

Data over Sound

Risks and Chances of an emerging Communication Channel

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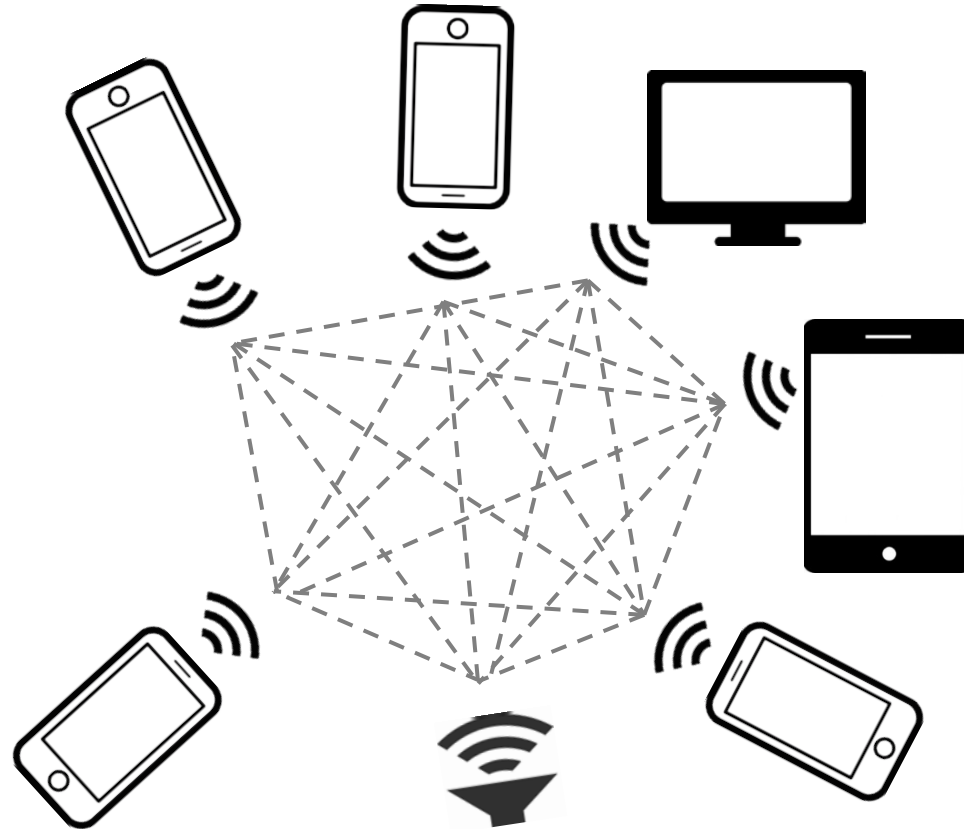
Reversing and Offensive-oriented Trends Symposium (ROOTS)

DeepSec Conference 2018, Vienna , 30.11.2018

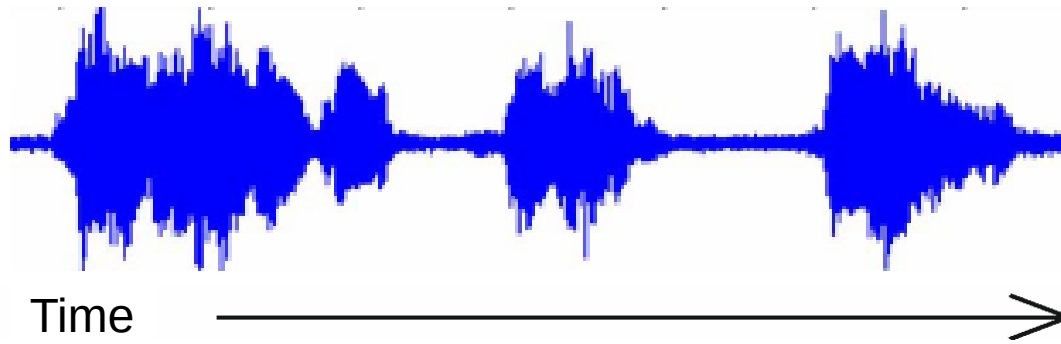
The background of the slide is a grayscale image of a musical score, showing several staves with notes and clefs. A semi-transparent gray rectangular box with rounded corners is centered horizontally across the middle of the image. Inside this box, the text "Who knows about ultrasound communication?" is written in a white, sans-serif font.

Who knows about ultrasound communication?

What is meant by Ultrasonic Communication?



What is Ultrasound?



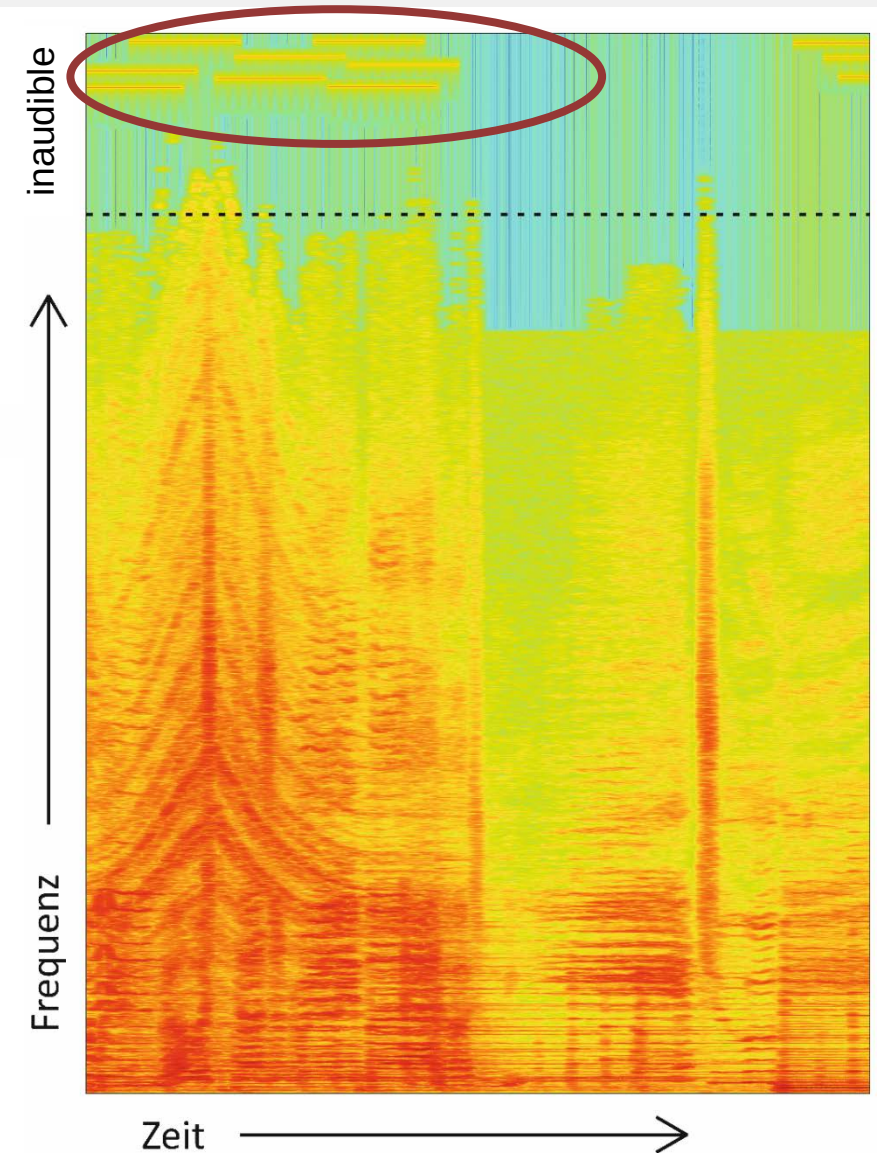
Frequency range:
18-22kHz

Why in this channel?

Inaudible (almost)

