

HEARING ENHANCEMENT TECHNOLOGY: THE 30,000 FOOT VIEW

Cynthia Compton-Conley, PhD
Compton-Conley Consulting, LLC
Annapolis, Maryland
ccomptonconley@gmail.com

HEARING ENHANCEMENT TECHNOLOGY: THE 30,000 FOOT VIEW

Current and future technologies
Applications
Barriers to Use
Suggestions for Removing Barriers

Cynthia Compton-Conley, PhD
Compton-Conley Consulting, LLC
Annapolis, Maryland
ccomptonconley@gmail.com

NORMAL

MILD

MODERATE

SEVERE

PROFOUND

HEARING INSTRUMENTS

HEARING AIDS

COCHLEAR IMPLANTS

HYBRIDS (Mild low frequency hearing loss/severe-to-profound HFHL)

BONE ANCHORED HEARING SYSTEM (BAHA)

MIDDLE EAR IMPLANTS (MEI)

HARDWIRED BODY STYLE AMPLIFIERS

WIRELESS (LOOP, FM, IR, Digital)

WIRELESS HEARING AIDS WITH ACCESSORIES FOR CONNECTIVITY

AUDITORY TELECOMMUNICATIONS DEVICES

VISUAL TECHNOLOGY FOR FACE-TO-FACE, MEDIA, TELECOMMUNICATIONS

ALERTING TECHNOLOGY

HEARING ASSISTANCE
TECHNOLOGIES (HAT)

There are many true statements about complex topics that are too long to fit on a PowerPoint slide ~ Edward Tufte

NORMAL

MILD

MODERATE

SEVERE

PROFOUND

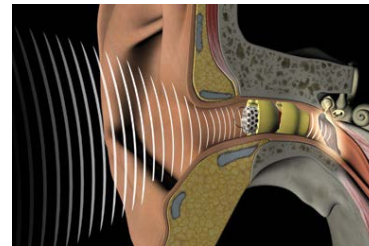
HEARING AIDS

COCHLEAR IMPLANTS

HYBRIDS (Mild low frequency hearing loss/severe-to-profound HFHL)

BONE ANCHORED HEARING SYSTEM (BAHA)*

MIDDLE EAR IMPLANTS (MEI)

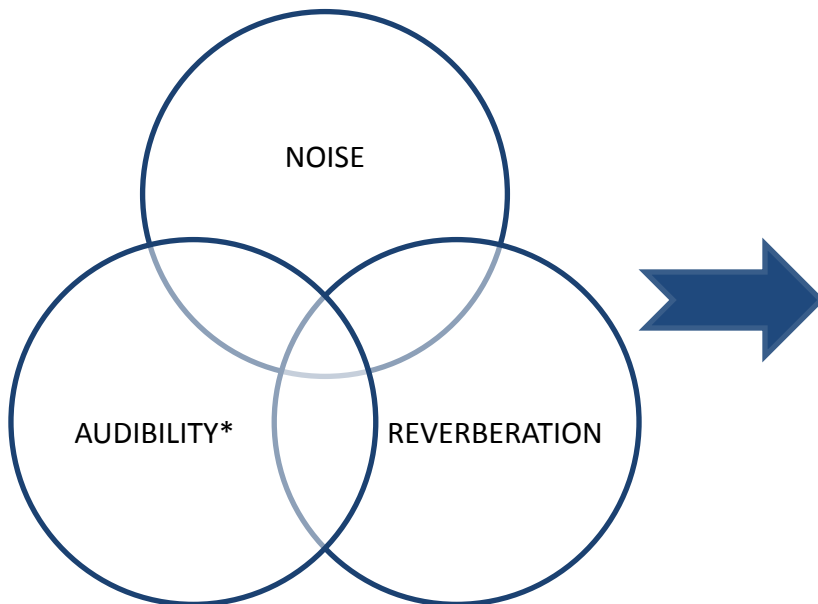


*Conductive, mixed, single –sided deafness

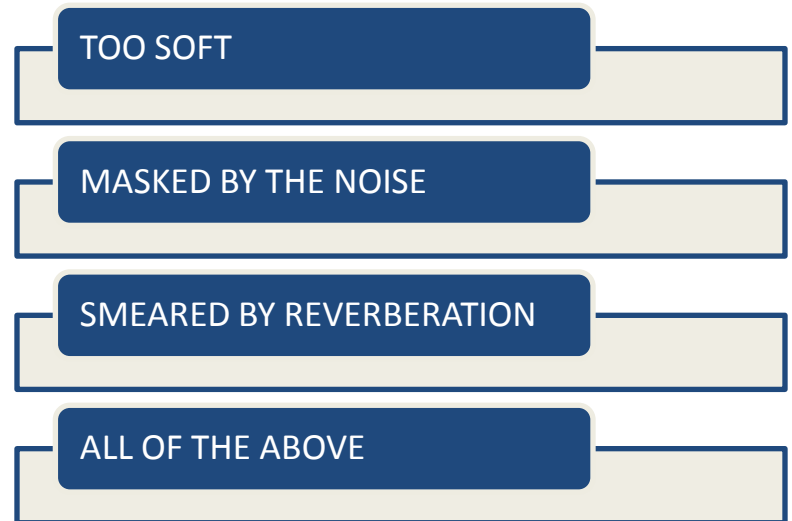
Why hearing aids/implants may not be enough

Because microphone is worn on the head, speech understanding can be negatively influenced by the synergistic effect of room acoustics.

HEARING LOSS AND ROOM ACOUSTICS



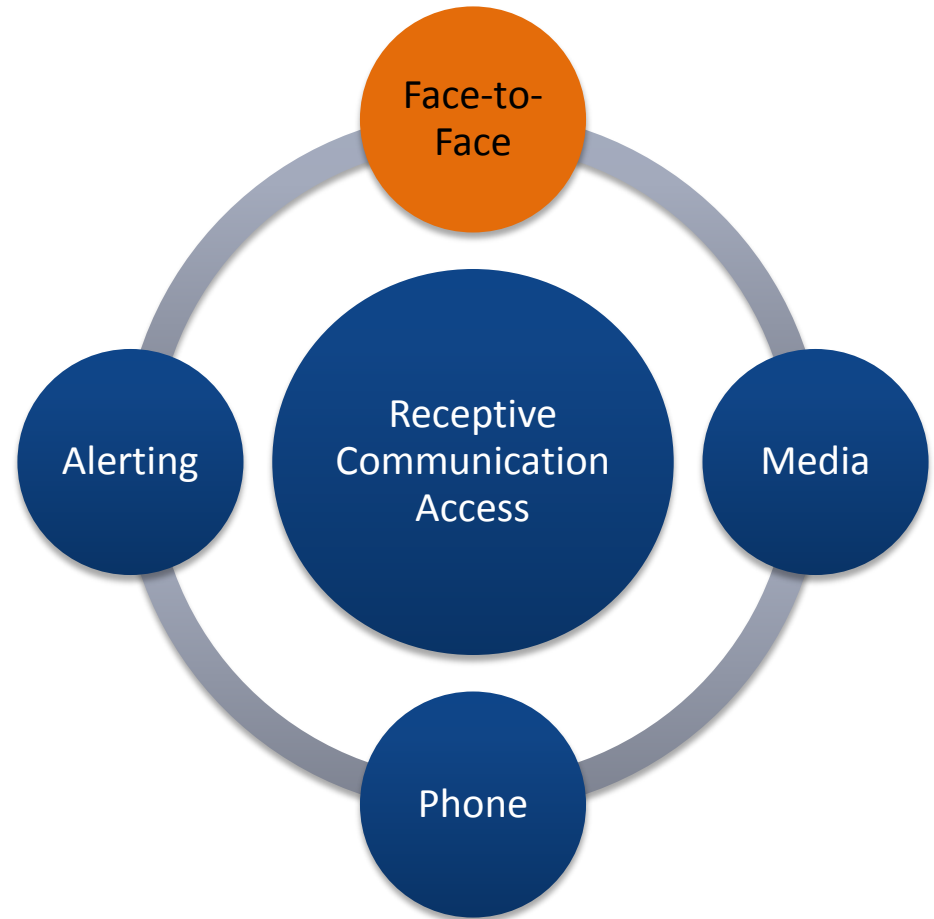
TARGET SIGNAL BECOMES:



*Determined by intensity of target signal, vocal effort of talker, distance, hearing loss.

Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.



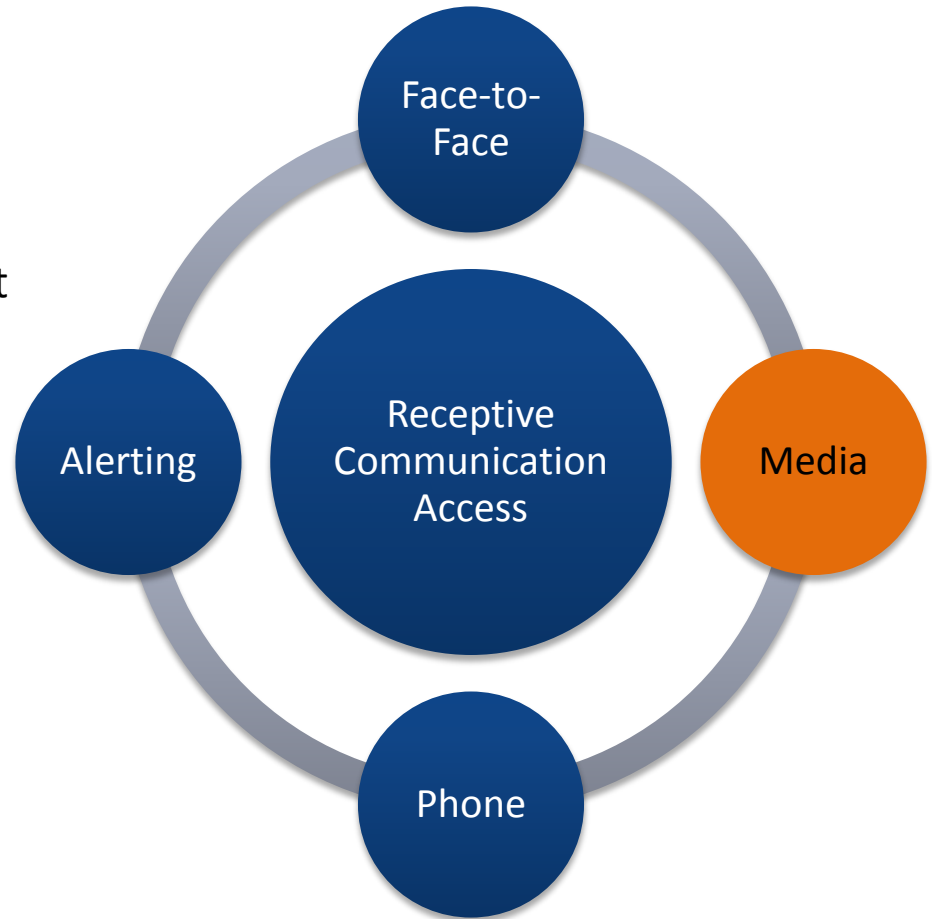
FOUR UNIVERSAL LISTENING NEEDS

Kochkin, S. 2010. Hearing Journal 63(1), pp. 11-19.

Compton-Conley, C. 2011. Perceived difficulty with face-to face communication by adult DMHA users with mild to moderate SNHL. Presented at the American Auditory Society Convention.

Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.
- In addition, HAs/implants alone do not always provide good reception for:
 - Media



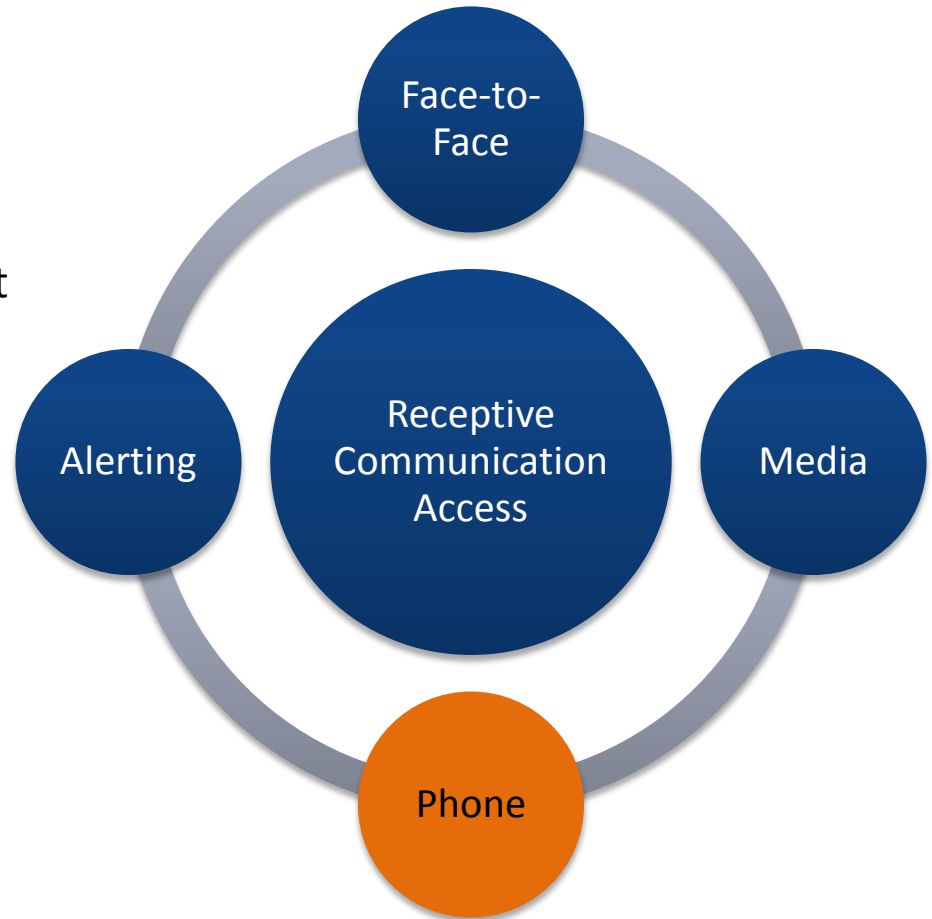
FOUR UNIVERSAL LISTENING NEEDS

Kochkin, S. 2010. Hearing Journal 63(1), pp. 11-19.

Compton-Conley, C. 2011. Perceived difficulty with face-to face communication by adult DMHA users with mild to moderate SNHL. Presented at the American Auditory Society Convention.

Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.
- In addition, HAs/implants alone do not always provide good reception for:
 - Media
 - Telephone



FOUR UNIVERSAL LISTENING NEEDS

Kochkin, S. 2010. Hearing Journal 63(1), pp. 11-19.

Compton-Conley, C. 2011. Perceived difficulty with face-to face communication by adult DMHA users with mild to moderate SNHL. Presented at the American Auditory Society Convention.

Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.
- In addition, HAs/implants alone do not always provide good reception for:
 - Media
 - Telephone
 - Warning/cueing signals



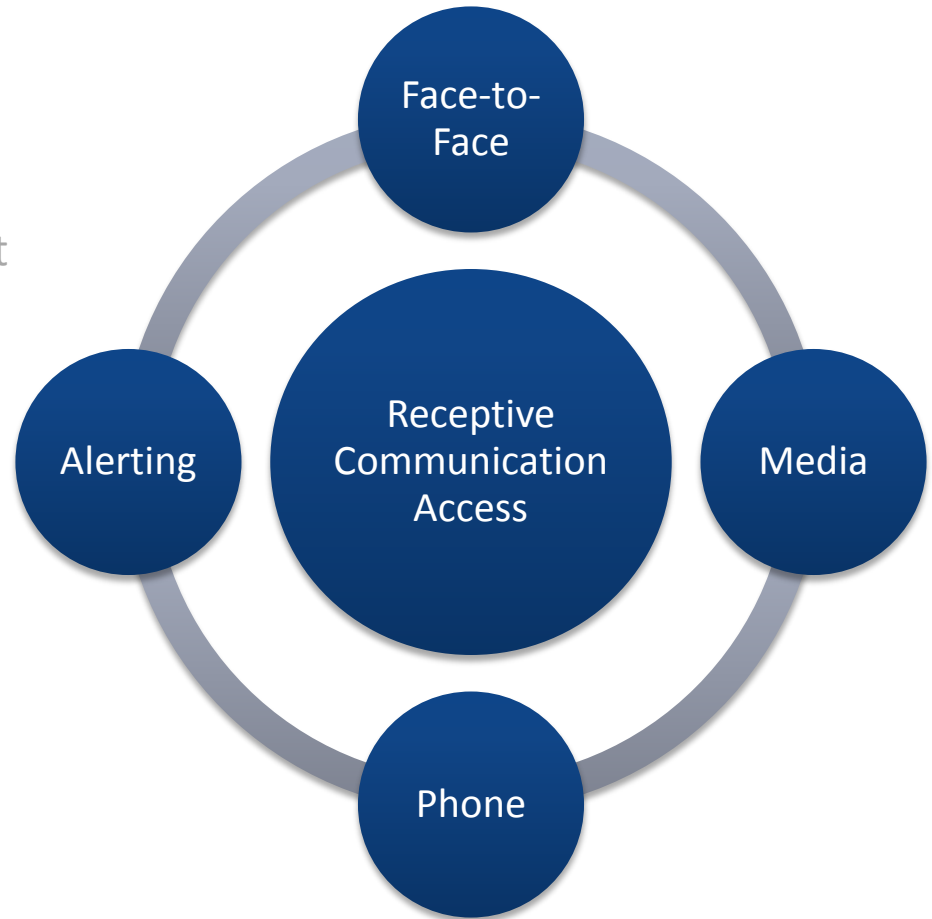
FOUR UNIVERSAL LISTENING NEEDS

Kochkin, S. 2010. Hearing Journal 63(1), pp. 11-19.

Compton-Conley, C. 2011. Perceived difficulty with face-to face communication by adult DMHA users with mild to moderate SNHL. Presented at the American Auditory Society Convention.

Why hearing aids/implants may not be enough

- Directional mics do not always provide significant real world improvement in face-to-face communication.
- In addition, HAs/implants alone do not always provide good reception for:
 - Media
 - Telephone
 - Warning/cueing signals
- We all have four receptive communication needs
- **FULL ACCESS REQUIRES ALL FOUR NEEDS TO BE MET – at home, work, play, school, volunteer work.**



FOUR UNIVERSAL LISTENING NEEDS

Kochkin, S. 2010. Hearing Journal 63(1), pp. 11-19.

Compton-Conley, C. 2011. Perceived difficulty with face-to face communication by adult DMHA users with mild to moderate SNHL. Presented at the American Auditory Society Convention.

A Necessary Partnership

PERSONAL HEARING INSTRUMENTS

HEARING AIDS

COCHLEAR IMPLANTS

HYBRIDS (Mild low frequency hearing loss/severe-to-profound HFHL)

BONE ANCHORED HEARING SYSTEM (BAHA)

MIDDLE EAR IMPLANTS (MEI)



HEARING ASSISTANCE TECHNOLOGIES

HARDWIRED BODY STYLE AMPLIFIERS

WIRELESS HAT (LOOP, FM, IR)

WIRELESS HEARING AIDS WITH ACCESSORIES FOR CONNECTIVITY

AUDITORY TELECOMMUNICATIONS DEVICES

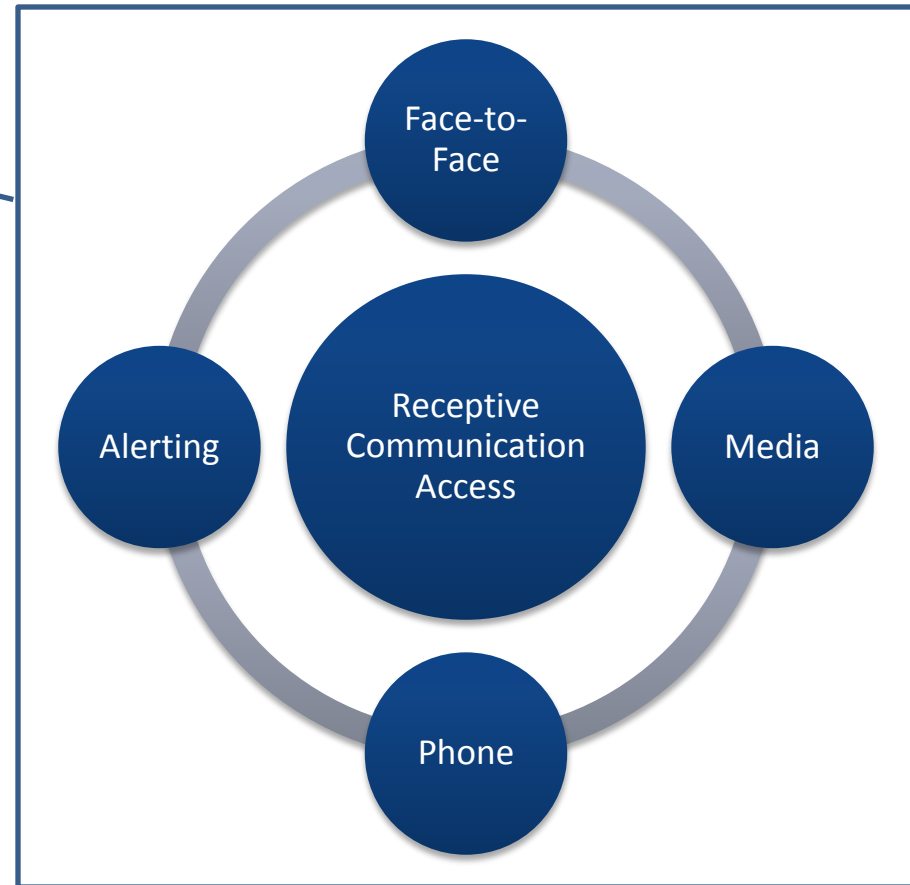
VISUAL TECHNOLOGY FOR FACE-TO-FACE, MEDIA, TELECOMMUNICATIONS

ALERTING TECHNOLOGY

That takes the improvement in communication that modern hearing aids and implants make possible...**and extends it even further.**

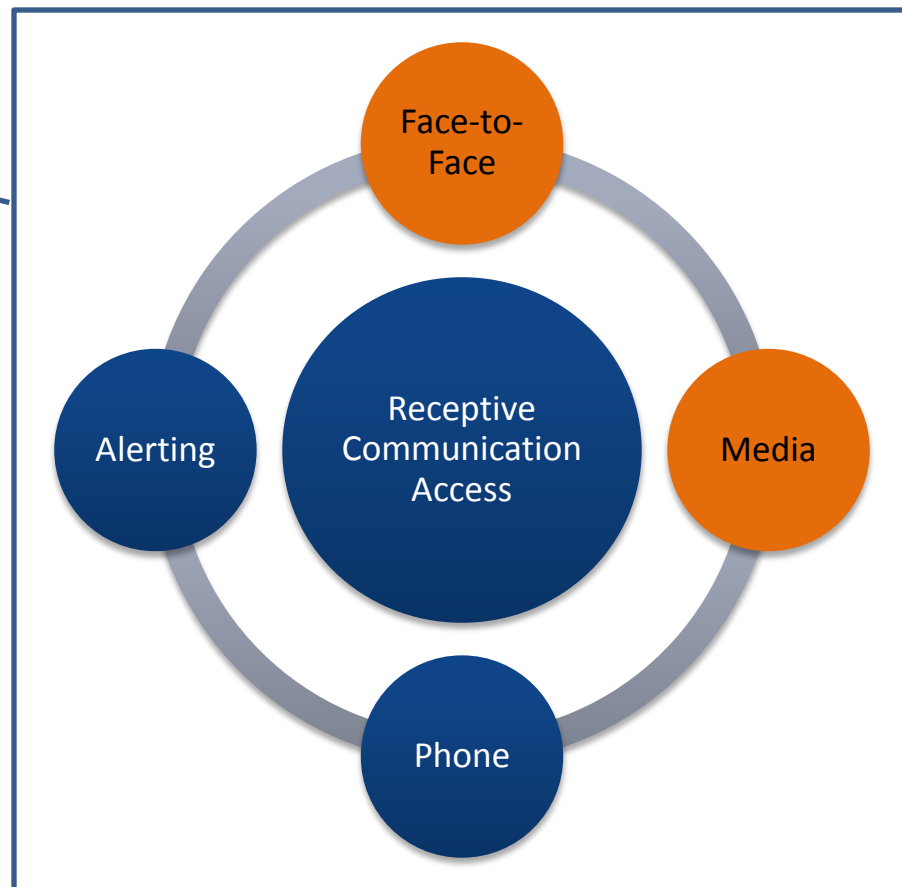
Hearing Assistance Technology Types

- 4 Needs
- Ownership: Personal/Public
- Portable vs. Stationary
- Hardwired vs. wireless



