hearing aid processing: Beamforming

With a binaural fitting, the directional microphones of both hearing aids are wirelessly connected to each other in order to provide an extreme directionality towards the front.

UltraZoom (Noise management)  StereoZoom (Signal preservation)
Directional Microphone Technology

The unique power of a four microphone network

Generation I = manual StereoZoom
Generation II = automatic StereoZoom

Subjects
- 20 test subjects (three female, 17 male)
  - experienced HI users
  - Ø age: 70.5 years (min: 63y, max: 81y)
Directional Microphone Technology

General setup – Speech in noise

OlSa Results (SRT in dB)

• Version 1

• Version 2

Oldenburg 2012
Future innovation… 3rd generation StereoZoom

- Combination of the best of adaptive directionality and best of Binaural VoiceStream Technology™.
- Binaural for specificity of the microphone characteristics.
- Adaptive for optimal noise cancellation.

MUSHRA result with prototypic device

Internal research
Phonak Staefa
2014
Directional Microphone Technology

What do listeners prefer?

- 78%偏向型/方向性
- 14%双边/全向性
- 8%双边性

Cord et al, 2002: How often is directionality used by those who know when/how to use it?

Directional Microphone Technology

Two ears send distinct information to the auditory cortex of the brain to create a complete, rich and accurate portrayal of the auditory environment.
Directional Microphone Technology

The ears are the messengers

**DETECT**
A new sound in the environment draws your attention.

**CHOOSE**
Filtering out sounds until you hear only what you want to hear.

---

**Directional Microphone Technology**

**Secondary Signal**

*Listener*

*Primary Signal of Interest*

---

9/26/2014
Directional Microphone Technology

ReSound Directional Options

Static:
• Fixed directional
• Fixed omni
• Natural Directionality

Automatic:
• Binaural Directionality
• Binaural Softswitching
• Adaptive directionality

Band-split directional processing

2-mic directionality with bass roll off
Traditional L/f compensation
Band-Split Processing

Reduced noise and provide directionality

Omni Directional

Continued
Directional Microphone Technology

Mixing point based on hearing loss and adjustable:
- High mixing point - greater HL to provide the best SNR
- Low mixing point - open fits for better quality with equal SNR benefit

has been shown to improve front/back localization abilities as compared to unaided and aided listening with omnidirectional or full-spectrum directional processing.


Directional Microphone Technology

Benefits ReSound Directional Options

Full range of directional options
- Automatic asymmetric and omni options to support environmental monitoring

Bandsplit processing in all directional options
- with flexible mixing point with hearing thresholds taken into account
- Low frequency localization cues preserved
- Better directional sound quality without artificial low frequency boost
- Switching is less noticeable and bothersome
Directional Microphone Technology

Unitron Product Philosophy

- PERFORMANCE (INNOVATION)
- SOUND QUALITY
- COMFORT

PSYCHOLOGICAL “LOOK OF THE PRODUCT”
WEARING COMFORT
ACOUSTICAL COMFORT

SmartFocus = Metafeature

Synergistic effect of SmartFocus

SmartFocus™ is a proprietary approach that combines multiple adaptive features into one powerful algorithm.

The technology’s philosophy is the creation of one control to achieve either a comfort or clarity objective.
Directional Microphone Technology

The benefits of SmartFocus

- Combines four effective features into one fine tuned control
- SmartFocus addresses two primary end user concerns:
  - Speech intelligibility in background noise and
  - Listening comfort
- SmartFocus delivers clinically proven improved speech intelligibility in noise
- No need to adjust or fine tune for those end users who want a fully automatic hearing aid

SpeechZone 2

continued
What’s SpeechZone

SpeechZone is a feature available to wireless hearing instruments. It uses binaural spatial processing to know when to zone in on speech in difficult listening situations.

When in a noisy environment SpeechZone automatically:
- engages maximum directionality when speech is coming from the front
- disengages maximum directionality when speech not coming from the front

The benefits of SpeechZone

SpeechZone feature is an industry first and addresses the number one client complaint – hearing in noise.

SpeechZone relies on binaural spatial processing to intelligently zone in on speech like no other hearing aids can.