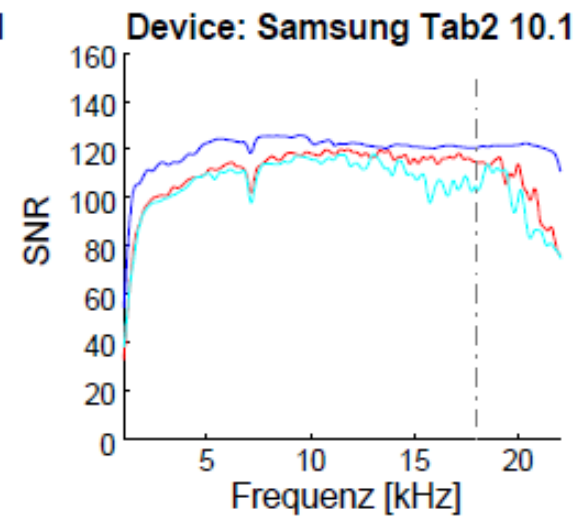
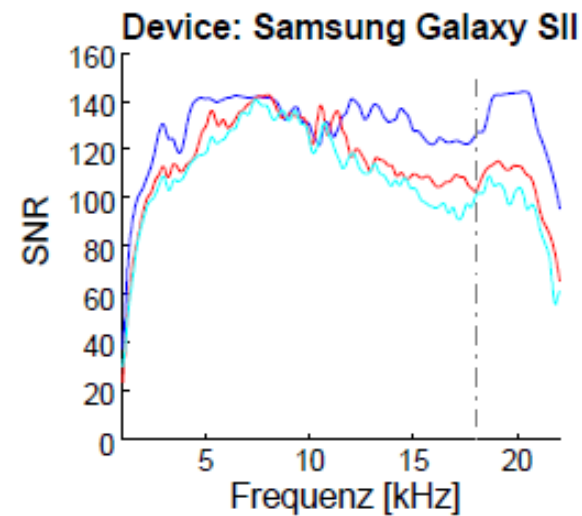
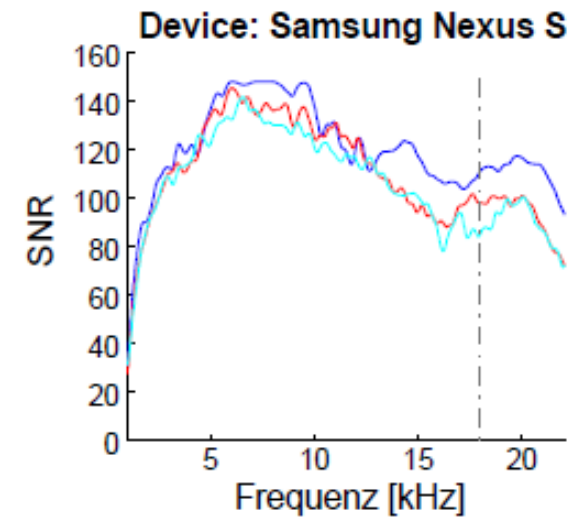
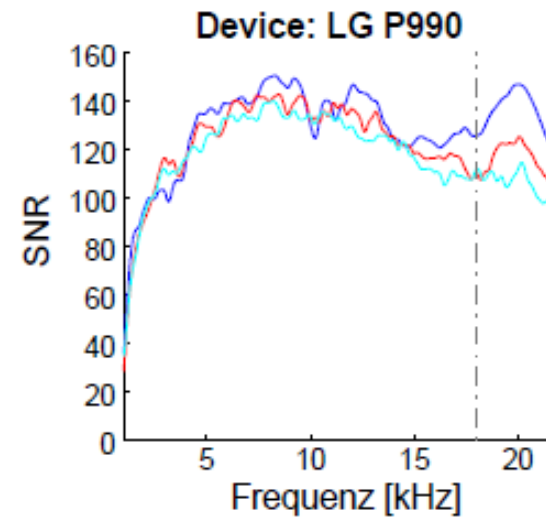
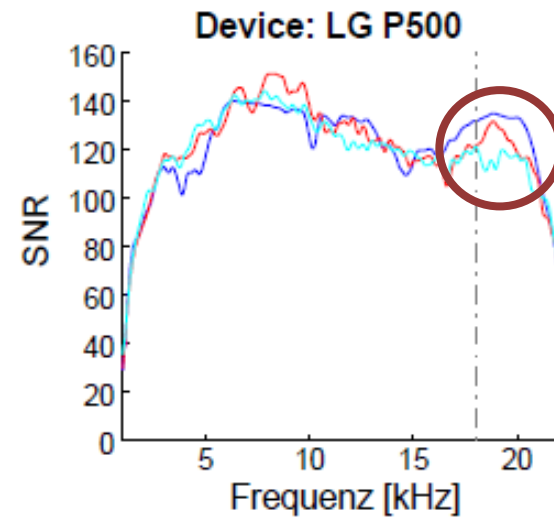
Low noise level

Higher data rates



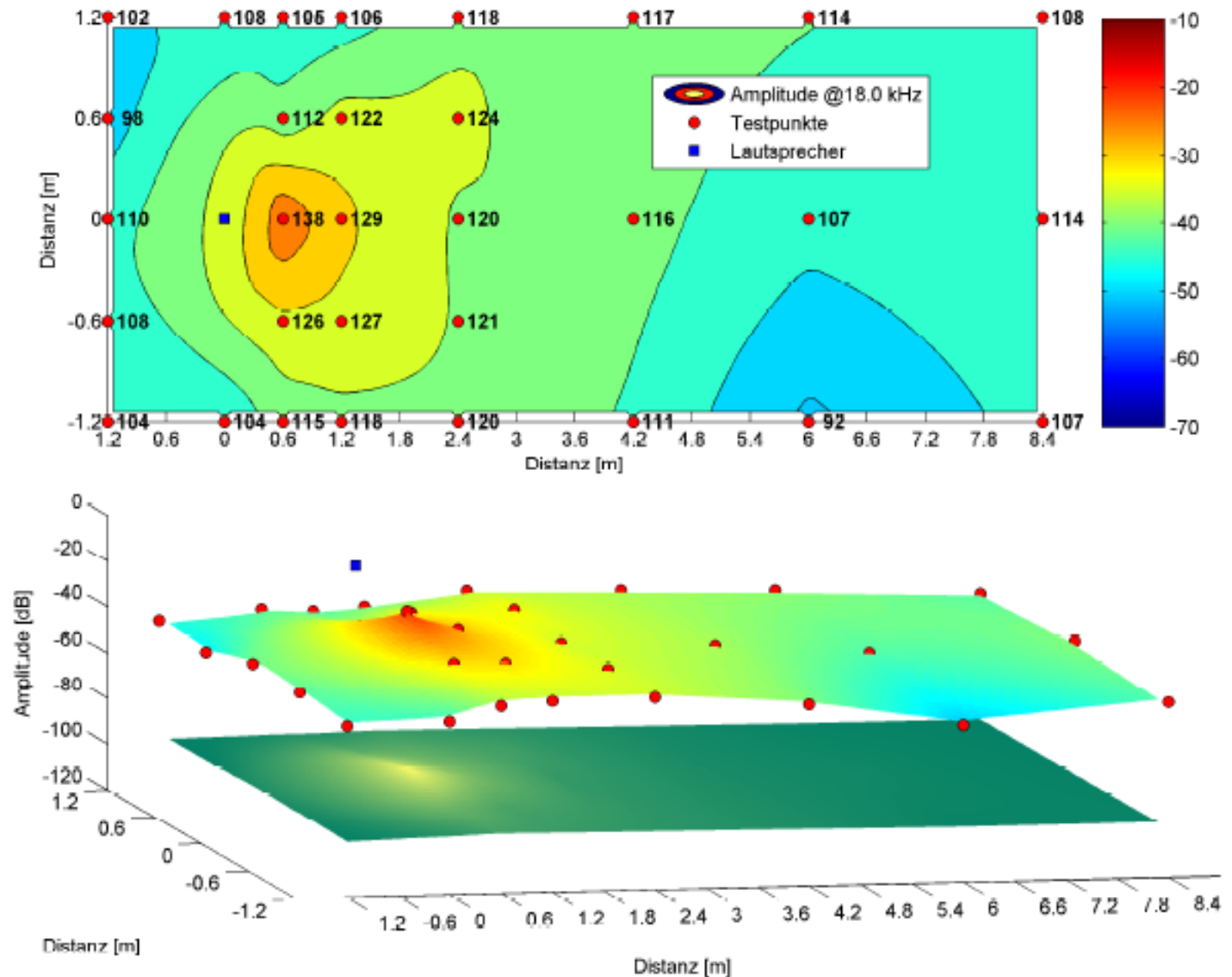
Can We Receive Ultrasound?

- Lab experiment
- Piezo Tweeter @ room volume
- Frequency response of smartphone mics



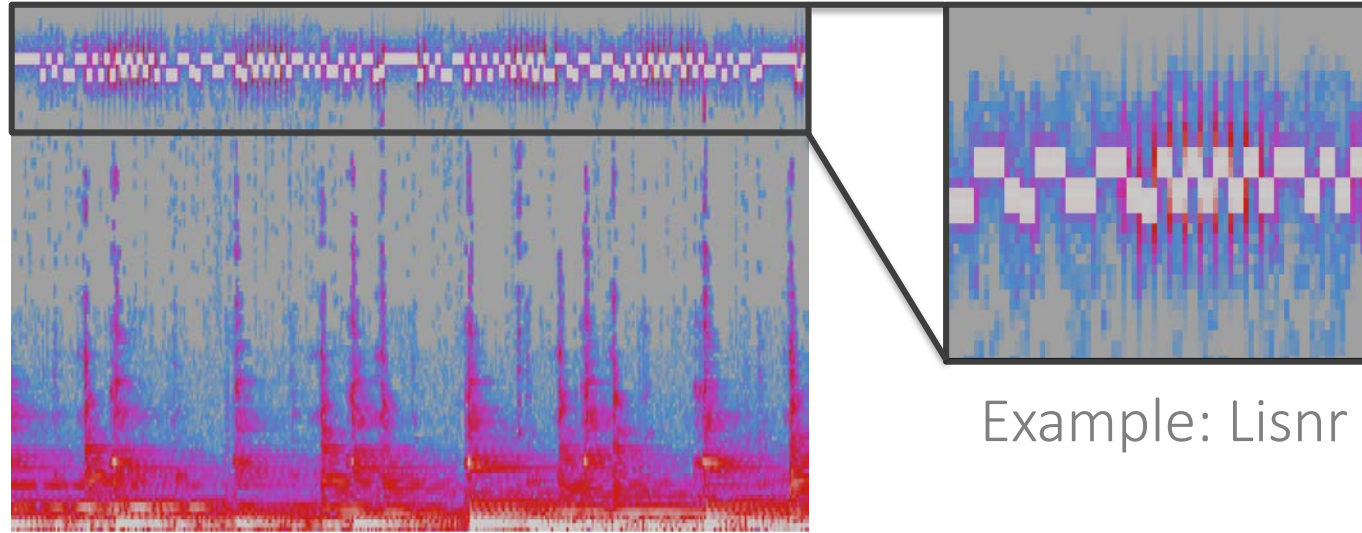
Range of Ultrasound

- Lab experiment
- Tweeter + Samsung Galaxy S2
- Omnidirectional data transmission
- Distance up to 8 Meter
- Stops at walls!