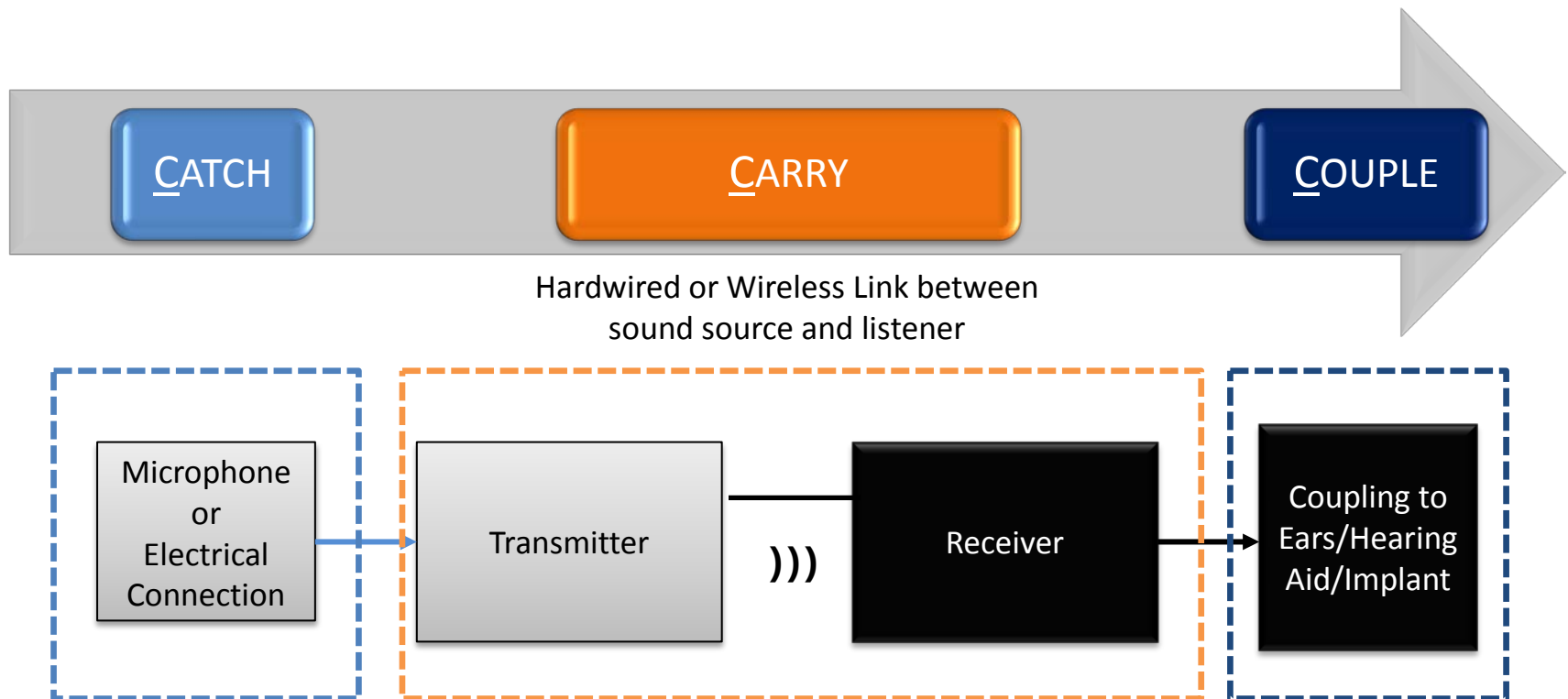
Hearing Assistance Technology Types

- 4 Needs
- Ownership: Personal/Public
- Portable vs. Stationary
- Hardwired vs. wireless



Concept Behind ALDs for Face-to-Face Communication and the Reception of Media

Sound is picked up and transmitted directly to the listener, thus overcoming deterioration due to distance and room acoustics.



NORMAL

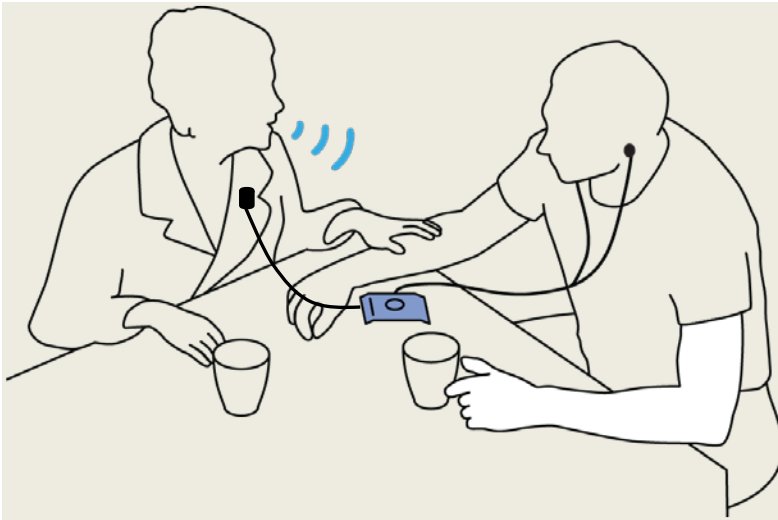
MILD

MODERATE

SEVERE

PROFOUND

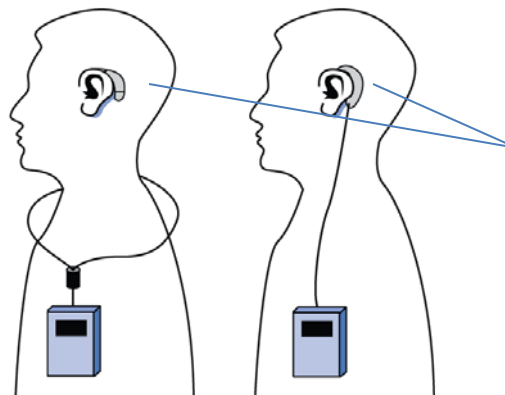
HARDWIRED BODY STYLE AMPLIFIER



- Affordable; Mild to profound
- Applications:
 - Face-to-face, media, phone
 - at home, work, car, hospitals
- Examples: Williams Sound, Comfort Audio, Bellman Symfon, etc.



1. Acoustic Coupling



2. Inductive Coupling



TELECOIL

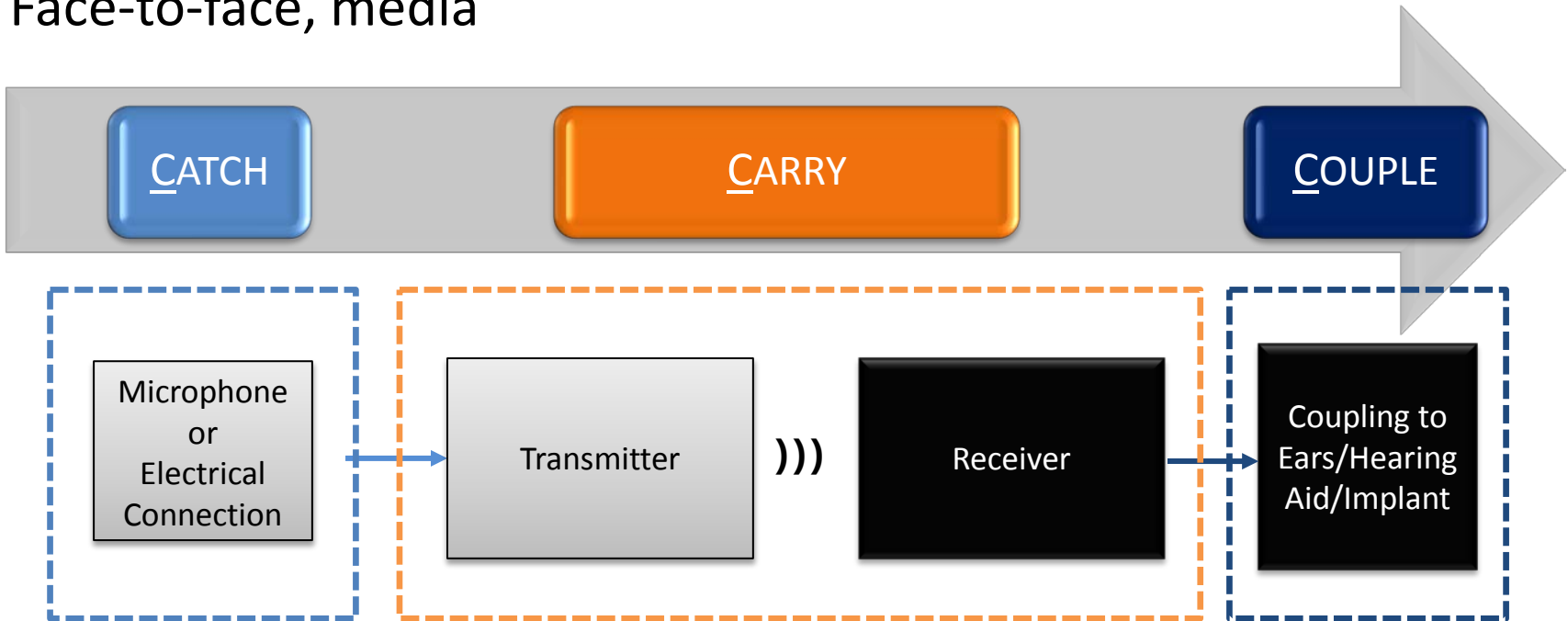


3. Direct Audio Input (DAI)



“CLASSIC” WIRELESS HAT (IR, FM, loop)