SpeechZone facilitates easier conversations:
- from the front by employing maximum directionality automatically
- from the sides by automatically opening up the directionality and allowing more awareness of the environment.
Feature philosophy

SpeechZone 2 conditions to engage

For SpeechZone 2 to engage, the following conditions must occur:

1. Binaural classification of speech in noise destination
2. Detection of direction of speech using
   A. Binaural spatial processing
   B. Signal to noise ratio difference
3. Engagement of directionality
Directional Microphone Technology

Engagement of directionality

Directional Microphone Technology

Feature Philosophy
Binaural Symmetric Directionality
No dominant speech

- If SpeechZone 2 detects that there is no dominant speech, it will use binaural fixed directional.
Directional Microphone Technology

Feature Philosophy
Binaural Symmetric Directionality
Speech from front

- If speech is present in the front, SpeechZone 2 uses maximum adaptive directionality.

Feature Philosophy
Asymmetric Directionality
Speech from the Left

- If speech is detected on the left side, SpeechZone 2 uses the SNR difference between both hearing aids and applies an asymmetric directional strategy.

- Left hearing aid: Omnidirectional with Pinna Effect
- Right hearing aid: Adaptive directional

continued
Directional Microphone Technology

Feature Philosophy
Asymmetric Directionality
Speech from the Right

• If speech is detected on the Right side, SpeechZone 2 uses the SNR difference between both hearing aids and applies an asymmetric directional strategy.

• Right hearing aid: Omnidirectional with Pinna Effect
• Left hearing aid: Adaptive directional

Sound perfectly designed

- miSound: Delivers sound so natural wearers may forget they are wearing hearing instruments
- miGuide: Learns and adapts to every situation
- miFocus: Effortless listening even in the most demanding environments
micon 48-channel adaptive TwinMic system

Offers a significant improvement in speech understanding when the speaker is located in the rear field
micon directional speech enhancement

![Graphs showing SRT in Background Noise (dB) for Moderate Hearing Loss and Severe Hearing Loss for Siemens and Leading Competitor microphones.](image1)

**Figure 2**: Group mean results for the Siemens micon compared to a leading competitor for a speech recognition in noise test (SNR). Results shown for two different hearing loss groups. Lower scores indicate better performance.

![Graph showing SRT in Background Noise (dB) for Omni and DIR + DNR with Siemens micon and Leading Competitor.](image2)

**Figure 3**: Group mean results for the Siemens micon compared to a leading competitor for the Hearing in Noise Test (HINT). Results shown for both the omni condition, and when directional processing and noise reduction were activated for both instruments. Lower scores indicate better performance.

---

**Directional Microphone Technology**

**UNIQUENESS OF WIDEX HD LOCATOR**

- Calibrated, fully matched dual microphones in a multi-channel fully adaptive system with sound classifier and digital pinna for consistent SNR advantage while ensuring audibility for speech
- Features for consistent SNR advantages (DI = 6 dB)
  - In-house calibration on KEMAR
  - 24/7 microphone matching
  - Adaptive microphone to zero in on primary noise source
- Features to ensure speech audibility
  - Fully adaptive to default in omni mode in quiet
  - Multiple channels for frequency specific noise
  - Sound classifier for speech, wind, ambient, and noise
  - Choice of reverse focus microphone for sounds from the rear (7-8 dB improvement)
  - Digital pinna to preserve front-to-back localization cues
Multichannel Directional mic - when noise is frequency specific

Sound classifier - Preserving audibility of speech
Reverse focus study (Kuk & Keenan, 2012)

Directional Microphone Technology

DIGITAL PINNA - IMPROVING FRONT-BACK LOCALIZATION
### Evidence on Directional Mic

Directional Microphone Technology Wrap-Up

Connectivity
Connectivity

Wireless Market Data

Percentage of Wireless Products Fit in 2013

68%

HIA 2013

Wireless Mix Styles

- 66.1% RIC
- 20.4% BTE
- 13.5% Custom

Wireless Mix Custom Styles

- 28.9% ITE
- 18% CIC
- 53.7% ITC

HIA 2013
Wireless Market Data

Wireless Mix Styles

- 66.1% RIC
- 24.7% Custom
- 4.9% BTE/other

Wireless Mix Custom Styles

- 46.8% CIC
- 33.8% ITC
- 19.4% ITE

What accessory is the most popular?