How does data transmission work?

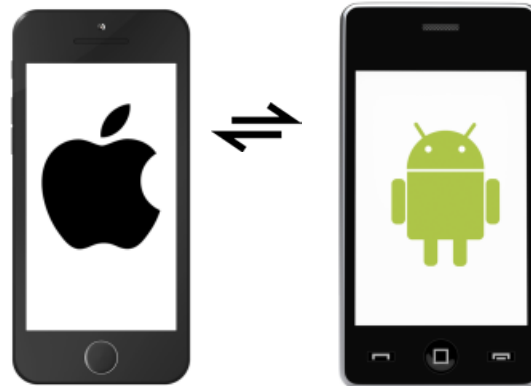
- Most often: Frequency Shift Keying (FSK) → compare fax machine / old school modem



Example: Lisnr

- Sending:

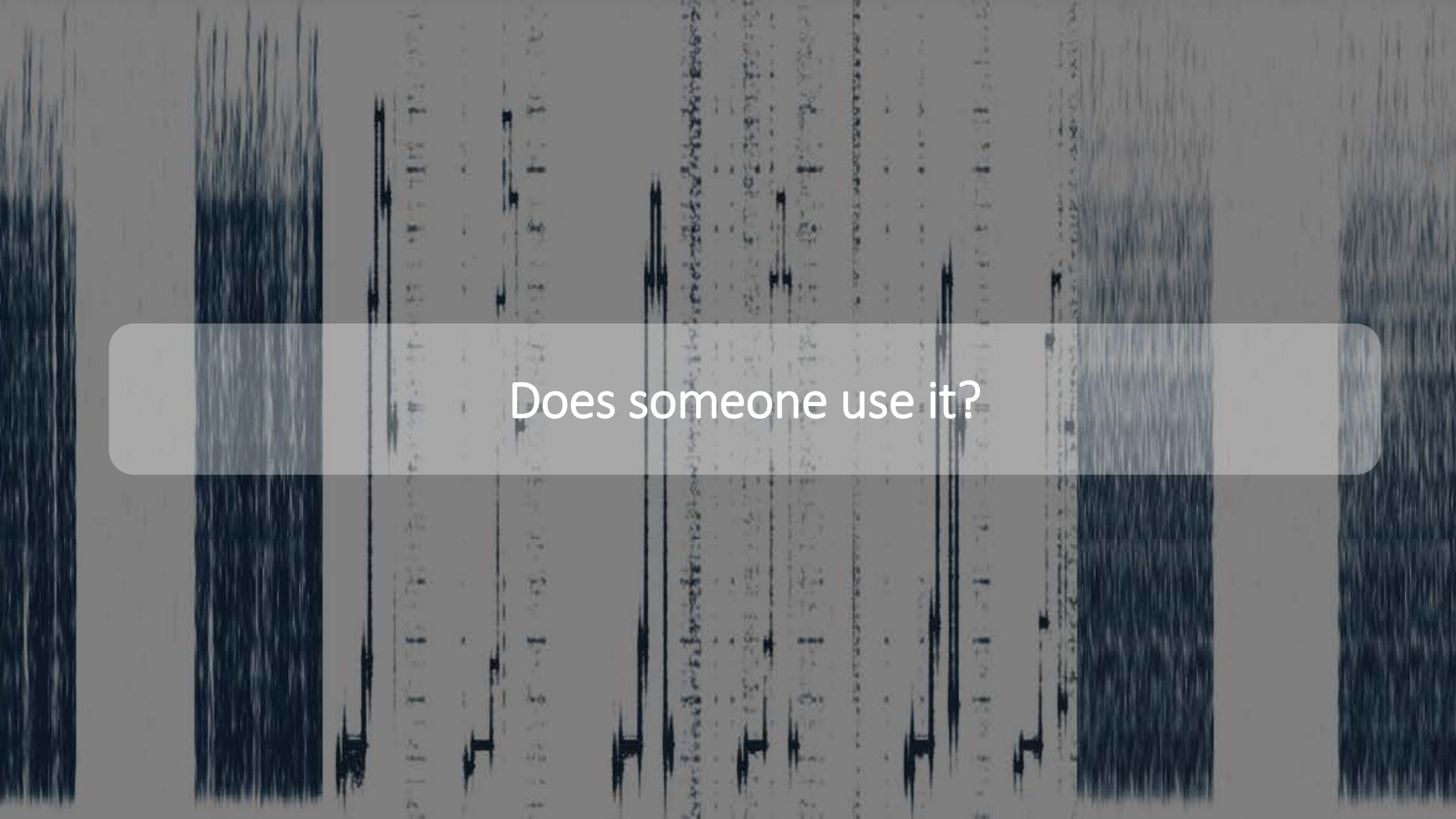
- Loudspeaker
- No permission necessary



- Receiving:

- Microphone
- One-time permission necessary

Credits: yahoo.com; Arp et. Al [1]

The background is a grayscale image of a handwritten manuscript, likely from a historical text. The script is a cursive or semi-cursive style, with dark ink on aged paper. A semi-transparent, light gray rectangular box with rounded corners is centered horizontally across the middle of the image. Inside this box, the text "Does someone use it?" is written in a clean, white, sans-serif font.

Does someone use it?

OPINION

The hottest wireless technology is now sound!

Or, the soundest new wireless technology is hot! Either way, let's make some noise!



By Mike Elgan

Contributing Columnist, Computerworld | DEC 20, 2014 4:01 AM PT



iStockphoto

Using sound for transferring data is nothing new. In the 1940s, when IBM tried to solve the problem of how to use regular telephone lines to connect two computers, it figured out a way to convert data into sound,

MORE LIKE THIS



7 Bluetooth speakers portable, now with b sound



Deep-dive review: iOS some snappy new fe



Cool tech from CES 2



VIDEO
Tech Talk: The technc scares us

NFC Alternative: Transferring Data Between Mobile Devices Using Ultrasound

By Ivan Ozhiganov on October 9, 2013



Ever since smartphones became mainstream, we've seen many new technologies emerging that make data exchange possible between mobile devices. Near Field Communication (NFC) has gained wide attention in the recent years, but only a small percentage of mobile users have adopted it.

Why Audio (and not BT / WLAN / NFC...)

Low hardware
requirements

High downwards
compatibility

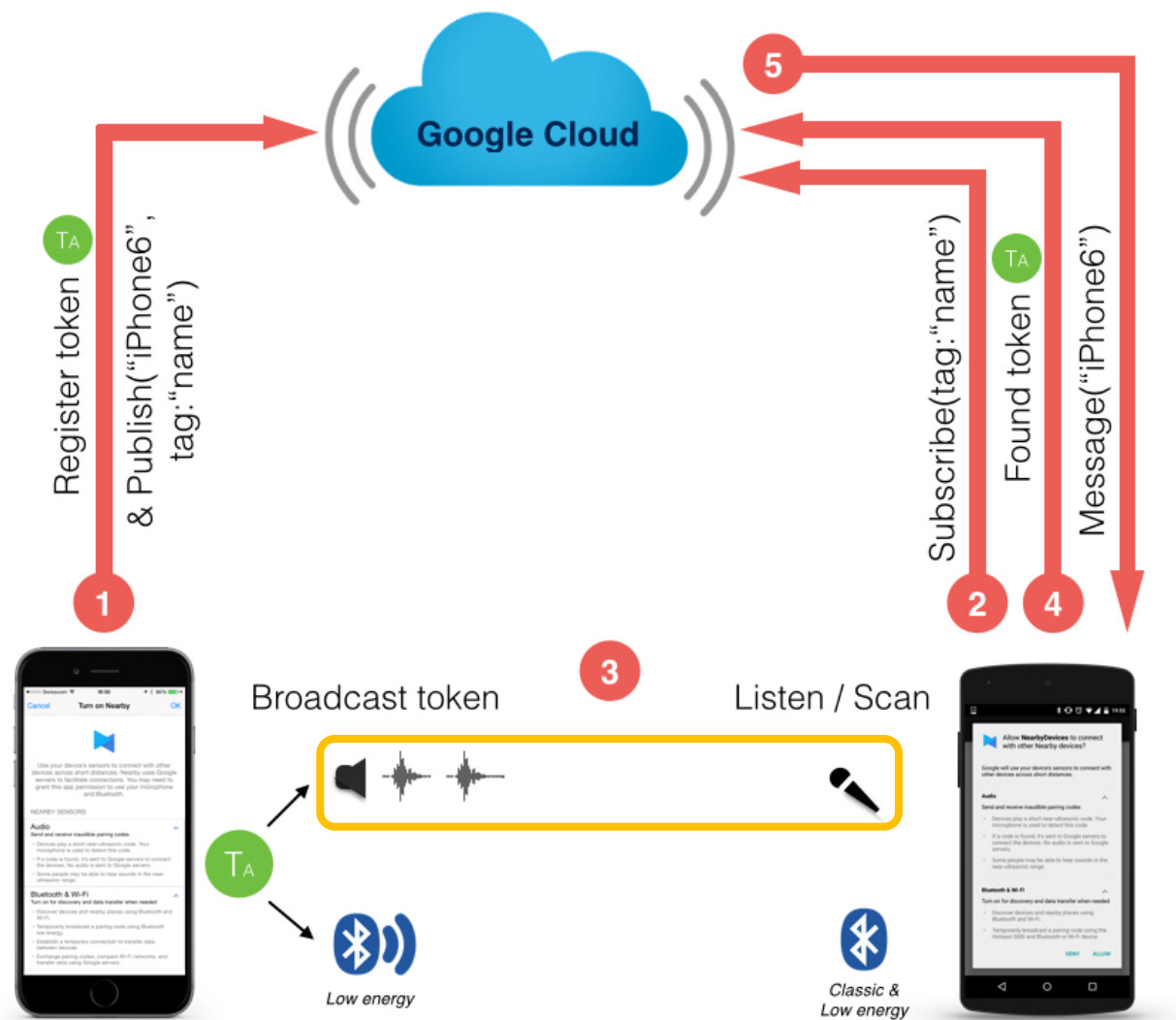
Instant
communication
(no pairing)

Controllable
range

Who develops this technology?

