

Deviceware[®]

Integration with Resonance™ Portable Diagnostic Devices

White Paper (v1.1)

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Preface

RemotEAR offers Deviceware as a subscription-based service for hearing care professionals, enabling them to utilize existing diagnostic devices to perform patient testing and counseling at a distance. Recently, the company has collaborated with Resonance Audiology, an Italian developer and provider of affordably priced hearing diagnostic products, to enable Deviceware to integrate with the devices and provide a turn-key solution for customers.

This whitepaper provides an overview of the integration and technical capabilities of the Resonance portable diagnostic devices as used with Deviceware to provide a robust tele-audiology platform for today's busy hearing care professionals.

Introduction

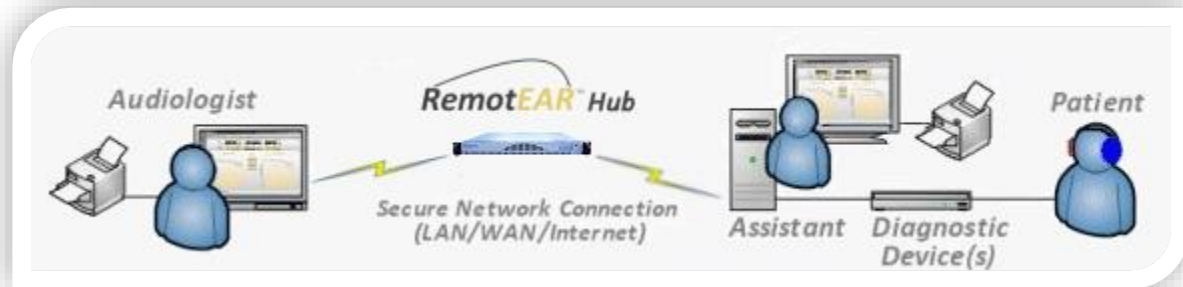
Hearing care professionals are becoming more receptive to tele-audiology, or the ability to remotely assess and assist patients with their hearing concerns and problems. Telehealth/telemedicine has existed in various forms since the mid 1970's, notably in early tele-radiology implementations, followed by the rise of remote care delivery across medical specialty and provider/patient continuums in the last two decades. This expansion of use and utility has been driven by two important technical trends: the emergence of affordable conferencing technology and the widespread availability of broadband communications.

Today, hearing care professionals are looking for new ways to improve efficiency in their delivery of high quality care, and tele-audiology is now a viable way to facilitate and create a paradigm shift in the care delivery model.

This whitepaper describes the combined solution of RemotEAR's Deviceware tele-audiology service with Resonance Audiology's range of portable diagnostic devices, which together create a turnkey solution for remote hearing care delivery and better patient care.

Environment Overview

The environment described in this whitepaper is an office to office setting for hearing care delivery, though many of the logistics and methods apply to a home-based care model as well.



As shown in the diagram above, an Audiologist (or hearing aid dispenser, ENT, or occupational health worker) who is based in a remote office location can connect, control and manage a complete interactive/videoconference encounter with a patient at a remote office location, when accompanied by an Assistant co-located with the patient and diagnostic equipment.

Importantly, the Assistant provides the hands-on capabilities needed in this model, such as placement of transducers, management of the ambient environment for testing purposes, operation of certain probes (e.g., tympanometer, otoscope) for remote viewing, etc. The Assistant must be trained and familiar with hearing care protocols and experienced in operating the equipment. They should also be trained in the conversion of existing equipment from traditional delivery to tele-audiology use and back again.

Within this delivery mode and environment, a range of diagnostic tests can be completed, including:

- Audiometry (air, bone, and speech)
- Real Ear Measurement
- Tympanometry and Acoustic Reflex
- Auditory Brainstem Response (ABR)
- Otoacoustic Emissions (OAE)
- Video Otoscopy
- Balance Testing

With the use of suitable quality videoconferencing as part of the configuration, the remote hearing care provider can interact directly with the patient and provide both instruction on the testing process as well as counselling on the results and planning for future care. Deviceware includes support for webcam conferencing if available on the PC's in use. Other implementation models using more

expensive and life-like conferencing equipment is also possible, therein using Deviceware to manage the application sharing of the PC software which manages the diagnostic equipment.