Face-to-face, media



Radio Waves

1. Infrared (IR)
2. Frequency Modulation (FM)
3. Induction (Hearing Loop)

NORMAL

MILD

MODERATE

SEVERE

PROFOUND

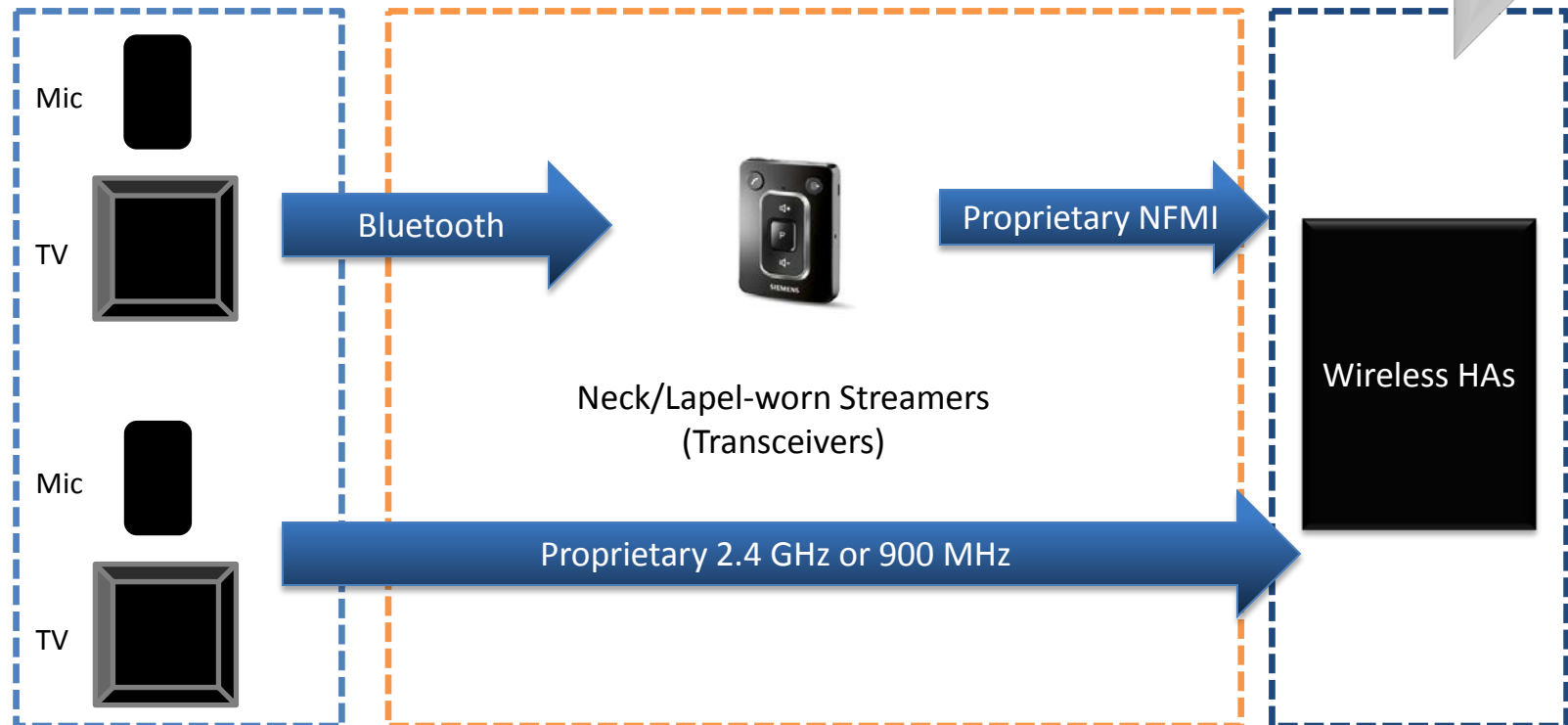
WIRELESS HEARING AIDS WITH ACCESSORIES FOR “CONNECTIVITY”

Face-to-face, media (as well as phone, remote control)

CATCH

CARRY

COUPLE



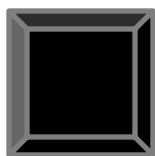
Wireless Hearing aids: Home/Office



Mic



TV



Bluetooth

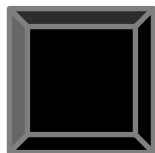


Proprietary NFM

Mic



TV



Proprietary 2.4 GHz or 900 MHz

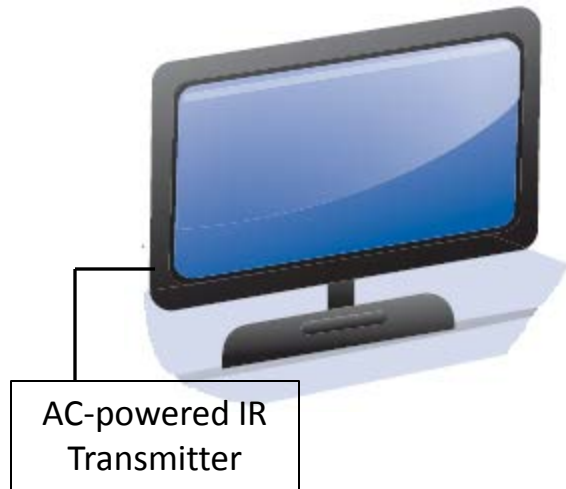


WIRELESS HAS



Things can become complicated if more than one employee has a hearing loss and each uses a different wireless hearing aid system.

Infrared (IR): Home/Office



AC-powered IR Transmitter
w/ 1 or more mics

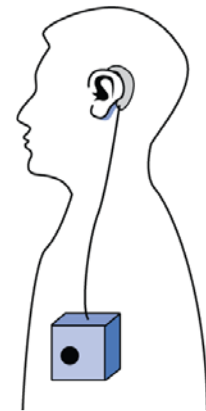
Receivers must
always be used



1. Acoustic Coupling

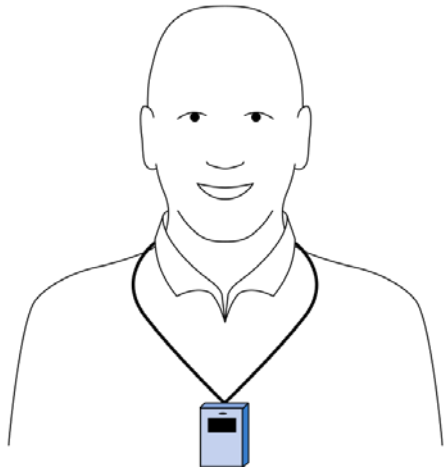


2. Inductive Coupling

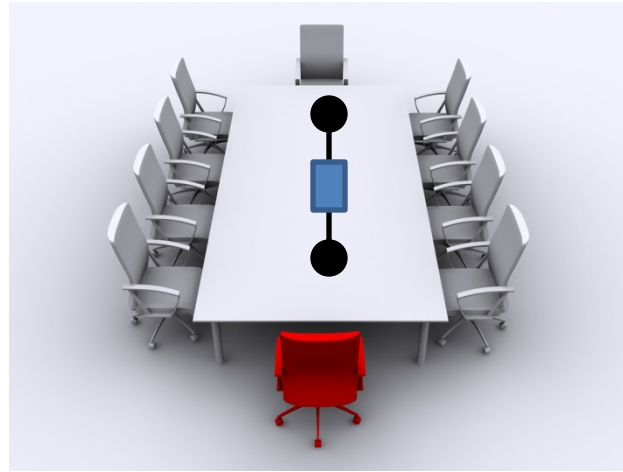


3. DAI

FM: Home/Office



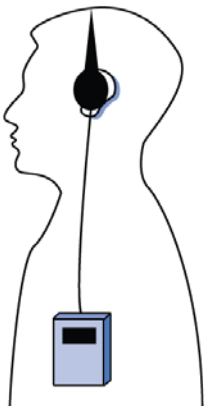
Battery-powered Transmitter
Neck-worn, Clip-on, Hand-held



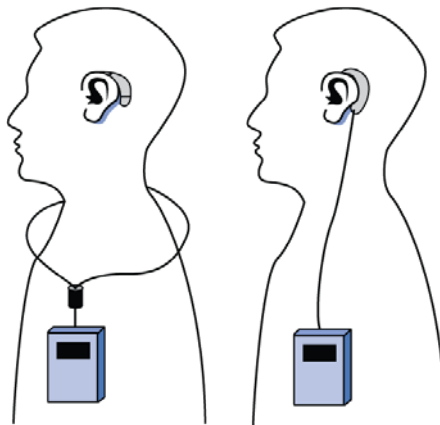
One or more mics



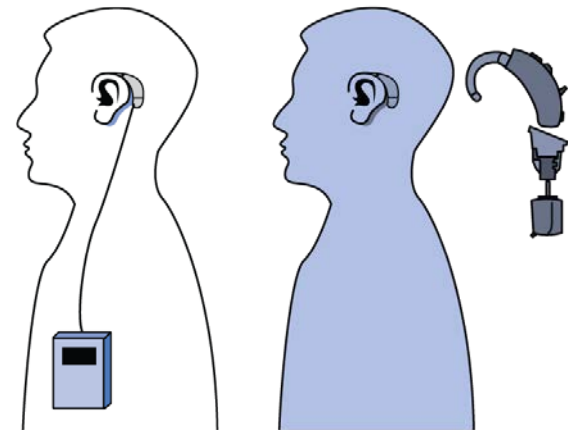
TV, etc.



1. Acoustic

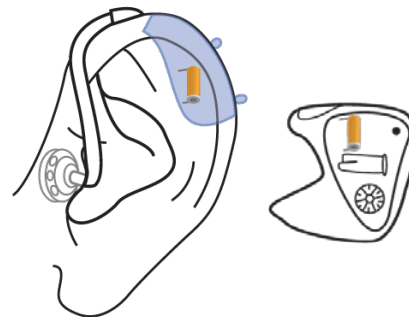
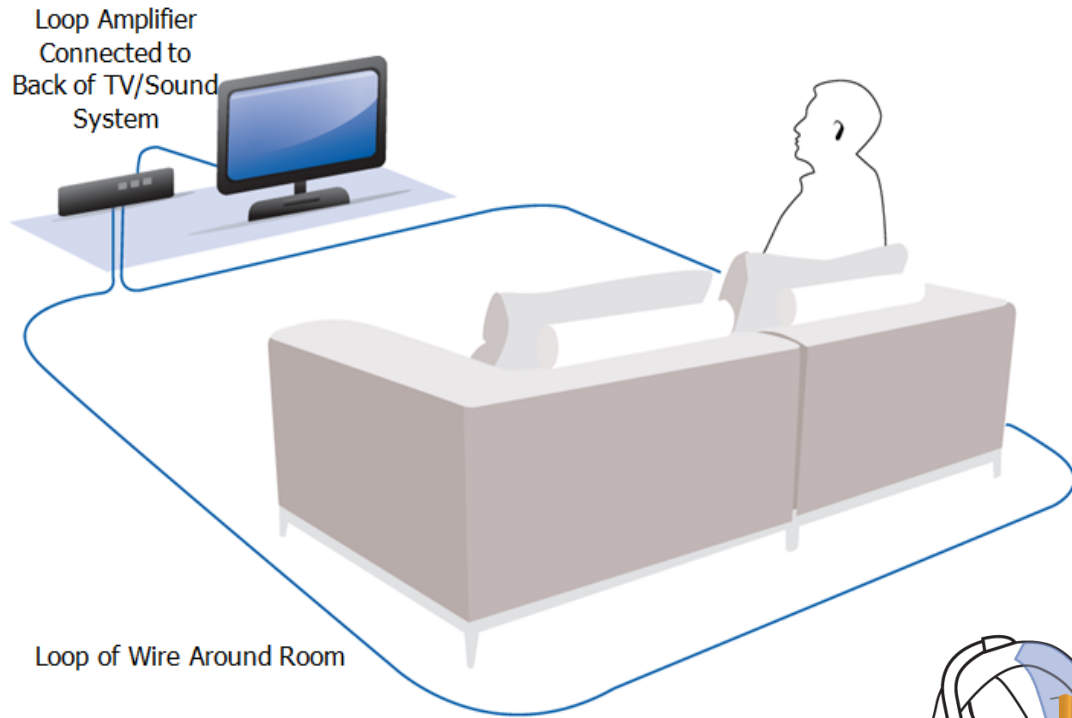