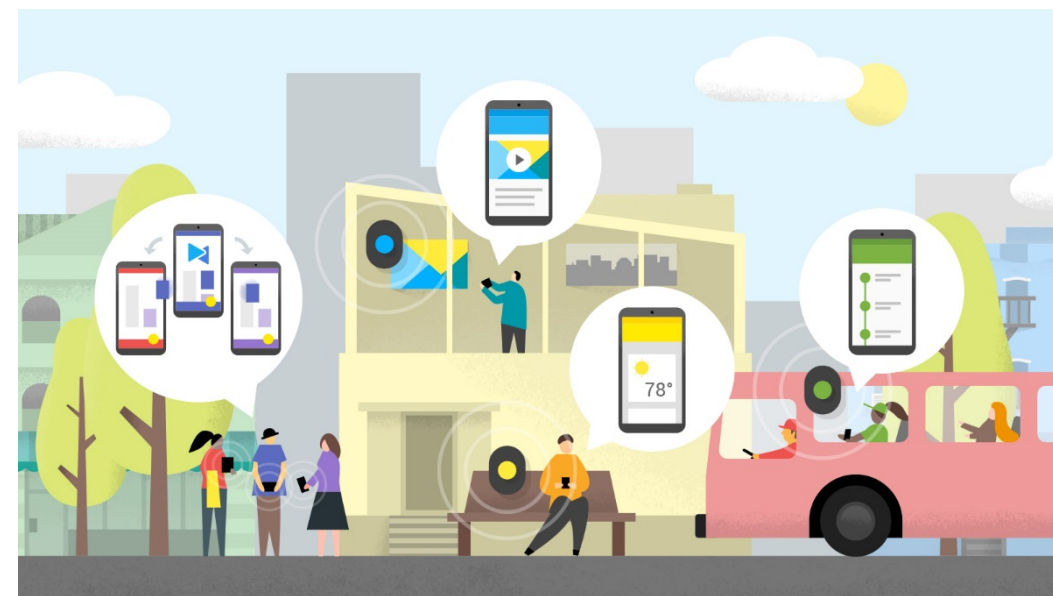


Google Nearby



How Google Nearby.Messages works?

- “Pairing” devices, e.g, Chromecast
- Location-based services
- SDK available – any app can use it



Credits: google.com, giga.de

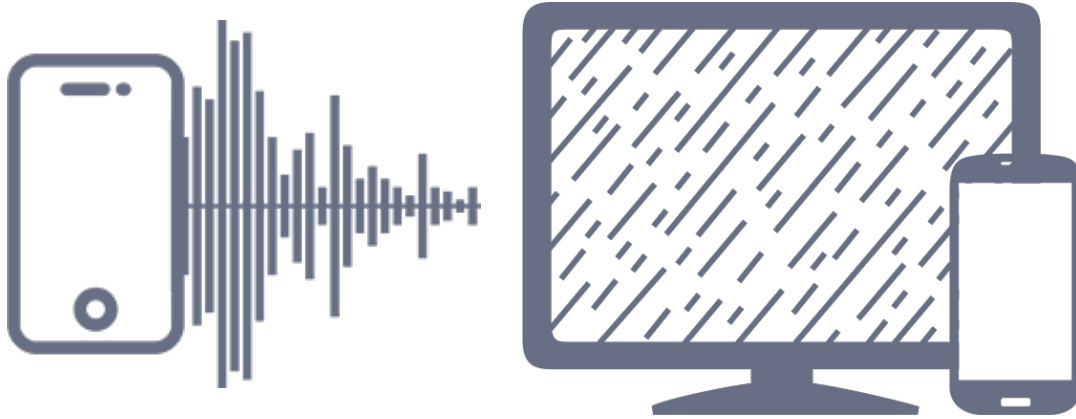


- FSK-based protocol
(18.7 – 19.5 kHz)
 - Offline data exchange
 - Location-based services
Authentication
 - Payments
 - Unlock doors
-
- SDK available (for all recent platforms)

- Reward system for commerce
- “Ultrasonic Beacons” at shop entry
- Bonus points on entry in exchange for ads
- via „Shopkick App“

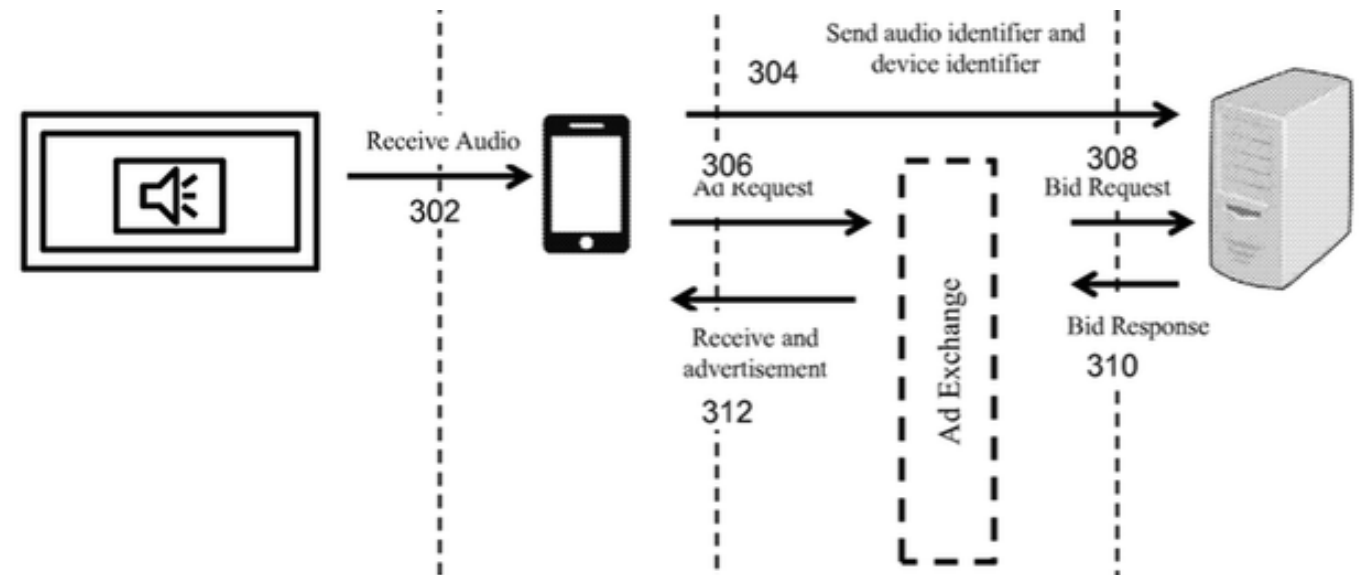


Credits:
www.rfidjournal.com
[www. http://teleautomaton.com](http://www.teleautomaton.com)



- Cross-device tracking between TV and smartphone
- Goal: placing ads
- SDK available
- Classified as malware in the meanwhile

Silverpush.com: *“Customers are matched across first and third party data using our proprietary technology.”*



Credits:
Pierluigi Paganini, securityaffairs.co
<https://www.silverpush.co>



Android: Tracking mittels Ultraschall nimmt rasant zu

6. Mai 2017, 17:17



236 POSTINGS

Application Name	Developer	Version	Downloads
100000+ SMS Messages	Moziberg	2.4	1,000,000 – 5,000,000
McDo Philippines	Golden Arches Dev. Corp.	1.4.27	100,000 – 500,000
Krispy Kreme Philippines	Mobext	1.9	100,000 – 500,000
Pinoy Henyo	Jayson Tamayo	4.0	1,000,000 – 5,000,000
Civil Service Reviewer Free	Jayson Tamayo	1.1	50,000 – 100,000

Source: D., Quiring, E., Wressnegger, C., & Rieck, K. Privacy Threats through Ultrasonic Side Channels on Mobile Devices, Technical Report, TU Braunschweig, Germany, <http://vamos-project.org/docs/2017a-eurosp.pdf>

foto: reuters/yip

Mehr als 230 Apps sollen mittels Ultraschall den User tracken können

Kunden zu tracken und das Konsumverhalten der Werbezielgruppe genauestens zu dokumentieren.