~23%
Connectivity

Wireless Market Data

**ACCESSORIES**
- 22.69% Phone Streamer
- 14.79% TV/Media Streamer
- 47.13% Remote Control

HIA 2013

Potential Barriers
- Cost
- Time
- Cosmetics
Connectivity

Addressing Every Wireless Patient Need

900MHz  2.4GHz

Iris Technology

Continued
Connectivity

SURFLINK ACCESSORIES

Remote

- Easy to use and personalize
- Basic
- Intermediate
- Advanced

Media

Set it and forget it
wireless media streaming
Connectivity

SURFLINK ACCESSORIES

Mobile

- Enhanced listening for speech, music, TV and phone
- Wireless media streaming
- Remote microphone options
- Just Talk hands-free communication

Connectivity

Addressing Every Wireless Patient Need

900MHz 2.4GHz
## Connectivity

### TruLink Personalized

<table>
<thead>
<tr>
<th>Personalization</th>
<th>Performance</th>
<th>Connectivity</th>
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![Image of TruLink Personalized app on an iPhone](image1.jpg)

## Connectivity

### Every Experience Enhanced

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![Image of person with arms crossed](image2.jpg)

---

*Continued*
Connectivity

TruLink Navigation

Connectivity

TECHNOLOGY TRENDS

Alpha Study Test Subjects
Developers
MFI

2.5% INNOVATORS
2.5% INNOVATORS

34% LATE MAJORITY
16% LAGGARDS

Mature Digital Feedback Cancellation
Non-Users

Directional Systems
Receiver in Canal Products

Advanced Noise Management
“Invisible Solutions”

Streaming Wireless Accessories

2.5% EARLY ADOPTERS
13.5% EARLY MAJORITY
34% LATE MAJORITY

2.5% EARLY ADOPTERS
13.5% EARLY MAJORITY
34% LATE MAJORITY

16% LAGGARDS

Continued
## Connectivity

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Connectivity

Observations (August 2014)

Overall Industry: 0.25% per day

2014 with Private Sector: 3.08% per day

VA/Government: 10.72% per day

Resulting SHT Market Share: 22.11% from 2013

Significantly higher than industry growth rate


Magnetic Induction vs. Radio Frequency

Distance

Energy Usage

Size

Binaural Data Exchange
Connectivity

- WRC
  - Near
  - Far

- Spatial Sound
  - On
  - Near
  - Far

- Spatial Sound
  - Off
  - Near
  - Far

10.5 dB  2.5 dB  9.5 dB
Connectivity

Unitron wireless

Unitron hearing instruments rely on different wireless technologies to communicate with each other and connect with our line of wireless accessories.
Connectivity

About wireless

Binaural Phone
  • Binaural Phone streams audio signal from phone ear to opposite ear without separate accessory
  • Both ears automatically receive audio signal
  • Works with any phone type – landline, cell
  • Select type of input – omni or t-coil
Binaural phone wireless specifications
  • Send signal via digitally inductive transmission at 10.6 mHz
  • Safety not a concern – low magnetic field strength far below other everyday devices (i.e., cell phones)

Connectivity

• Enjoy relaxed and easy phone conversations
• Hear phone conversations louder and clearer
• No need for additional accessory
About wireless

Duolink

- Adjustments on one device are instantly wirelessly synchronized on the other
- Volume dial/lever changes
- Push button (program) changes
- Only adjusts paired devices – e.g., devices that are part of same fitting

Duolink wireless specifications

- Send control data via digitally inductive transmission at 10.6 mHz
- Safety not a concern – low magnetic field strength far below other everyday devices (i.e., cell phones)

Connectivity

- Simplifies adjustment for client
- Ensures product is balanced
- Eliminates need for control redundancy
  - VC on one device, push button on the other
  - Can provide smaller, more cosmetically appealing instruments

DuoLink
Connectivity

Why 2.4 GHz Wireless Technology?