2. Inductive

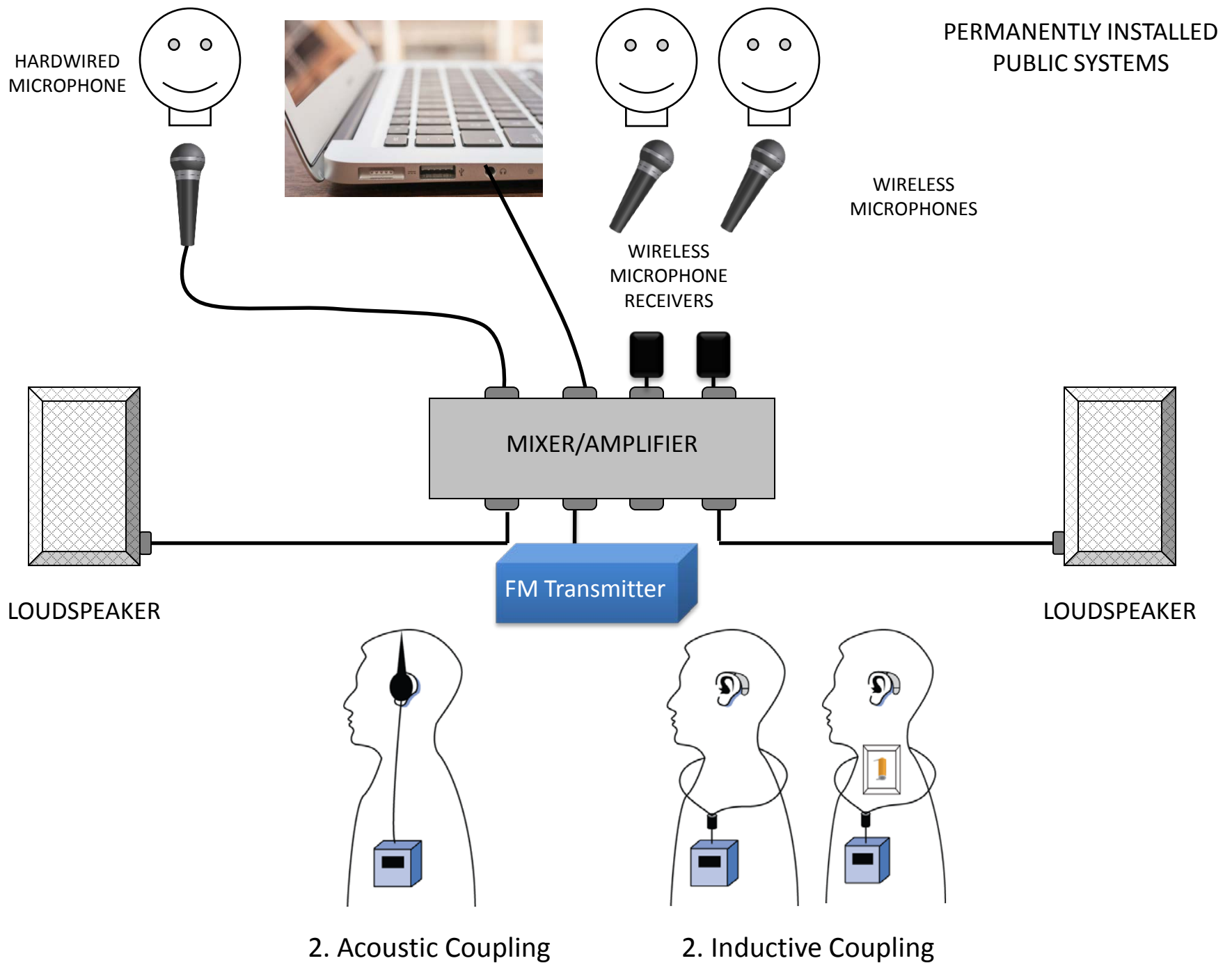


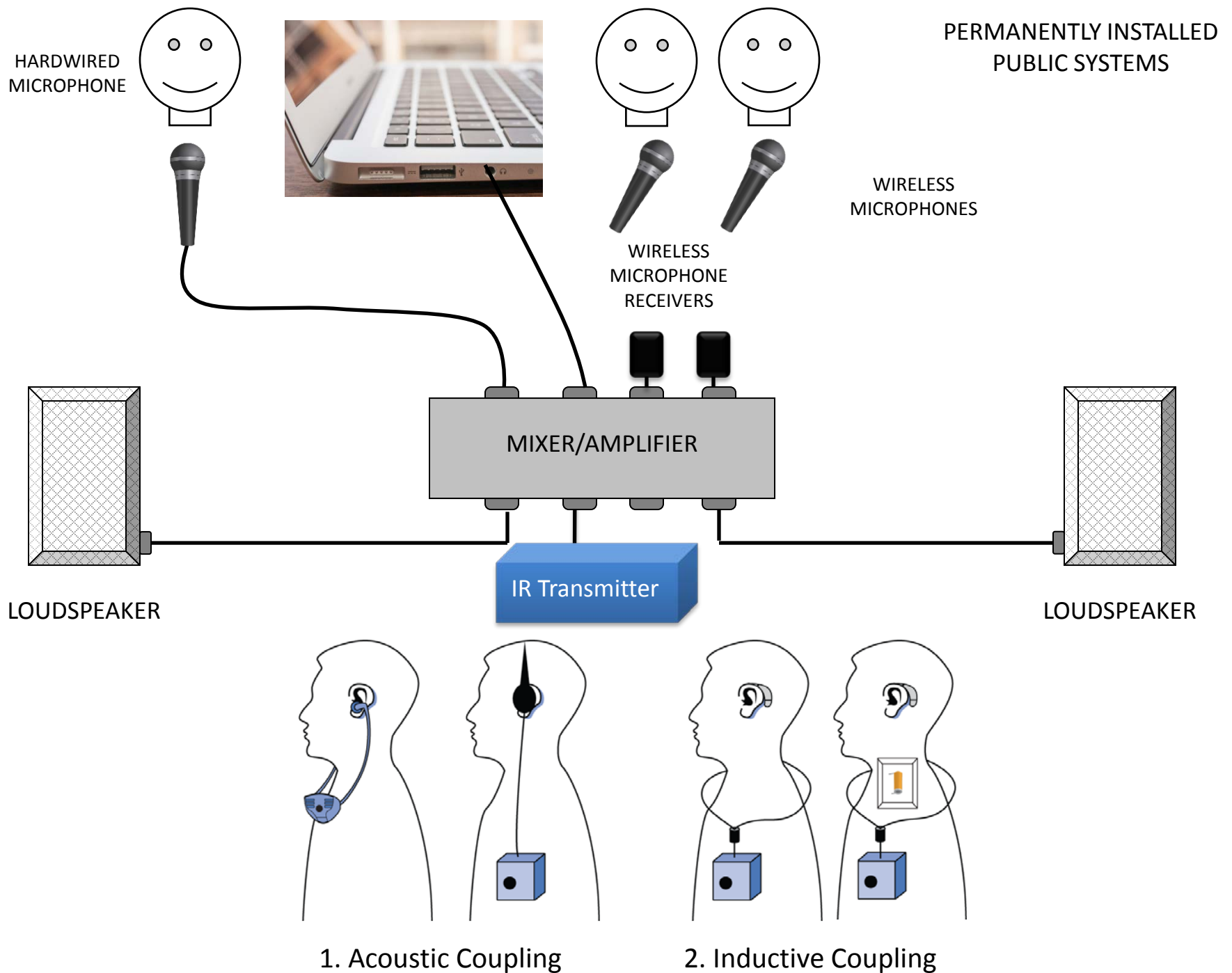
3. DAI (cabled or BTE Receiver)