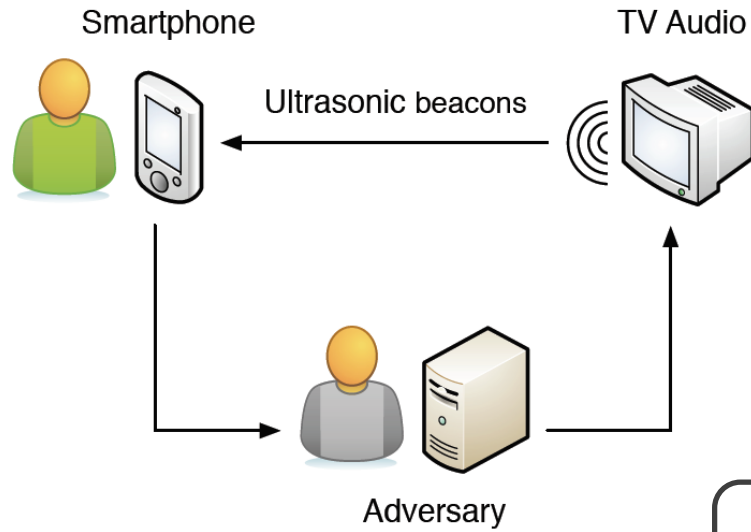
(K)eine Entwarnung

Focus

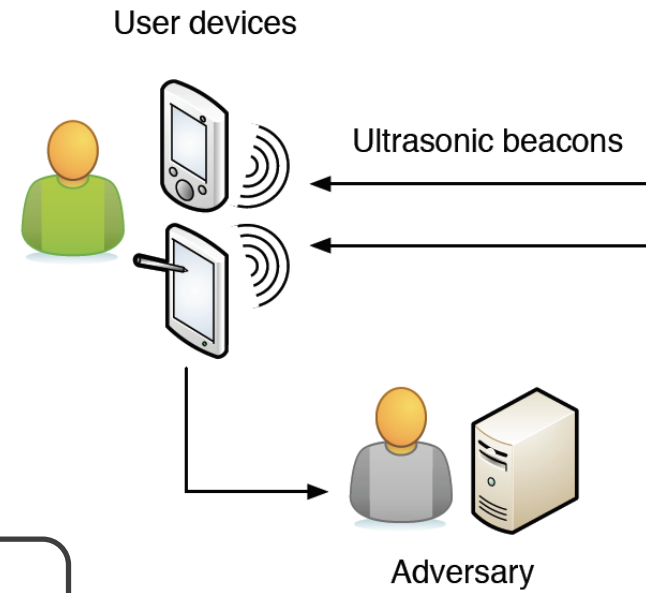
RISKS AND CHANCES OF ULTRASOUND COMMUNICATION



Media Tracking

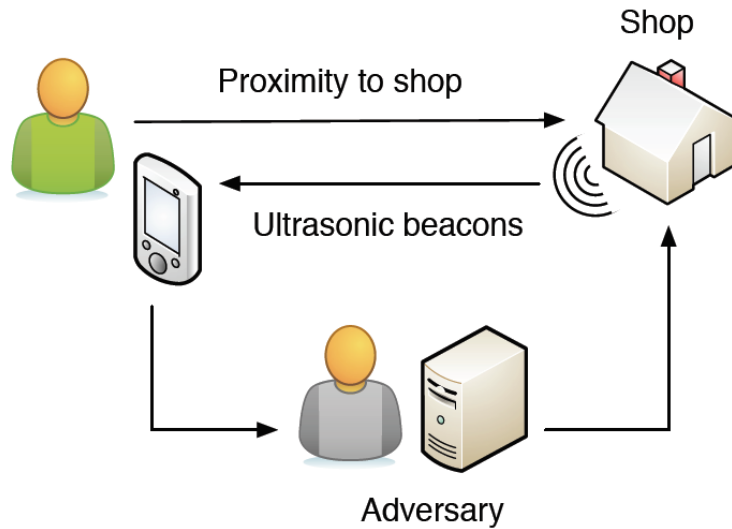


Cross-device Tracking

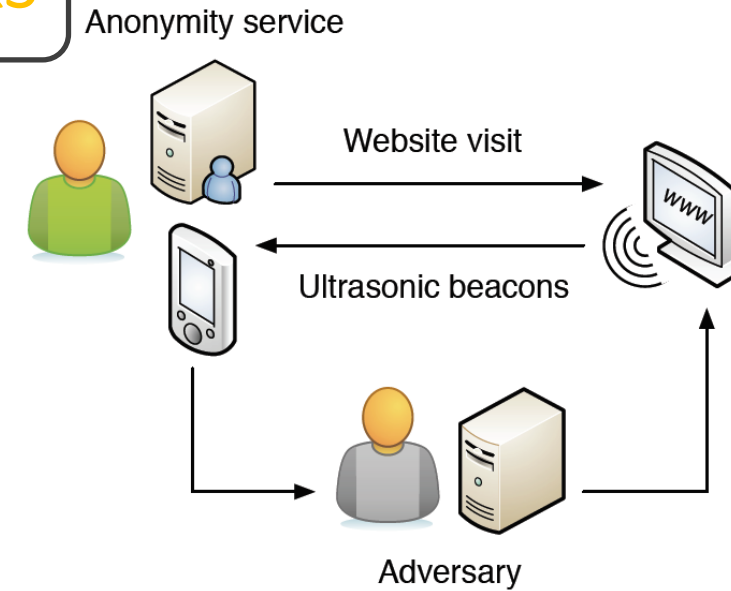


RISKS

Location Tracking



De-Anonymisation



Can ultrasound transmission be blocked?

[5 Replies](#) [9165 Views](#) [0 Tags](#)

0 Members and 1 Guest are viewing this

[bluecrystal48 \(OP\)](#)

First timers



3

Activity:

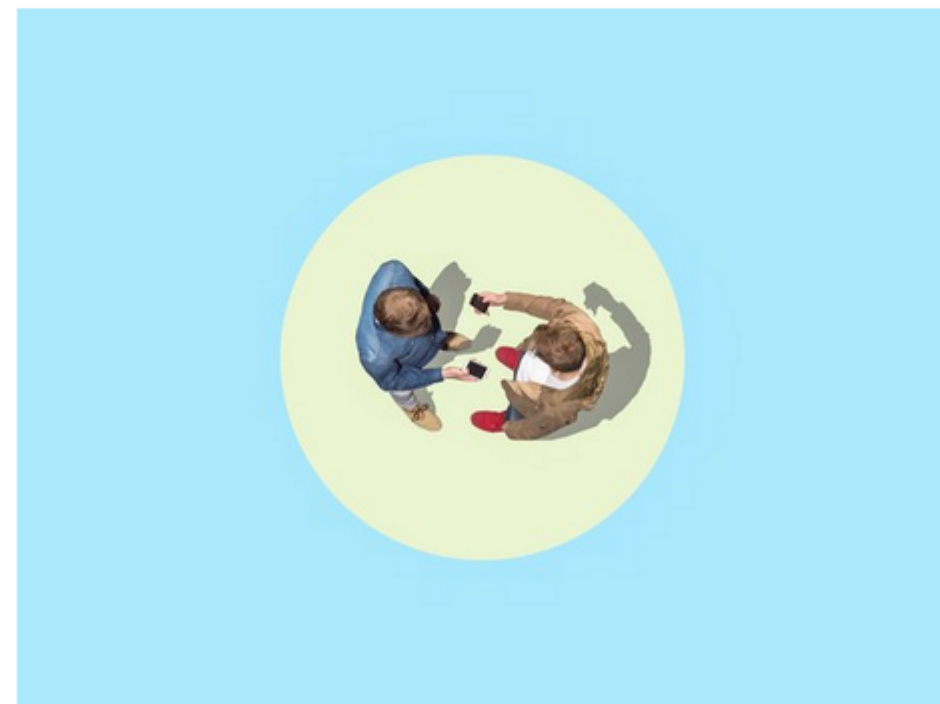
[Can ultrasound transmission be blocked?](#)

« on: 20/06/2007 21:57:22 »

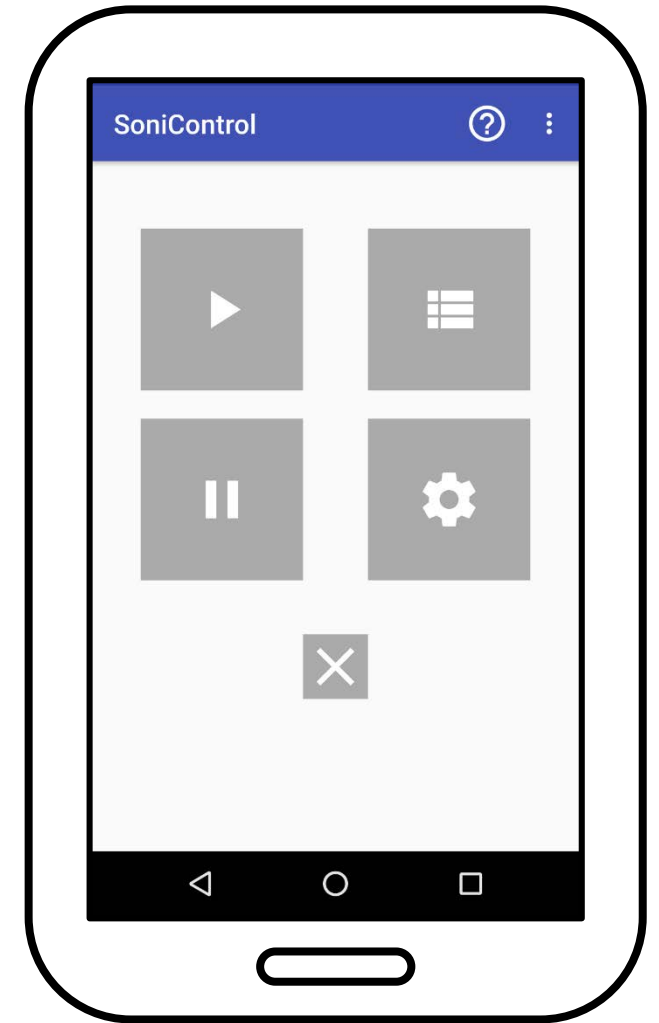
Please explain the ways in which one can block the transmission of ultrasonic sound. I am especially interested in a cost-effective solution a layman can utilize. Your input will be greatly appreciated. Thank you very much.