• We chose 2.4 GHz wireless technology to address immediate needs of the fitter and user
• To determine these needs, we referenced:
  • Published surveys, such as MarkeTrak, and
  • Market research (Groth & Anthonsen, 2010) in defining user requirements to a hearing instrument system with wireless features.

Long range of connection, easy to use, no neck worn device, minimal delay, strong connection, connect to many devices, excellent sound quality

Why 2.4 GHz Wireless Technology?

Consumer electronics operates on this frequency which allows a quick transition into this market and a more “future proof” system
Connectivity

**Bluetooth**

- Traditional Bluetooth consumes too much power to make direct implementation in hearing instruments feasible.

**Bluetooth Smart (v4.0)**

- Introduced in 2011
- contains a low energy feature that has enabled a new breed of products that can communicate wirelessly for long periods of time without requiring much power
- products include fitness monitors and many others. They can transmit data to Bluetooth Smart Ready devices, such as PCs, tablets and smartphones.

---

**Connectivity**

**ReSound LiNX**

- Direct to iPhone
- Direct Smart Control
- Direct Ear-to-Ear
- Direct to Accessories
- Direct Wireless Fitting

**ReSound Verso**

- ReSound Alera

**Platform**

- **Range**
  - 2010
  - 1st gen.
- **Range II**
  - 2012
  - 2nd gen.
- **SmartRange**
  - 2013
  - 3rd gen.

Direct Streaming – In Stereo – In a Robust Signal
No Need for Intermediate Devices
Connectivity

Benefit of ReSound Unite Mini Microphone

- Directional Microphones
- Personal Mic with HA Mics
- Personal Mic without HA Mics

SNR (dB)

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CONTINUED
Connectivity

More than audio streaming

- Sound adjustments
- Geo tagging
- Hearing aid Finder
- Counseling

Facilitates user independence

Ear to ear connectivity (with 2.4GHz)

Connectivity and programming

Convenience features

- Synchronized volume control and push button
- Automatic telephone handling

Enhanced signal processing

- Using wireless capability to make a feature work better/provide better benefit, e.g., Coordinated features
- Think synch!

“Binaural” processing

- Using exchange of data for streaming or enhanced signal processing
## Connectivity

### Advantages 2.4 GHz Wireless Technology

- MFi capability
- Does not require a ‘Gateway Device’
- Robust connection over long distance signal transmission
- High transmitted data capacity: bandwidth, stereo, low distortion
- Low latency so no echo problems and no lip synchronization
- Worldwide applicable
- “Future proof” in that it is technology that is continuously being developed

## Connectivity Wrap-Up
Innovations for Individuals with Severe Hearing Loss

- High frequency audibility
- SoundRecover

- Conversation in large groups
- Roger

- In-car
- auto ZoomControl
- Cell Phones
- DuoPhone
- ComPilot

- Television
- TVLink S

- Restaurant
- auto StereoZoom
- SoundRelax
- Phonak RemoteMic
- SP QUEST GB

- Conversation in small groups
- Roger

CONTINUED
Innovations for Individuals with Severe Hearing Loss

Naída Q
Life changing power

SoundRecover: longstanding proven solution for providing audibility at high frequencies

- Less gain required
- More residual dynamics
- Less overload distortion
- More feedback stability
- Less pitch discomfort

Amplification Frequency compression

Output level
Threshold
/s/
Frequency

Output level
Threshold
/s/
Frequency

continued
Innovations for Individuals with Severe Hearing Loss

SoundRecover
Spectrograms

/asa/

Original Signal
High frequency HL
Non-linear frequency compression

SoundRecover
Different frequency compression settings

Frequency

Original
4000 1.5:1
2000 2:1
1500 4:1

Graph showing frequency compression settings
Let's Meet the Newest Additions to the severe to profound solutions

Innovations for Individuals with Severe Hearing Loss

A history of firsts for wireless

Dynamic FM
The first adaptive FM system

Multi-frequency FM
The first frequency-flexible FM system

MLx
The first universal ear-level FM receiver

MicroLink
The first miniaturized ear-level FM receiver

The first to use adaptive digital wireless transmission at 2.4 GHz
Innovations for Individuals with Severe Hearing Loss

Why hearing aids are sometimes not enough

Overcoming the challenges of noise and distance

NOISE ▲

- Loud bar
- Noisy restaurant
- Quiet environment

DISTANCE ▼

10 meters

Roger Pen, Roger Clip-On Mic
StereoZoom
Directional
Omni Microphone
Phonak RemoteMic

What is Roger?