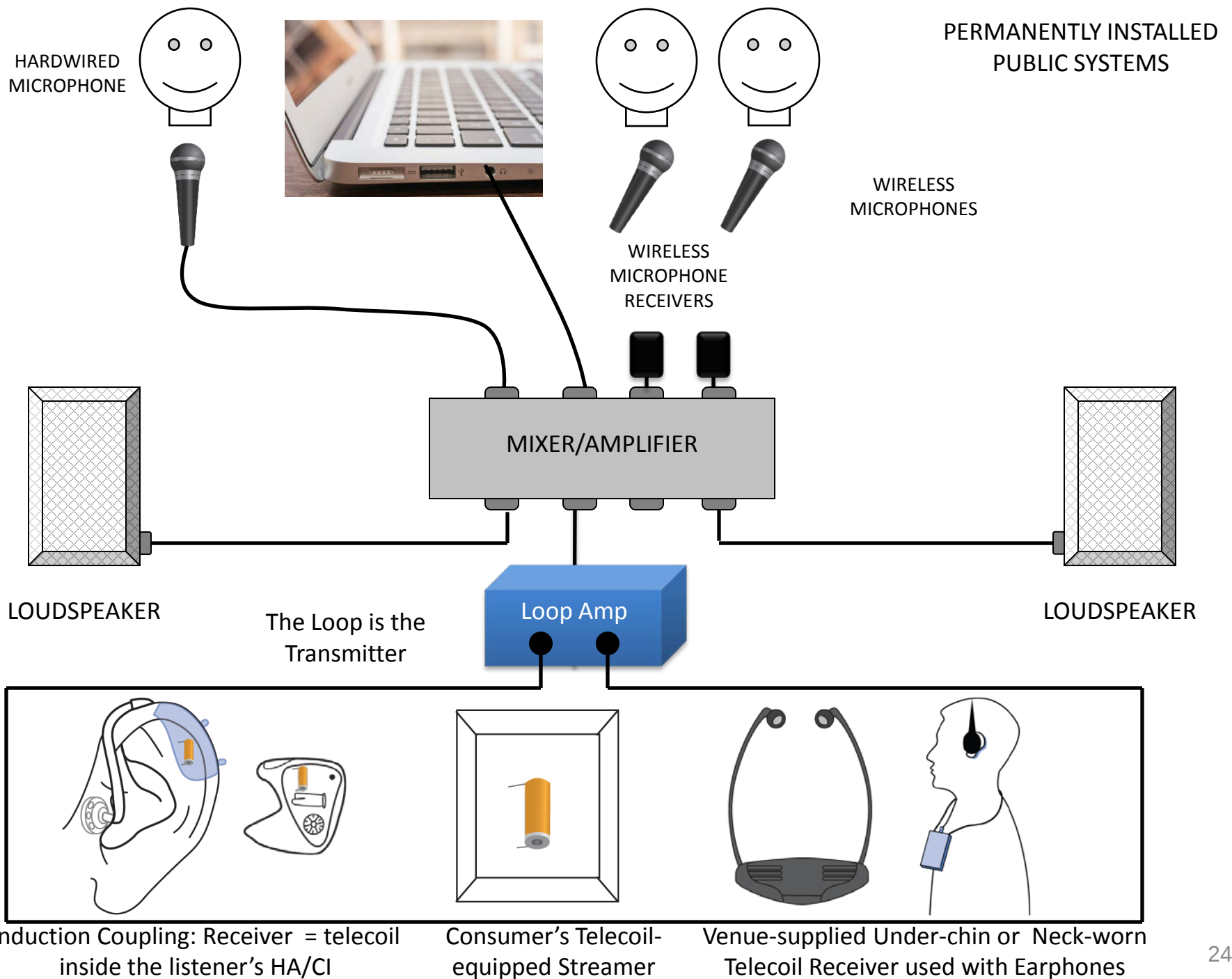
Induction Loop: Home/Office



Hearing Aids (or Implants)
with Telecoils

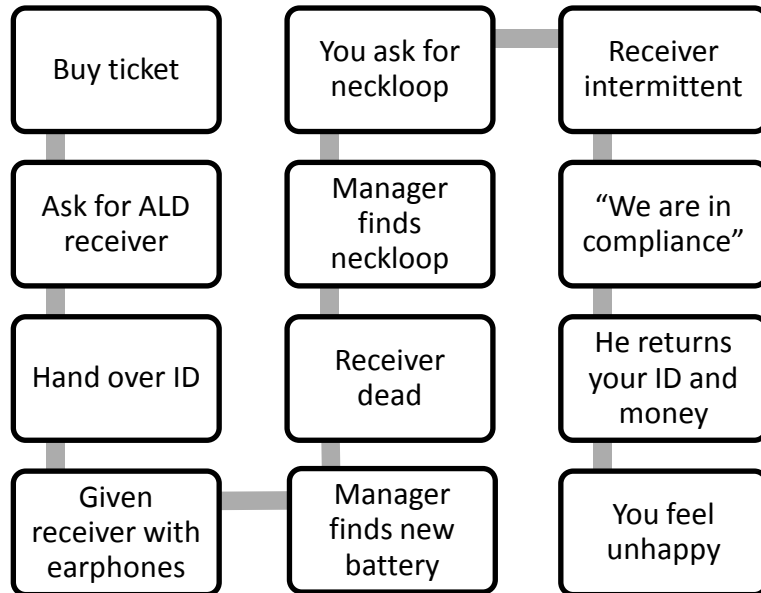




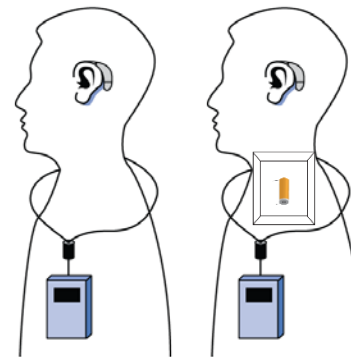


Accessibility Scenarios

FM/IR SYSTEMS



TELECOIL IN HA/IMPLANT
OR STREAMER



A RECEIVER IS ALWAYS
NEEDED WITH FM OR
INFRARED SYSTEMS

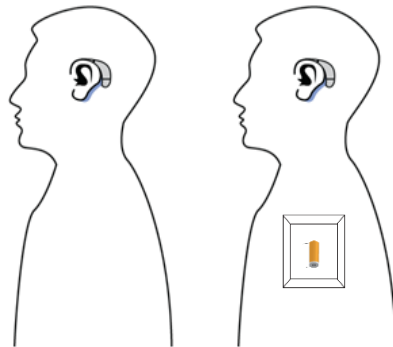
Accessibility Scenarios

FM/IR SYSTEMS

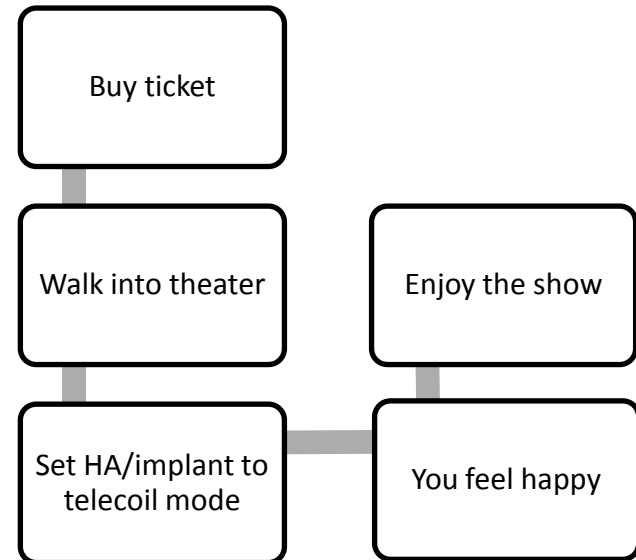


Accessibility Scenarios

TELECOIL IN HA/IMPLANT
OR STREAMER



HEARING LOOP



Accessibility Scenarios

HEARING LOOP



Accessibility Scenarios

FM/IR SYSTEMS



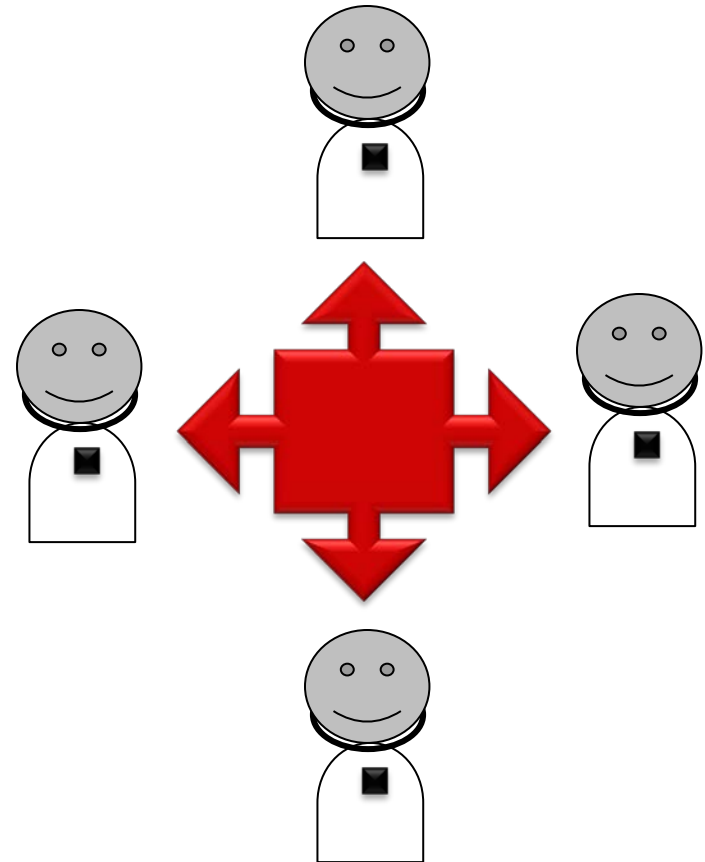
HEARING LOOP



Newer Digitally Modulated Technologies

Spread Spectrum/Frequency Hopping 2.4 GHz

- Portable 1:1 or group conversations at home, office, public venues.
- Same coupling options as FM
- Encrypted; pass-code protection
- **MULTI-MIC OPTIONS: 1-WAY OR 2-WAY**
- Customized solutions for ADA ACCESS

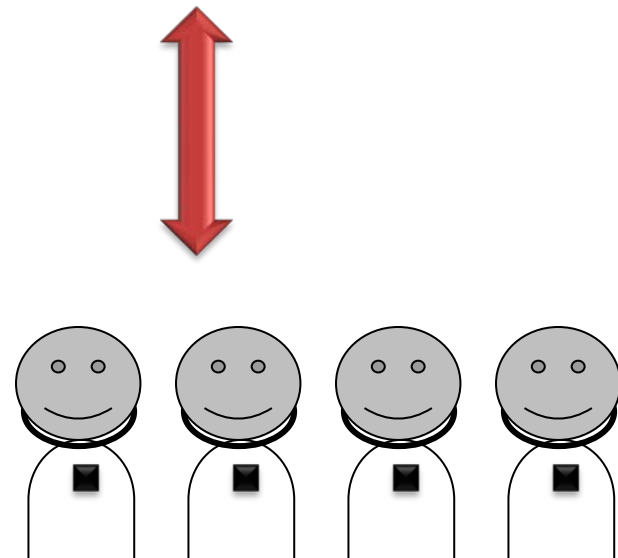
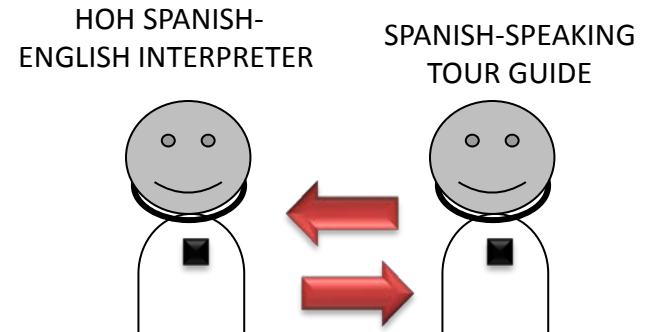
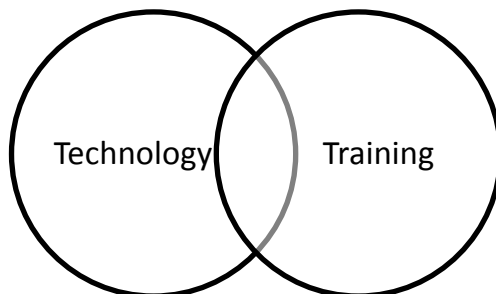


NOISY RESTAURANT

Newer Digitally Modulated Technologies

Spread Spectrum/Frequency Hopping 2.4 GHz

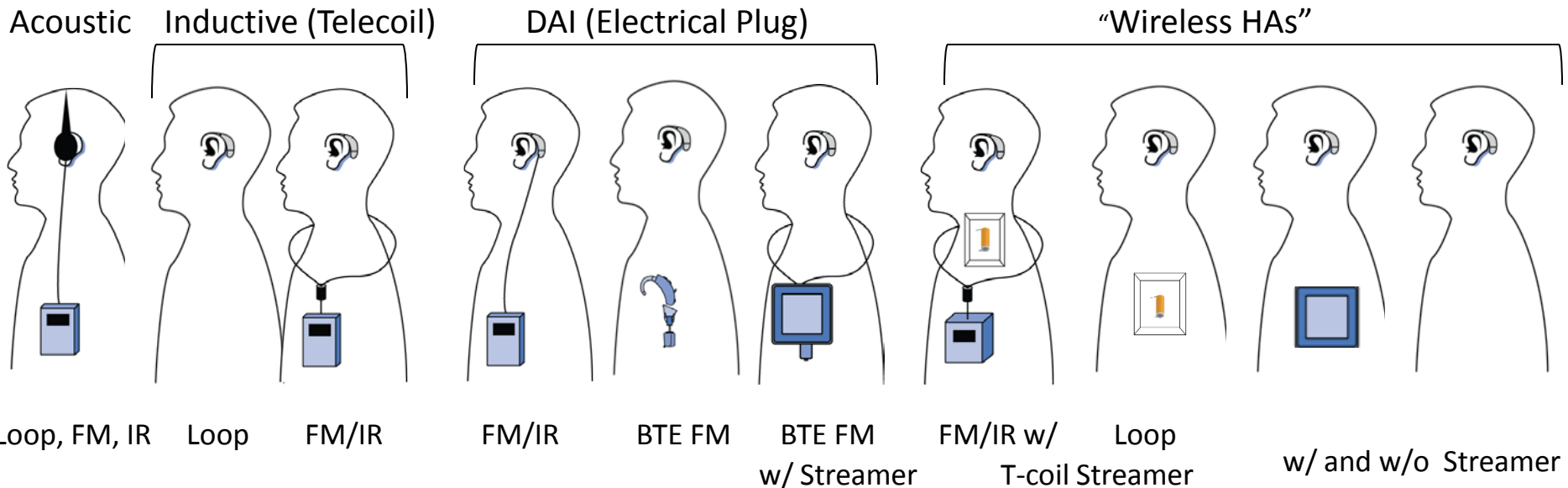
- TOURS
- PROFESSORS WITH HEARING LOSS
- BOARD MEETINGS
- OPERATING THEATERS
- TRAINING TIPS:
 - Change seating configuration
 - Proper lighting
 - Rules of communication



Normal hearing and/or HOH Audience
enjoying the narration without negative
effects of distance, noise, echo

Face-to-face/Media Takeaway

1. Cacophony of coupling options for private and public venues/too many systems
2. Incompatibility among systems
3. Each person's system must be adjusted achieve the best signal.
4. Systems requiring receivers require maintenance