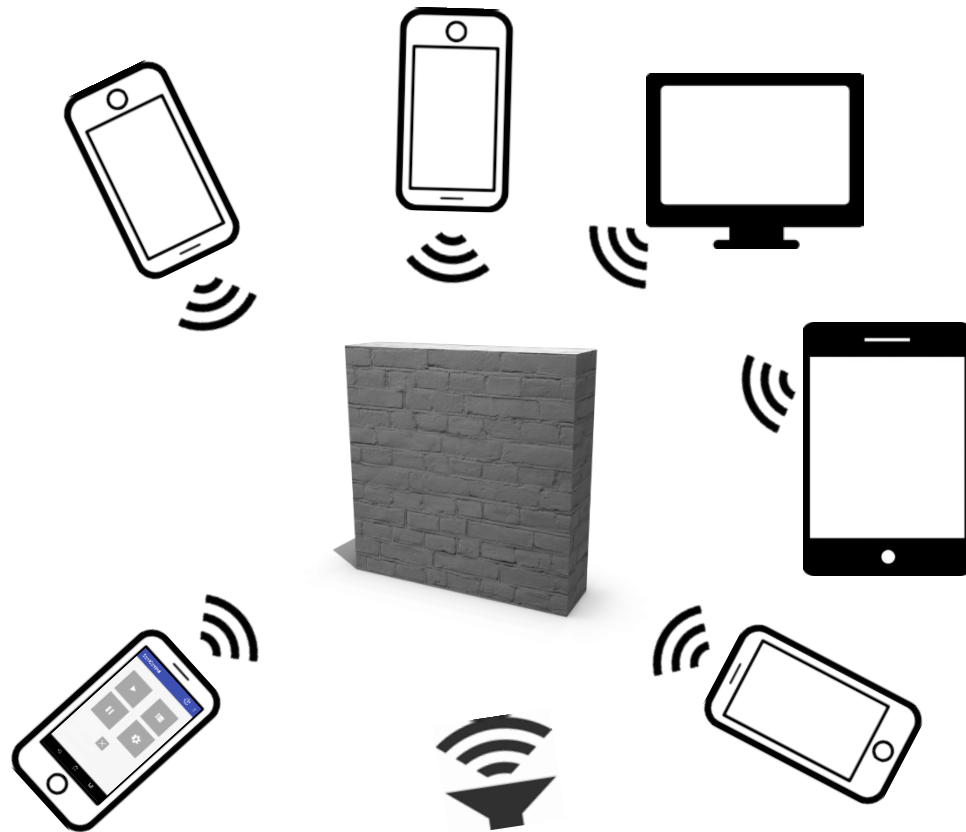
« Last Edit: 14/11/2015 09:26:52 by [chris](#) » Logged

HOW TO BLOCK THE ULTRASONIC SIGNALS YOU DIDN'T KNOW WERE TRACKING YOU



SoniControl





<http://sonicontrol.fhstp.ac.at>

SoniControl

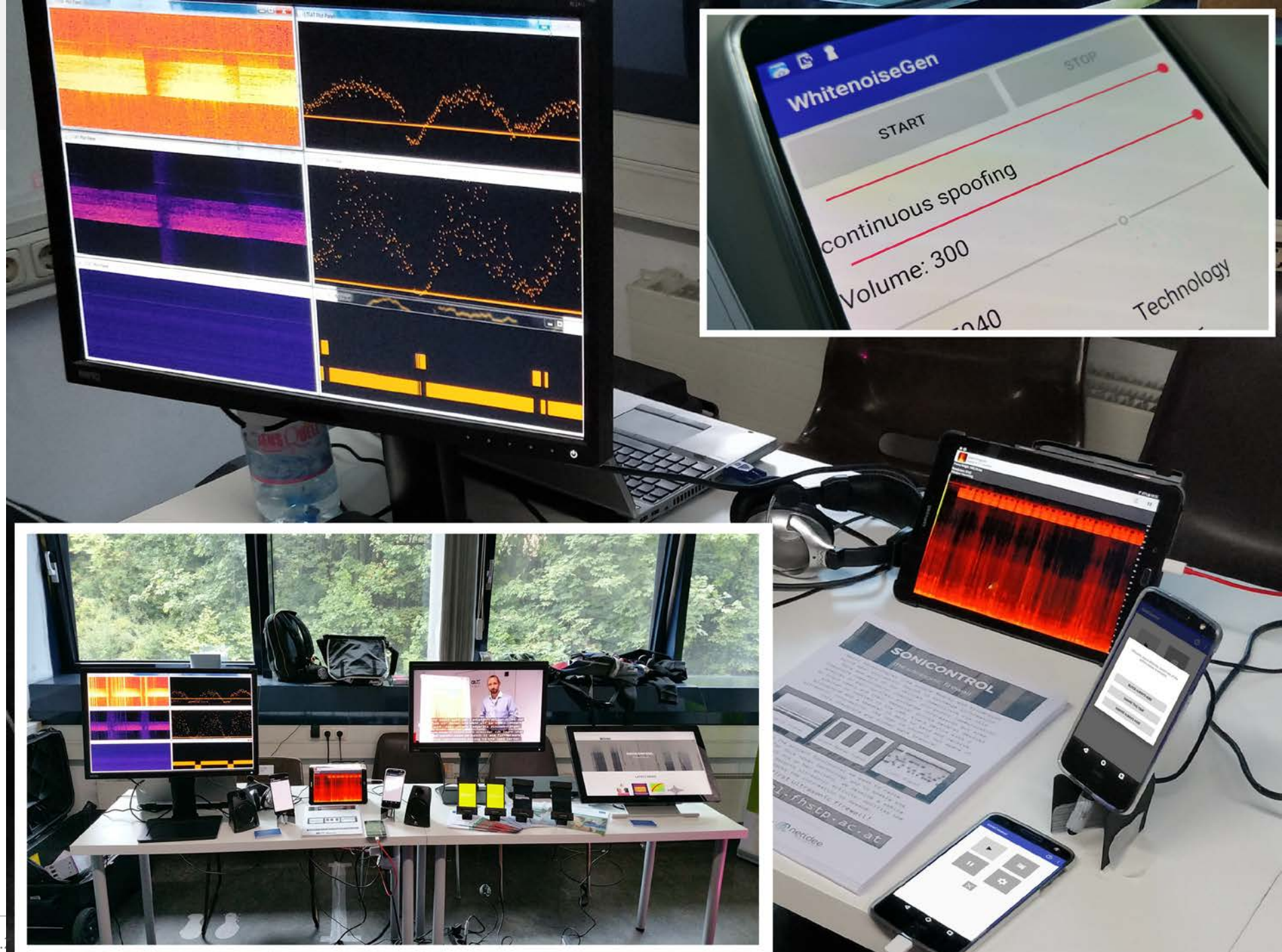
Continuous
monitoring of
ultrasound band

Detection of
different
transmission
technologies

Notification of
user

Active blocking
(spoofing)

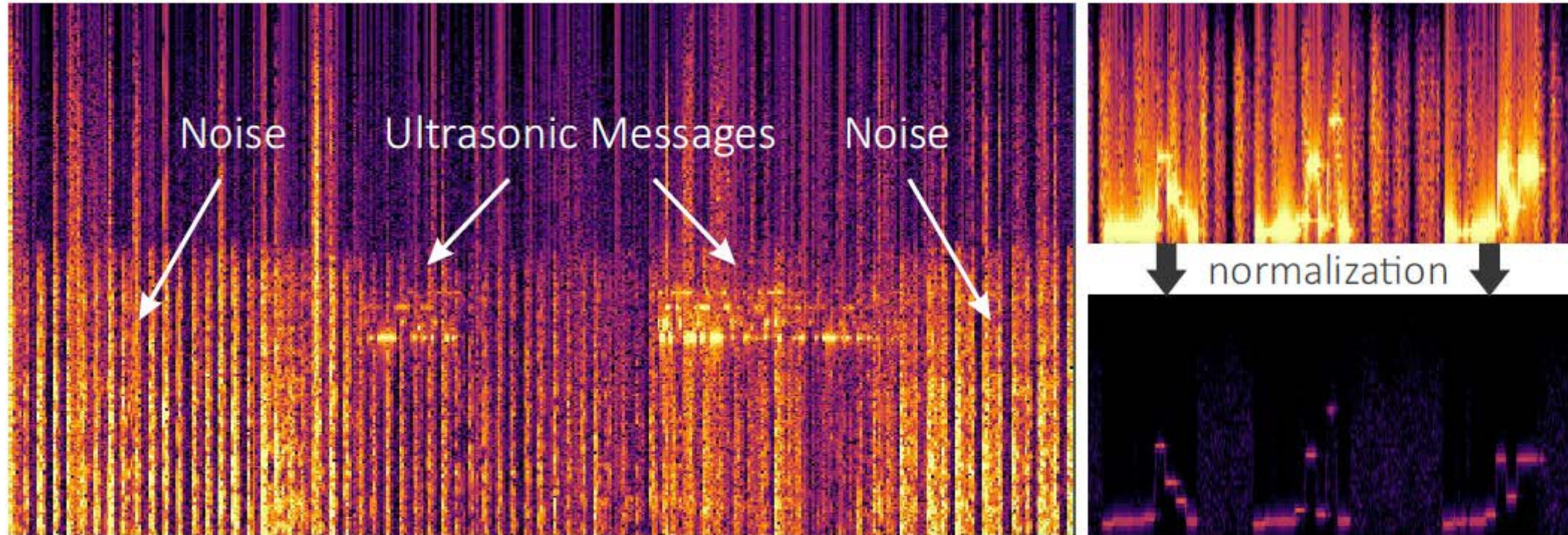
SoniControl



- How does it work?
 - Continuous capturing ultrasonic channel in the background
 - Spectral decomposition (FFT)
 - Spectral normalization (→ remove noise)
 - Statistical modeling of background (→ model environment)
- Anomaly detection by statistical analysis
 - Compare spectral distributions of background model and current signal



- How does it work?