It is worth noting that while diagnostics are the focus of this whitepaper, many of the same features apply to the delivery of both office and in-home care for hearing aid wearers and the ability for them to receive counselling and adjustment of their hearing aids in real-time.

Key Points

- Adequate broadband communications must exist between the two locations, and be both consistent and reliable in operation
- For a suitable interaction between remote hearing care provider and patient, careful attention must be given to the adequacy and type of videoconferencing used
- Diagnostic equipment used in this type of delivery model must be PC software controllable
- The Assistant must be trained and experienced in all facets of the diagnostic processes
- Instructions on how to minimize disruption due to technical problems is a key factor in the success of this type of hearing care delivery

Configuration Overview

The configuration will vary a bit depending on the diagnostic device used, but in general the following features are common across all devices. The configuration assumes the user/reader has already acquired and installed both the Display Screen app and Deviceware.

Establish Setup

- Ensure that the patient is appropriately positioned and comfortable prior to starting the interaction with the remote provider.
- Turn on the diagnostic device to be used for testing, and place transducers (if appropriate) on the patient.
- Connect the USB cable from the diagnostic device to the PC, and launch the Display Screen app so that the device screen is displayed on the PC monitor.

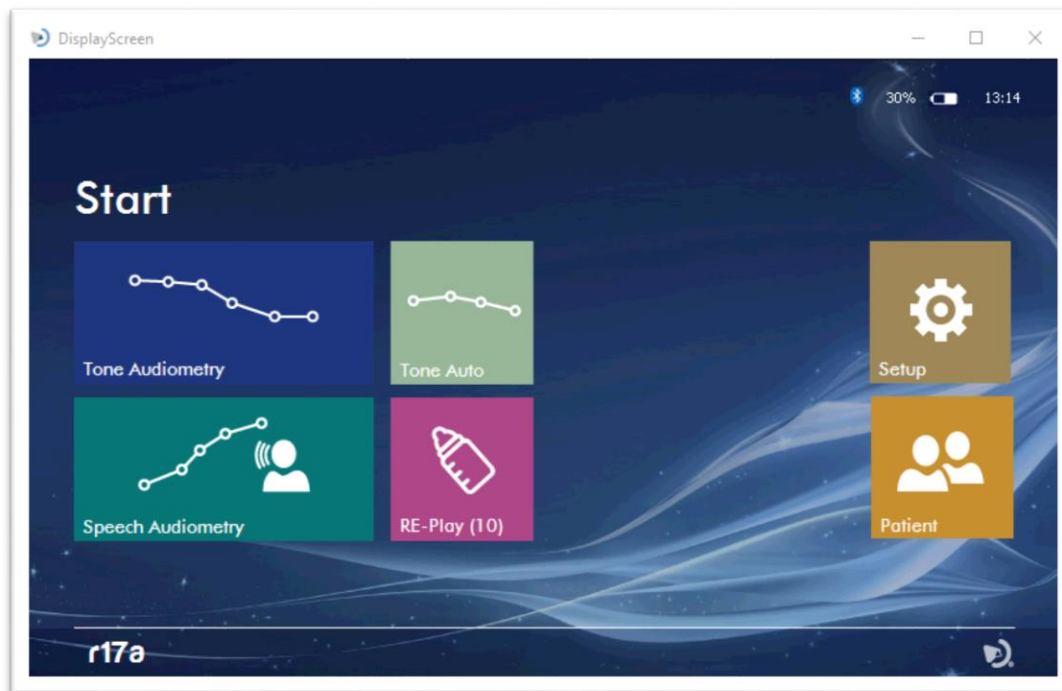


Figure 1: R15C screen shown in Display Screen app

- Launch Deviceware and select Host a session to begin the remote access process.
- Invite the remote hearing care provider to join the session, either by email from the app or by phone, communicating the meeting ID code to join the session.
- Once the remote provider has joined the session, launch the webcams on both ends thereby establishing a visual communication link between the two sites.
- Turn control of the diagnostic device(s) over to the remote hearing care provider using the Deviceware 'Give Control' button, enabling them to control the device software and manage the testing process.