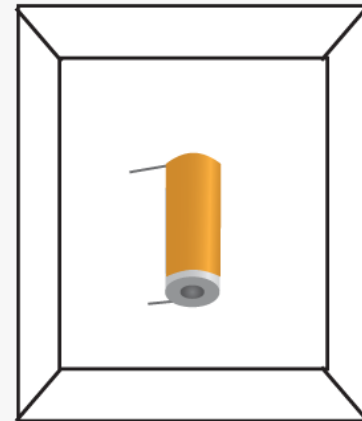
Face-to-face/Media Takeaway

5. HA/implant users need telecoils for access to public ALDs

INSIDE THE HEARING AID
OR IMPANT



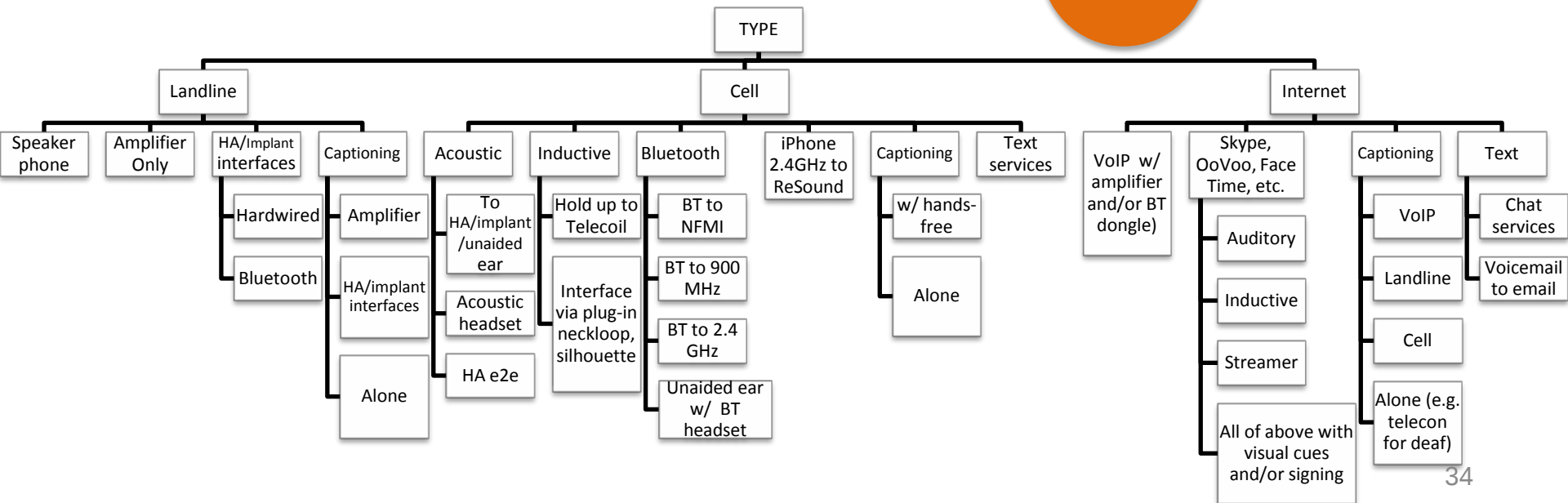
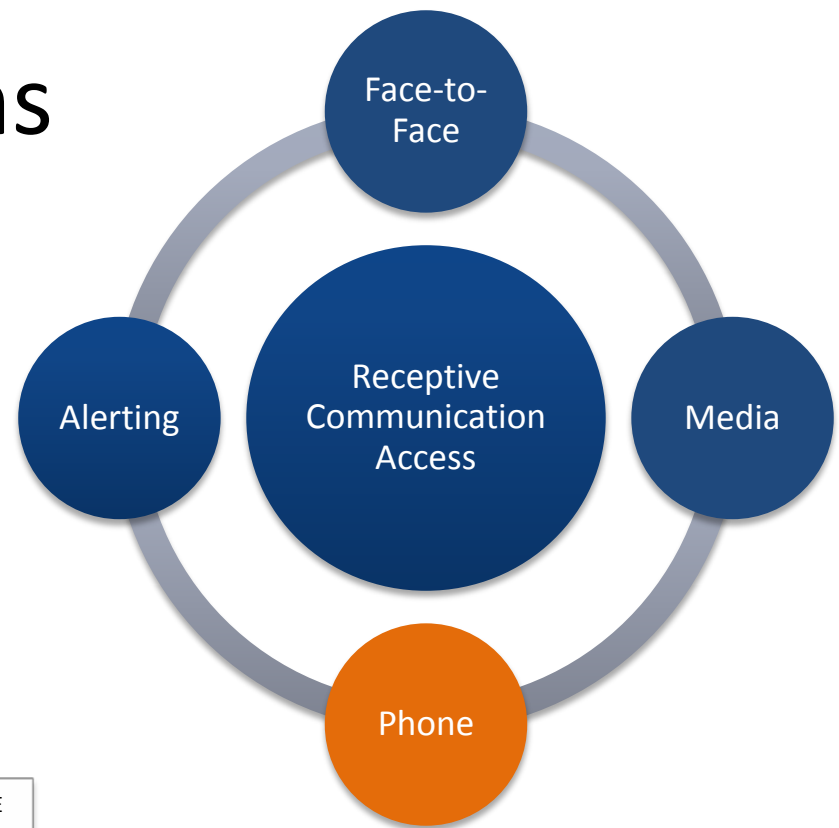
INSIDE THE STREAMER



Telecommunications

Many options available for access to all telecommunications platforms: with or without HAs/implants:

- Amplified phones; add-on amplifiers
- Hands-free interfaces
- Speech-to-text services



Binaural Listening: Mobile Landline, VoIP,

HARDWIRED



Tecear T-Link
with Telecoils



Clearsounds
CLAV2 Amplified
Neckloop



Plantronics Vista M22
Mic/headset w/
Clearsounds Neckloop

WIRELESS



ClearSounds
Quattro

Plantronics HC-
MDA200BT BT Hub



Bluetooth to HA
streamer instead of
headset

Captioning



Landline

- Clarity Ensemble
- Caption Call
- Hamilton CapTel

Smart Phone Apps

- Used w/ hands-free Hamilton, Sprint
- IOS/Android, 4G or Wi-Fi
- Register for special number.
- Missed calls go to built-in captioned voicemail

Web-based

- Use any phone
- But receive captions on web browser of a computer/smartphone
- Captioning for teleconferencing

Captioning



Landline

- Clarity Ensemble
- Caption Call
- Hamilton CapTel

Smart Phone Apps

- Used w/ hands-free Hamilton, Sprint
- IOS/Android, 4G or Wi-Fi
- Register for special number.
- Missed calls go to built-in captioned voicemail

Web-based

- Use any phone
- But receive captions on web browser of a computer/smartphone
- Captioning for teleconferencing

Other Text Services



- Email
- Instant messaging
- **Automatic voicemail transcription services that convert voicemail to text and send it via texts or email.**
 - SimulScribe (www.simulscribe.com)
 - CallWave (www.callwave.com)
 - Spinvox (www.spinvox.com)
 - Gotvoice (www.gotvoice.com)
- Remote transcription
- More info: <http://tap.gallaudet.edu/>



Amplified/Visual Stethoscopes

<http://www.cardionics.com/pdf/CatalogE-Scope.pdf>



<http://www.thinklabsmedical.com/iphone-a-ipod-touch-app.html>

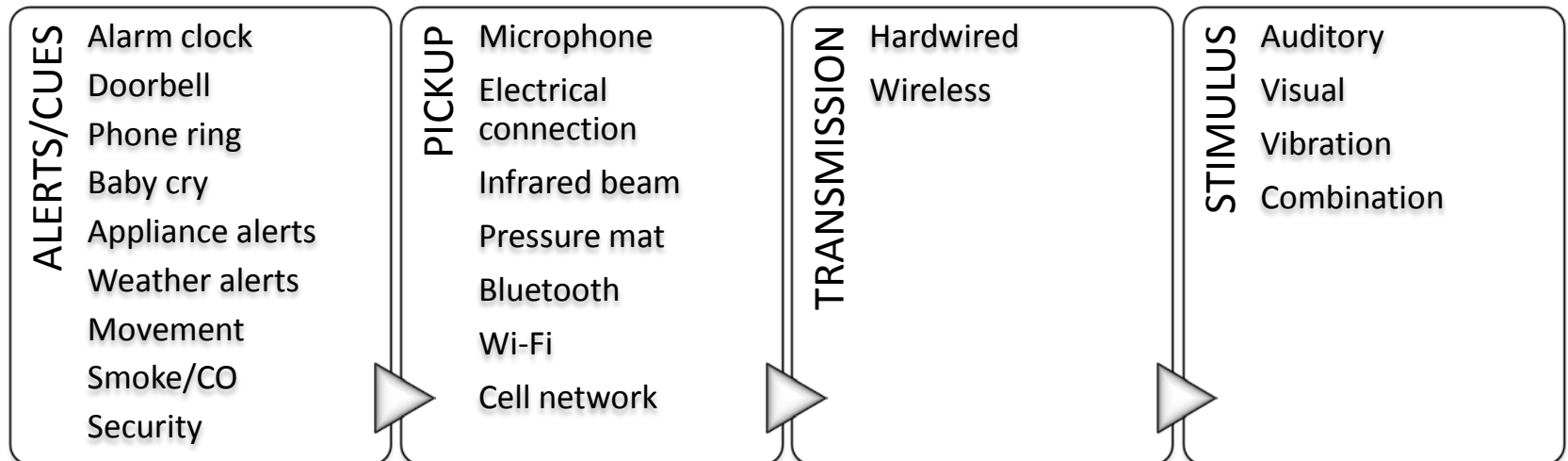
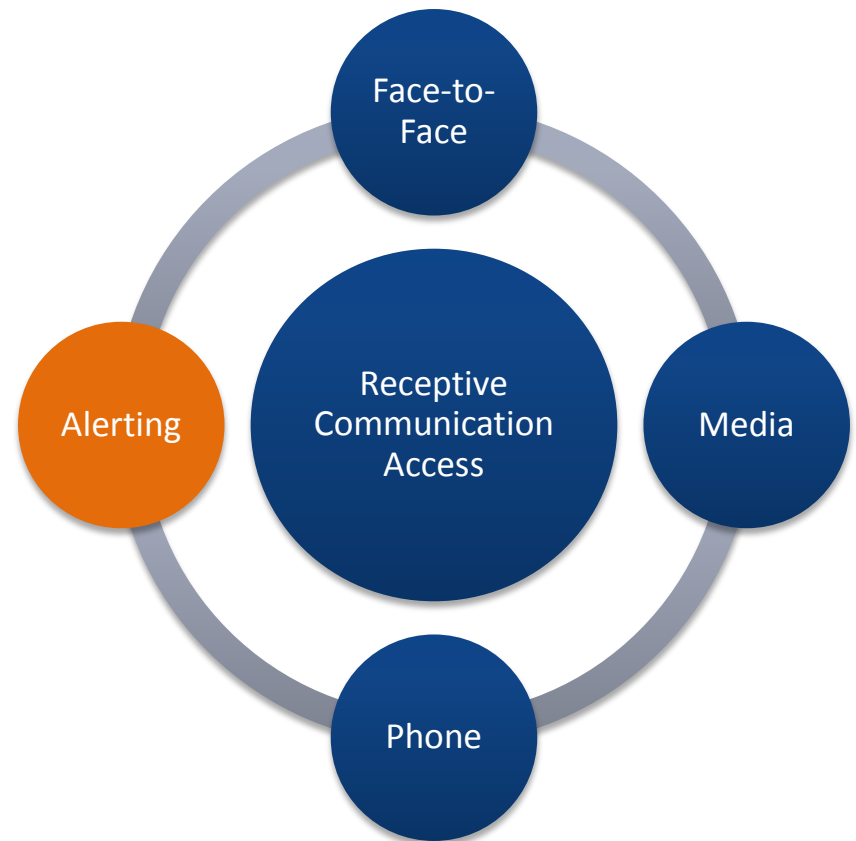
<http://www.amphl.org/StethVisual.php>



Alerting Systems

(Home, Office, Public Areas)

- Used with or without HAs/Implants
- Normal hearing people
- Stand-alone or integrated w/ hearing aids – e.g. Unitron, iPhone?



Fire Safety and Hearing Loss

- Individuals age 65+ have a fire death rate of > twice national average. (Geiman & Gottuk, 2006).
- Most current smoke detectors peak at 3100 Hz, right where older people have hearing loss (Cruickshanks, et al., 1998.)
- ~ 40 dB difference between detecting a signal when awake vs. asleep; thus, many older adults may possibly sleep through a standard high-pitched alarm (Bruck, 2001).
- People w/ hearing loss incorrectly assume that they will be alerted to their smoke detector with HAs off (Compton-Conley and West, 2008).
- For more info on fire safety: [soundstrategy.com/tutorials/how-alerting-technology-can-keep-you-and-your-family-safe-and-add-convenience-your-life](https://www.soundstrategy.com/tutorials/how-alerting-technology-can-keep-you-and-your-family-safe-and-add-convenience-your-life)

Disruptive Technology

Leaping to Change the Paradigm



First Generation Streaming From Smartphone to Wireless HAs



Second Generation Streaming From Smartphone to Wireless HAs



<http://www.reuters.com/article/2013/11/24/us-denmark-hearingaids-idUSBRE9AN05M20131124>

Lo and behold!
It's the holy
grail!



Wait a minute. Don't I
still need a telecoil at
the movies?