- Roger is a new digital wireless technology standard that replaces FM
- Allows for low delay and reliable long-range broadcast to miniature, low-power receivers
- Operates on 2.4 GHz band (ISM), with intelligent adaptive protocols
- Audio bandwidth up to 7300 Hz
- Privacy is guaranteed
Phonak configurations for severe to profound

<table>
<thead>
<tr>
<th>Hearing instrument</th>
<th>Receiver</th>
<th>Roger Pen / Roger Clip-On Mic</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireless BTE or RIC</td>
<td>Design-integrated</td>
<td>Microphone</td>
<td></td>
</tr>
<tr>
<td>Wireless BTE, RIC or Custom</td>
<td>ComPilot with Roger X</td>
<td>Microphone</td>
<td></td>
</tr>
<tr>
<td>BTE, RIC, or Custom with telecoil</td>
<td>Roger MyLink</td>
<td>Microphone</td>
<td></td>
</tr>
<tr>
<td>Wireless BTE, RIC or Custom</td>
<td>ComPilot</td>
<td>RemoteMic</td>
<td></td>
</tr>
</tbody>
</table>

Innovations for Individuals with Severe Hearing Loss

The winning Roger strategy

1. Bringing the microphone **to the source**
2. Optimizing SNR at the source with **beam former** (i.e. Accelerometer)
3. **Adaptively** mixing wireless mic signal and ear-level microphone
   - **increasing** the gain of the Roger receiver in higher ambient noise levels
4. **Reducing** the gain when no voice is present
Speech understanding at 5.5 m in various noise levels

<table>
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<tr>
<th>Noise level (dB(A))</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
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</tr>
</tbody>
</table>

Thibodeau 2013

Improvement over Traditional FM: 54%
Improvement over Dynamic FM: 35%

Innovations for Individuals with Severe Hearing Loss

Speech understanding in various noise levels; Cochlear Nucleus 5

<table>
<thead>
<tr>
<th>Signal Level (dBA)</th>
<th>Noise 65</th>
<th>Noise 70</th>
<th>Noise 75</th>
<th>Noise 80</th>
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<tr>
<td>N=20</td>
<td>HINT % Correct</td>
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<tr>
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<td>55</td>
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<tr>
<td>No FM</td>
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<td>45</td>
<td>40</td>
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</table>

Wolfe 2013
### Innovations for Individuals with Severe Hearing Loss

<table>
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<tr>
<th>NEW!</th>
<th>+</th>
<th>=</th>
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</thead>
<tbody>
<tr>
<td>![Phone Icon]</td>
<td>Finally enjoying the food... and the conversation</td>
<td></td>
</tr>
<tr>
<td>![Phone Icon]</td>
<td>Keeping in touch with your friends</td>
<td></td>
</tr>
<tr>
<td>![Phone Icon]</td>
<td>TV pleasure for the whole family</td>
<td></td>
</tr>
</tbody>
</table>

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### Innovations for Individuals with Severe Hearing Loss Wrap-Up
Hearing Aid Technology -
Industry Roundtable
Wrap-Up

Hearing Aid Month

- Advances in Implantable Amplification Devices (#24716)
  Brad A. Stach, PhD

- Hearing Aid Solutions for the Speech-in-Noise Problem (#24702)
  Joshua M. Alexander, PhD

- Vanderbilt Audiology’s Journal Club (#24207)
  Todd A. Ricketts, PhD

- An Evidence-Based Approach to Reporting Hearing Aid Benefit (#24714)
  Ron Leavitt, AuD

- Hearing Aid Technology Industry Roundtable (#24717)
  moderated by Catherine Palmer, PhD