Workflow Overview

Once the connection with the remote provider is established, the diagnostic encounter process can begin. The remote hearing care professional can direct the entire interaction with the patient and the testing process as though they are there with the patient. However, the Assistant, as previously noted, plays an important role for the hands-on things that the remote provider cannot do, such as placement/operation of the transducers, monitoring the testing process for appropriateness, etc.

Note that while the interactive session is designed to emulate a real-time encounter, certain accommodations will be needed to compensate for the distance. For instance, the hearing care

professional can operate the remote device, such as the audiometer directly, but must account for minor timing issues inherent in the remote exam. This typically is a half-second or so delay in response and screen refresh, but may be more depending on your connection speed, network traffic, and other factors.

Compatible Devices

The following devices are based on Resonance's portable R1x-series platform, and are therefore compatible with Deviceware:

- R17A Audiometer – [specs](#) (*Ctrl+click to open in a new window*)
- R16M Middle Ear Analyzer – [specs](#)
- R15C Combined Audiometer/Tympanometer – [specs](#)
- R14O Otoacoustic Emissions – [specs](#)

Together, this family are a truly portable yet powerful line of diagnostic devices, which can be purchased in a range of configurations that are both excellent in their performance, and also very affordably priced.

Resonance and RemotEAR worked together to create the Display Screen module that enables the Resonance devices to be used with RemotEAR's Deviceware tele-audiology service, enabling hearing care professionals to expand their practice to include remote diagnostic services

Device-specific Notes

When operating the various Resonance device models, some characteristics differ, which are listed here.

Audiometer (R17A/R15C):

- Full keyboard support is offered, enabling use of the directional buttons to operate the movement on-screen. The up/down buttons change the decibel level at a given frequency, and the left/right buttons move across the frequency range (of those frequencies selected in the settings). The keyboard Spacebar actuates the stimulus signal.

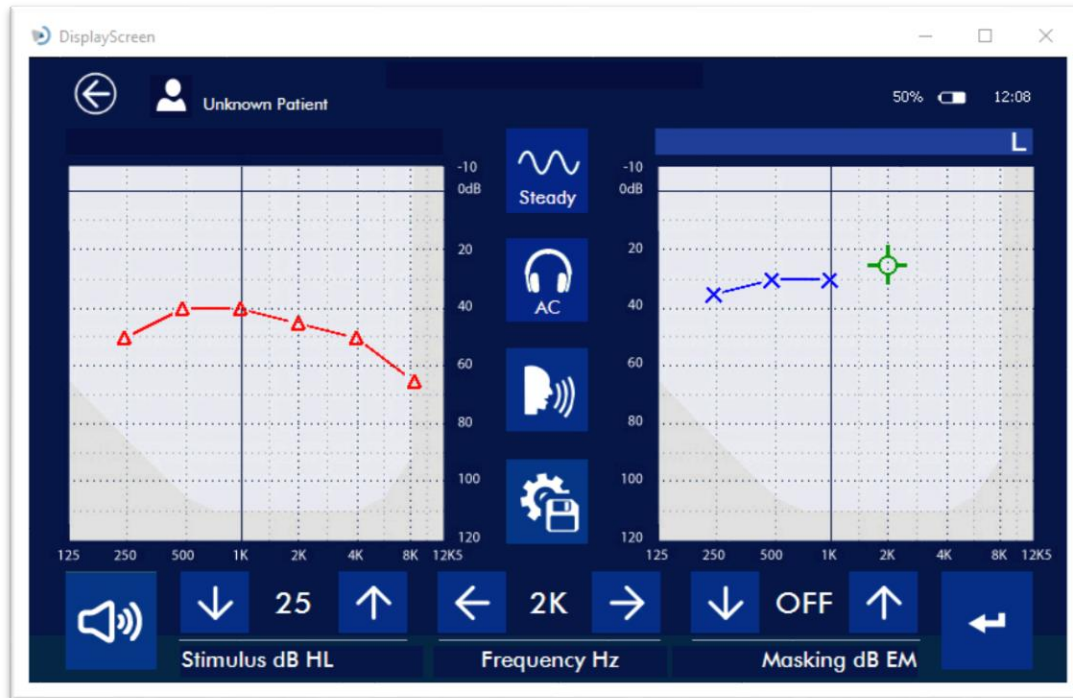


Figure 2: Use the directional buttons and space bar for audiometry functions

Closing the Session

When the diagnostic testing and counseling process is complete, the session can be closed by following these steps.