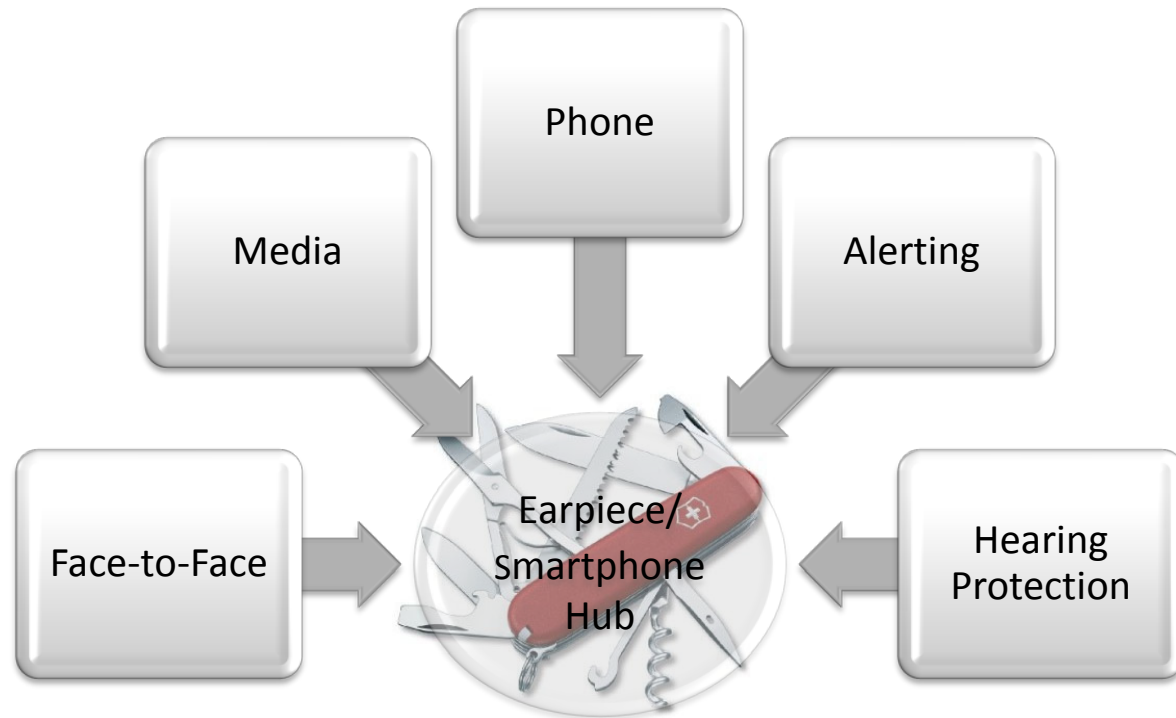
Envisioning the Future



- Public venues would transmit audio directly to smartphones (or HAs), avoiding receiver maintenance and coupling issues.
- TV chips for audio transmission directly to the hearing enhancement device (home, nursing homes, etc.)

Apple/ReSound partnership illustrates the critical role that smartphones, and their hosted applications, will play in the future.

One “total communication” device?



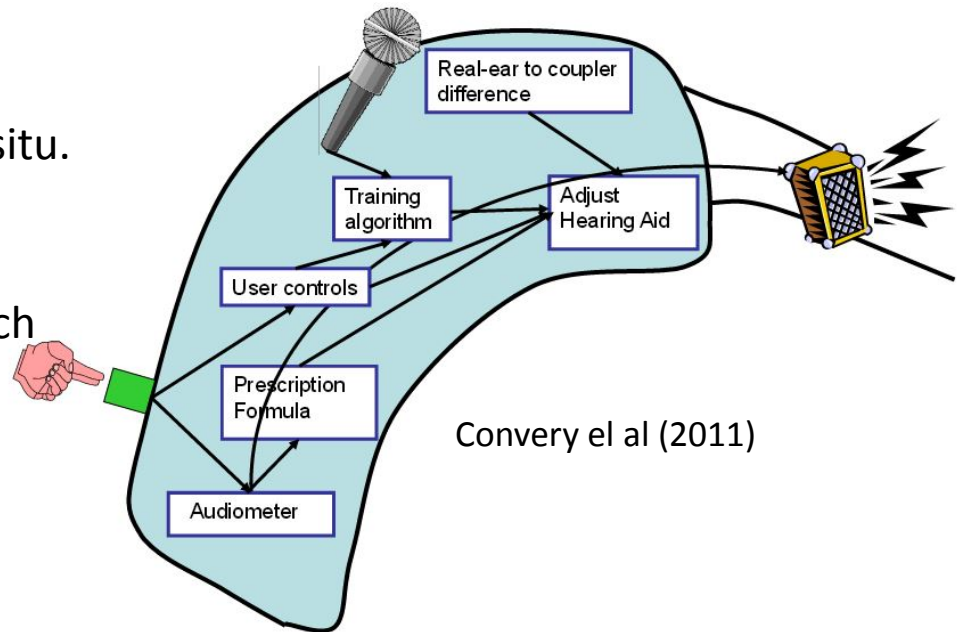
- One device w/ smartphone hub, programmable via an app/multiple apps
- Default settings used when you don't have your mobile device
- Meets all 4 needs, in changing venues/environments
- Hearing protection device
- Self fitting

Self-fitting Devices?

- Research Being Done at National Acoustics Laboratories
(Trends in Amplification 2011 15: 155)

- Self-fitting hearing aid:

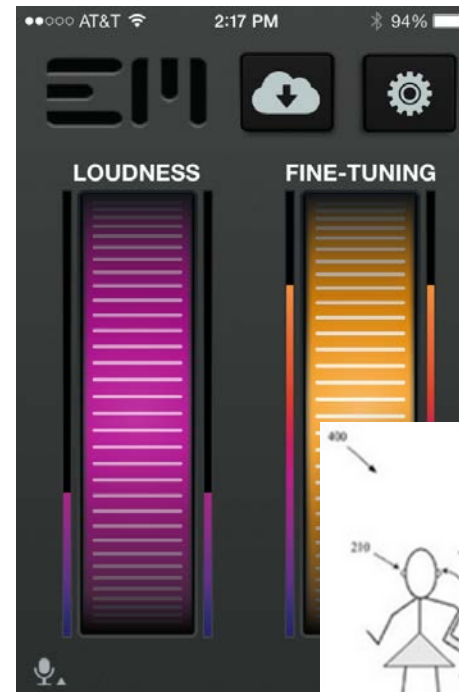
- Measures hearing thresholds in situ.
- Creates a “prescription.”
- Fine-tunes over time to meet each person’s listening demands.



- Software to enable CI users to optimize processing

Smartphones as Hardwired Hearing Enhancement Devices

- 25 - 30 apps
- With an app, good earphones and a high fidelity add-on mic, phone becomes a body aid or hard-wired ALD.
- “Social” iPhone/hearing aid system?
 - Users save settings that work well for certain environments/activities.
 - Settings shared w/ friends via phone.

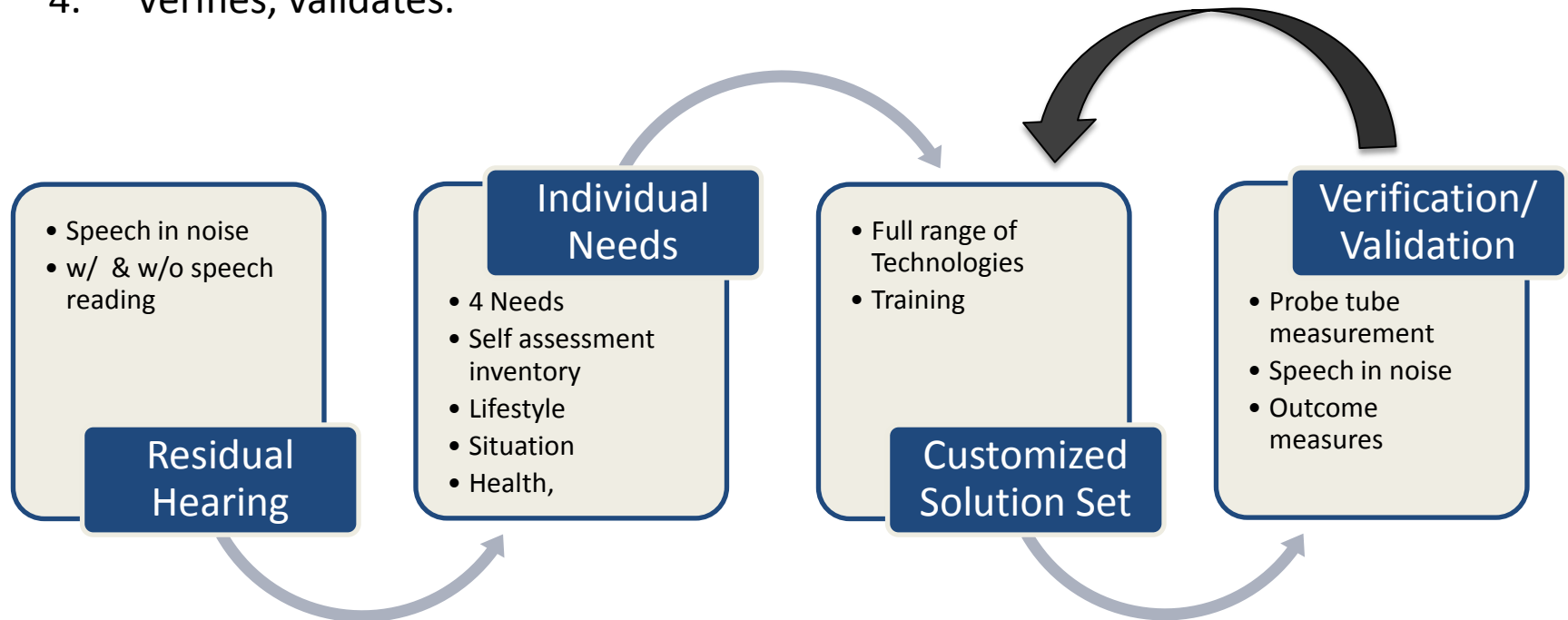
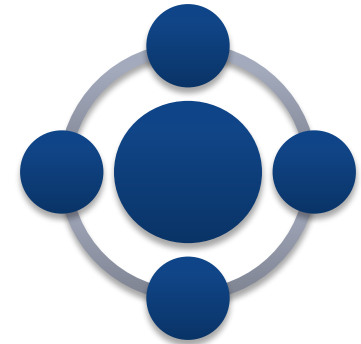


EarMachine by Ear Machine



- 
- An aerial photograph showing a vast, dense layer of white and grey clouds stretching across the horizon. The sky above is a deep, clear blue. The clouds are thick and textured, with some darker patches visible within the white mass.
1. What do consumers with hearing challenges want/need?
 2. How do we meet their /needs?

1. FULL receptive communication access– for a lifetime.
2. Employing a holistic systems-engineering approach that:
 1. Carefully assesses residual hearing using best practices
 2. Focuses on individual needs based
 3. Considers full range of technologies & training
 4. Verifies, validates.



NEED INFLUENCES TECHNOLOGY . . .
TECHNOLOGY SERVES NEED

CHALLENGES

SOLUTIONS

Lack of standardized training in needs assessment, selection, fitting, verification, validation of hearing enhancement technology.	Required sequence of didactic/clinical coursework standardized across training programs, focusing on best practices. More rigorous accreditation.
Too many confusing technologies and coupling options. Too much time required to learn (professionals and consumers).	Open-platform, universal design providing: 1. Simplified selection/fitting process 2. Easier consumer access 3. Minimal maintenance for venues Instructional apps for personal/public access; ALD Locator
Lack of information on technology and full access in general. In 2009, only 34% of consumers were aware they had a telecoil in their hearing aid . Kochkin, S (2010) HJ 63(1).	ADA places onus on the consumer. Massive informational campaign (TV, internet, print) ; consumer checklist
Lack of a variety of price points for hearing enhancement solutions. Consumers want more choice and more input into their hearing health care.	Continued R & D of self-fitting, self-adjustable, open platform devices. Open market to <u>both</u> prescribed/non-prescribed products for hearing enhancement.

Thank You

Some resources for unbiased information on hearing enhancement technology

- <http://soundstrategy.com/>
- <http://tap.gallaudet.edu/>
- <http://www.hearingloss.org/>
- www.hearingloop.org



“It’s a special hearing aid. It filters out criticism and amplifies compliments.”