Zeppelzauer, M., Ringot, A. and Taurer, F. (2018) SoniControl - A Mobile Ultrasonic Firewall. In 2018 ACM Multimedia Conference (MM'18), October 22–26, 2018, Seoul, Republic of Korea. ACM, New York, NY, USA, <https://arxiv.org/abs/1807.07617>.

File Edit View History Bookmarks Extras Help

SoniControl - Apps bei Google

https://play.google.com/store/apps/details?id=at.ac.fhstp.sonicontrol

Suchen

Meistbesucht CIS - FH St.Pölten: Gui... DIGITAL LIFESTYLE PR... Intranet Fachhochsch... UT-Austin Computer ... WebVPN TU MC Admin

Google Play

Suchen Anmelden

Apps Kategorien Startseite Top-Charts Neuerscheinungen

Meine Apps
Einkaufen
Spiele
Familie
Empfehlungen
Konto
Meine Abos
Einlösen
Geschenkkarte kaufen
Meine Wunschliste
Meine Play-Aktivitäten
Leitfaden für Eltern

SoniControl

FHSTP Kommunikation

★★★★★ 106

3 PEGI 3

Zur Wunschliste hinzufügen

Installieren

The image shows four screenshots of the SoniControl app interface. The first screenshot shows a notification 'Ultrasonic signal detected. Select one of the options below to proceed' with buttons for 'BLOCK THIS TIME', 'BLOCK ALWAYS HERE', 'IGNORE THIS TIME', and 'IGNORE ALWAYS HERE'. The second screenshot shows a control panel with play, pause, and settings buttons. The third screenshot shows a list of 'Detected signals' with details like location, time, and spoofing status. The fourth screenshot shows the 'Instructions' screen, explaining that the app scans for ultrasonic signals and can block them.



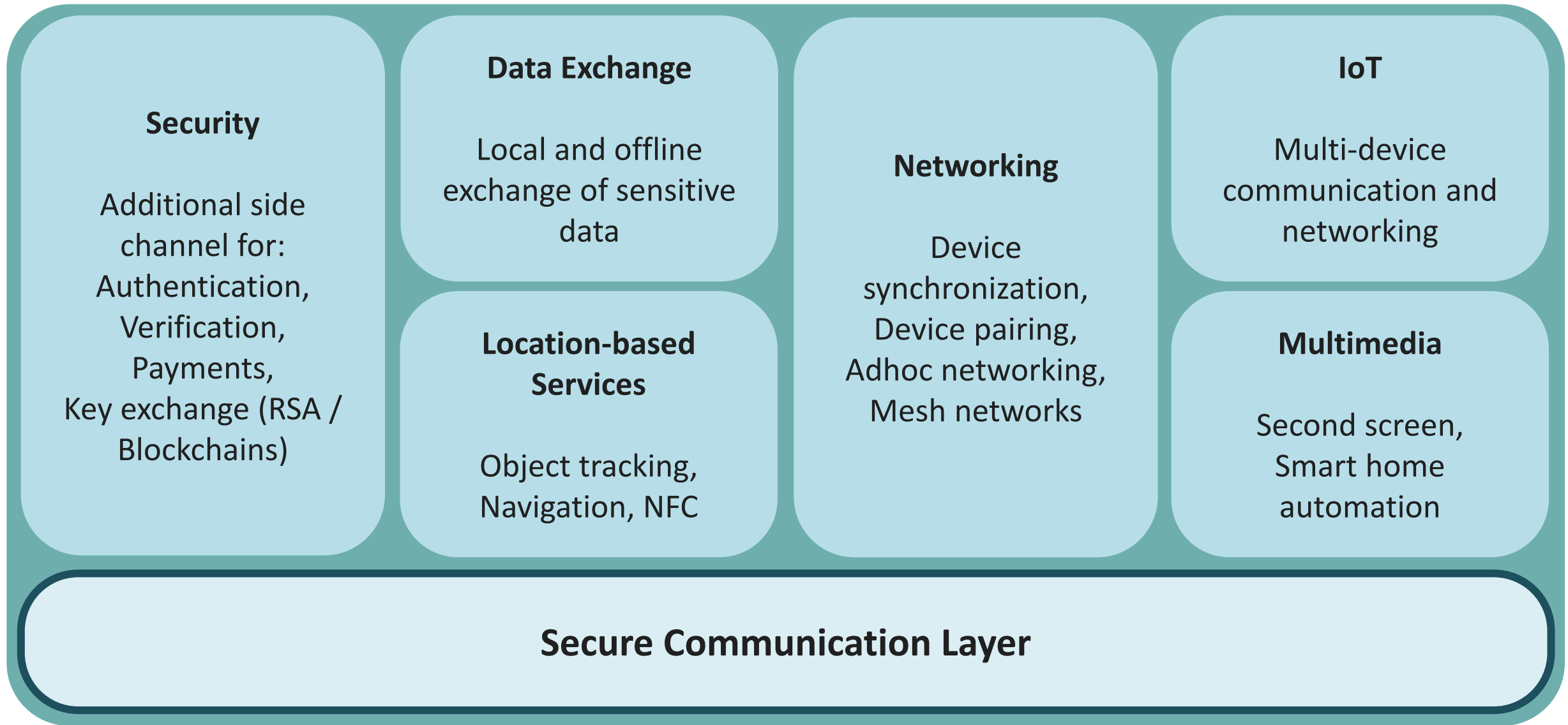
<https://play.google.com/store/apps/details?id=at.ac.fhstp.sonicontrol>

Focus

RISKS AND **CHANCES** OF ULTRASOUND COMMUNICATION



Potential of Ultrasound Communication

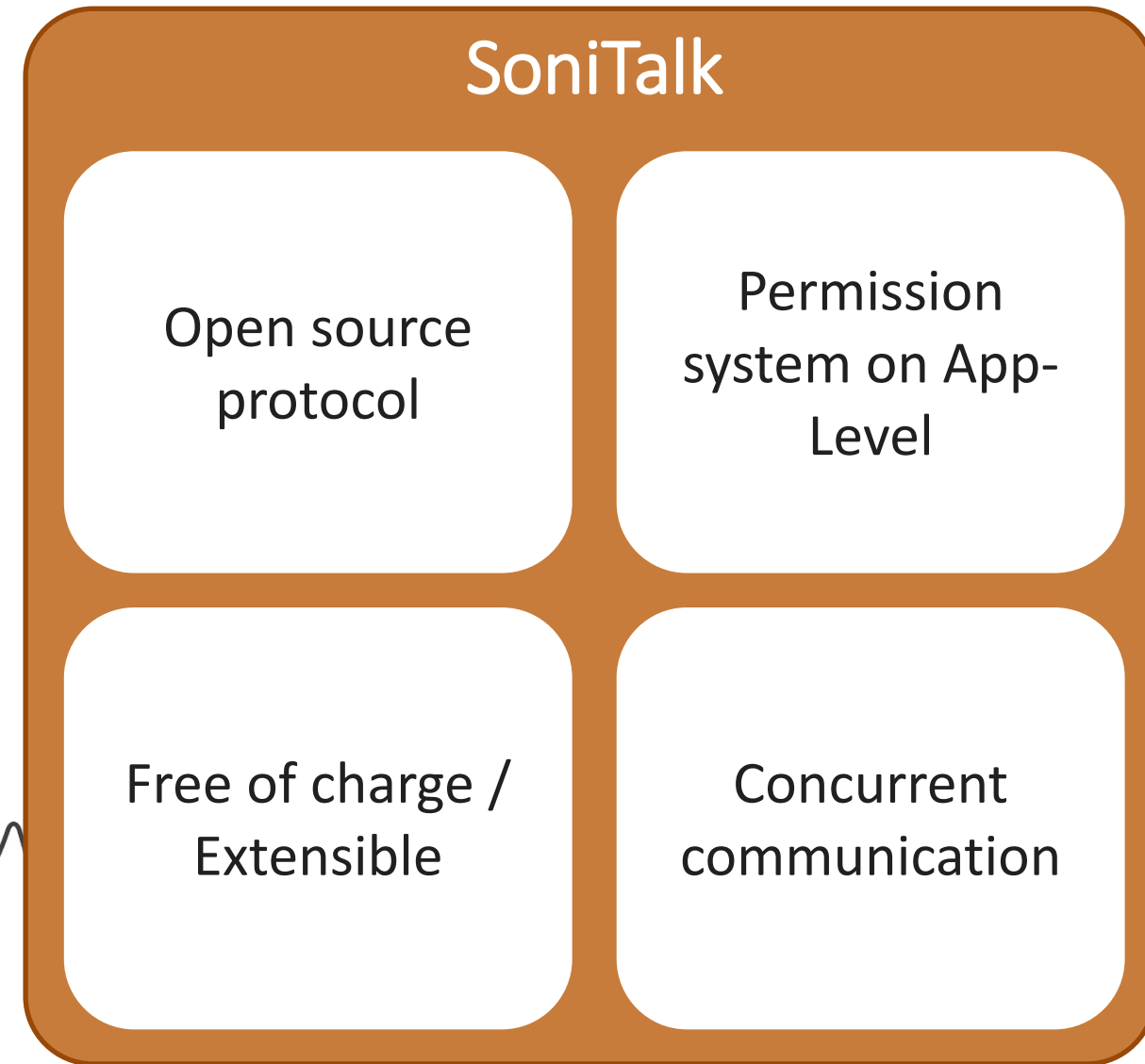
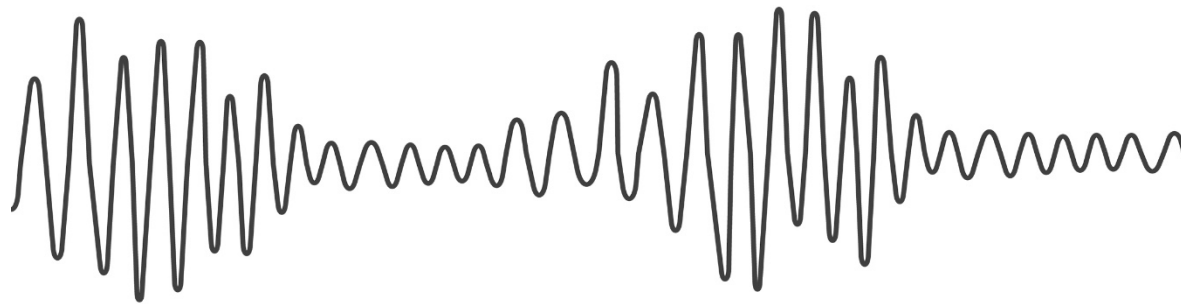