- Remove any transducers or sensors in contact with the patient.
- Turn off the webcam or videoconference camera using the Deviceware app or external codec control.
- Close the Deviceware session.
- Close the Display Screen app on the PC.
- Disconnect the diagnostic device USB cable from the PC.
- Save and close the patient test results if not previously done.
- Power down the diagnostic device.

Summary and Recommendations

The integration of RemotEAR's Deviceware platform with Resonance Audiology's portable diagnostic line of devices is a simple to use and powerful way to provide remote testing and counselling. The implementation is based on having appropriate broadband communications between the two participating locations, and videoconferencing capabilities to make the interaction as true to life as possible.

The clinical protocols used for the diagnostic process mirrors that used in a direct face-to-face patient encounter, with some adjustments for distance and timing in the performance of the care delivery model. Importantly, RemotEAR offers both a Software-as-a-Service (SaaS) version of Deviceware as well as the ability to purchase a hub for those companies and enterprises who require complete end-to-end security and control of the communications. In either mode, the Deviceware app works seamlessly with the diagnostic equipment to make testing as simple and effective as possible.

When evaluating Deviceware for use in your organization, be sure to observe the following guidelines for its optimal use:

- Insure that the communication link between the office locations is sufficient and consistent, monitoring for network or computer variations due to resources used by other parties or software running concurrently.
- Avoid the use of wireless communications (Wifi) when possible, as the variability in wireless networking can dramatically impact the performance of the systems and hence the effectiveness and patient satisfaction.
- Define and document any problems encountered during the testing, and identify the root causes of the problem, creating a checklist for how to overcome problems which can and will occur during live patient testing.
- Recognize and plan for the cost factors/savings in implementing tele-audiology, including the trade-offs in windshield time for providers and the ability to manage multiple encounters from a central location.

Conclusion

In conclusion, the combination of RemotEAR's Deviceware platform with Resonance Audiology's high-quality portable diagnostic devices provides a simple, elegant and affordable means to enable remote diagnostic testing for hearing care professionals. With just a connection of the device to the PC with Display Screen, and launch of the Deviceware app, a hearing care provider can provide meaningful diagnostic help and services to a remote office where the patient is located. Central to the success of this delivery model is the training and expertise of an Assistant, who provides the hands-on and monitoring functions that are a critical part of an effective patient encounter.

By combining these two technologies in a simple and straightforward manner, we believe that a new way of delivering hearing care is now possible for the first time. We look forward to your feedback as you begin your journey with these new tools that help extend your patient care delivery.

Appendix A – Troubleshooting Setup & Operation

While we've attempted to make the setup and operation of the integrated Deviceware and Resonance equipment as straightforward as possible, we recognize that problems will inevitably occur. Following is a list of potential problems and solutions or workarounds that can be implemented:

Problem	Solution or Workaround
<i>Display Screen does not display image from device</i>	Unplug and plug-in the USB cable, await the USB tone. Display Screen should then display the device screen. If not, close Display Screen and reopen.
<i>Using a touchscreen, not all the buttons are usable with Display Screen</i>	Microsoft's implementation of touchscreen in Windows 10 (and potentially prior versions) can make it difficult to press, hold, and release buttons such as a stimulus button on the audiometer. We recommend using the keyboard shortcuts for this and some of the operations of the device.
<i>A delay in refreshing the screen makes this less than ideal</i>	The refresh rate of the screen is directly tied to a variety of factors, such as connection speed, other software running on either PC, network traffic, etc. While the response on the patient end is very quick, it often can take a half second or more to refresh the local screen. We recommend testing this at various times and situations and accounting for this in your testing protocol documentation. The best outcomes will exist if connection speed is > 2 Mbps, and network traffic is low.
<i>How do I acquire the Display Screen app? Is it free?</i>	It will be provided when you receive your device, or a download from our website will be available and posted. The Display Screen app is free.
<i>How much does Deviceware cost?</i>	We offer a subscription to the Deviceware Software as a Service platform for a very reasonable price. Please contact RemotEAR for pricing and options, as well as pricing and details for a dedicated hub which may be purchased and installed in your organization's network for maximum security and administrative control.