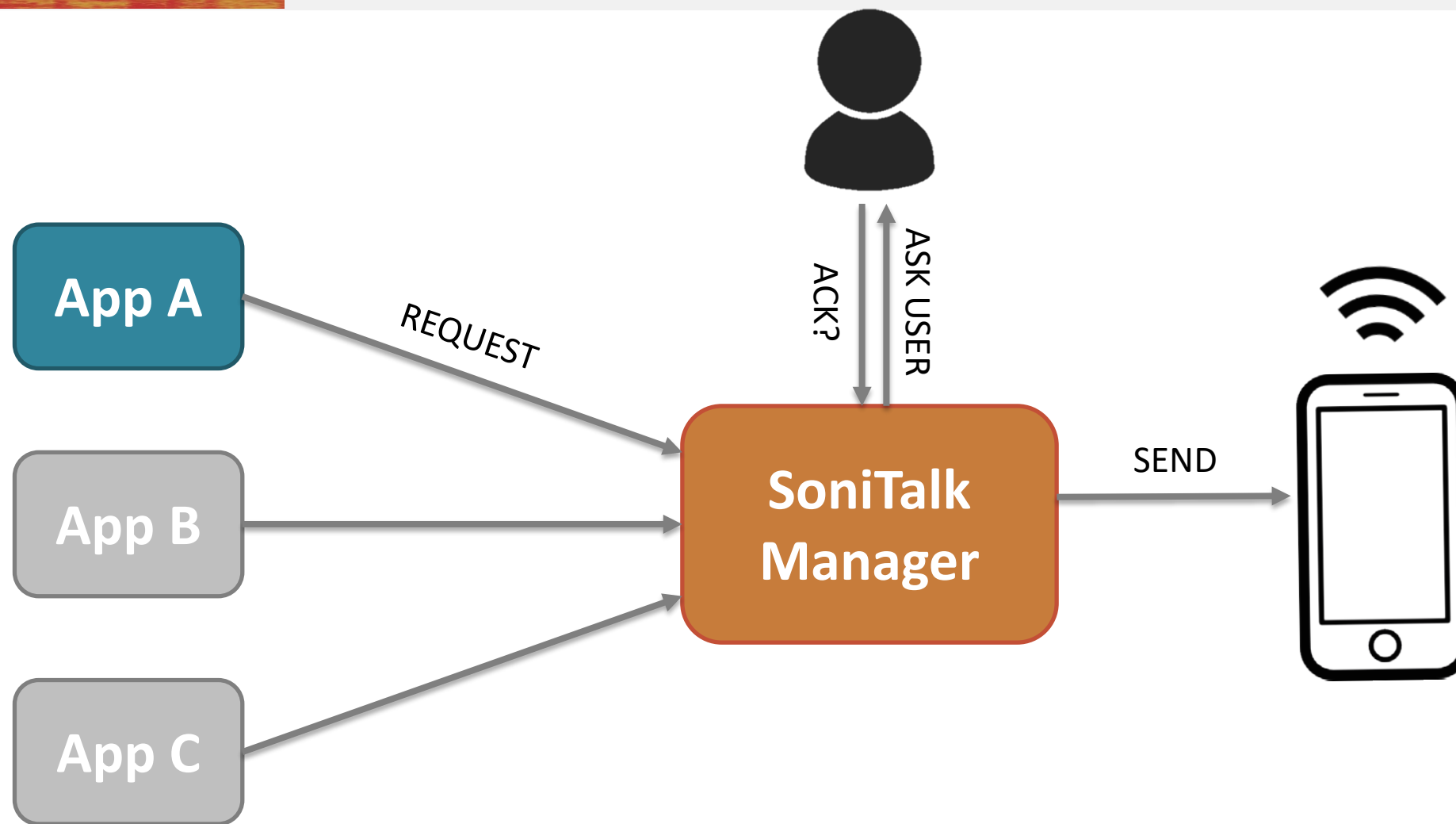
SoniTalk

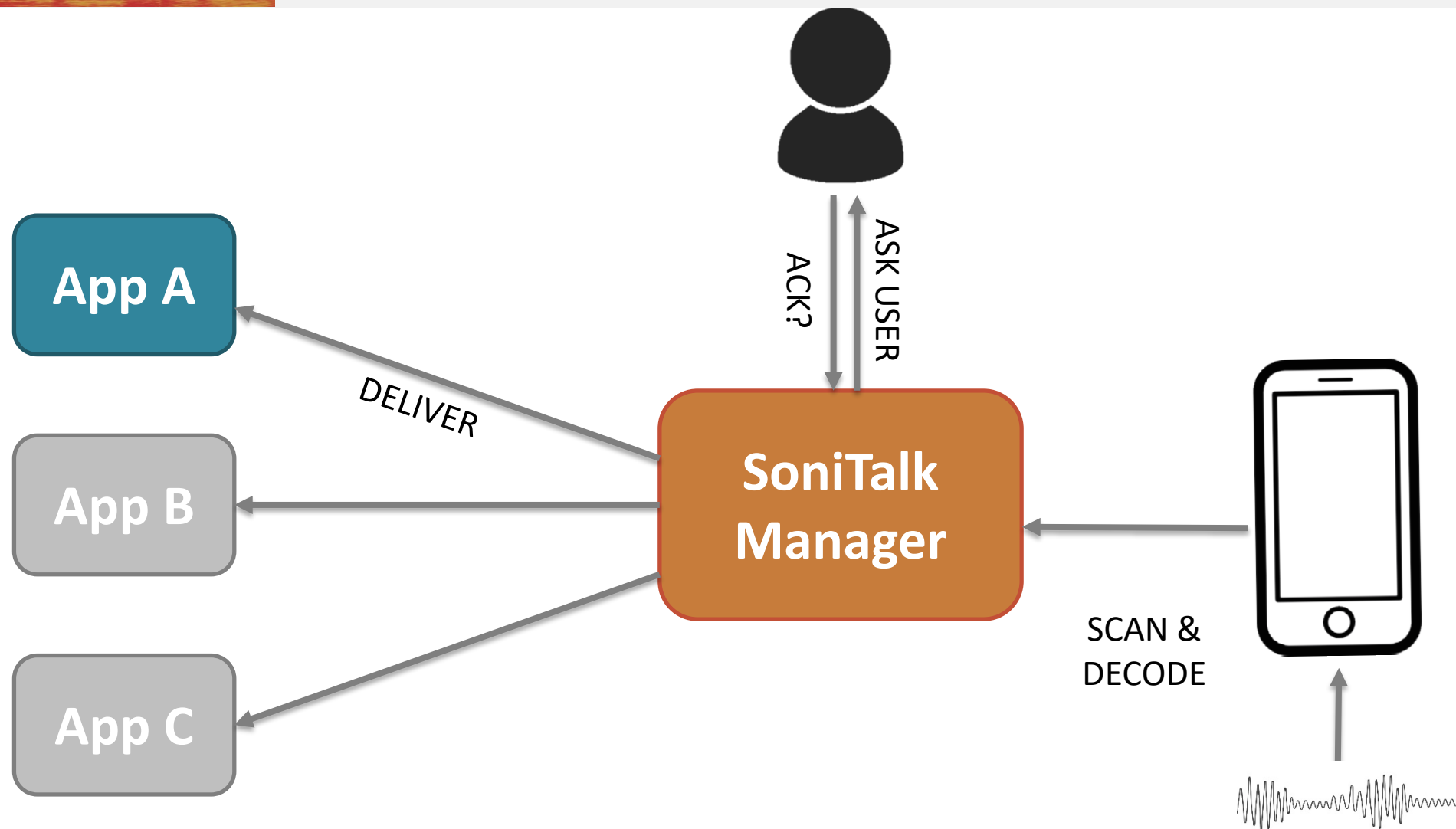
The logo for SoniTalk features the word "Soni" in a dark grey, sans-serif font. The letter "i" is stylized with three curved lines radiating from its top right, resembling a speaker or sound waves. To the right of "Soni" is a black line drawing of a sound wave. Below this, the word "Talk" is written in a white, sans-serif font on a rectangular background with a horizontal gradient from orange to red.

**...a secure and
privacy-oriented
protocol for
ultrasonic
communication**

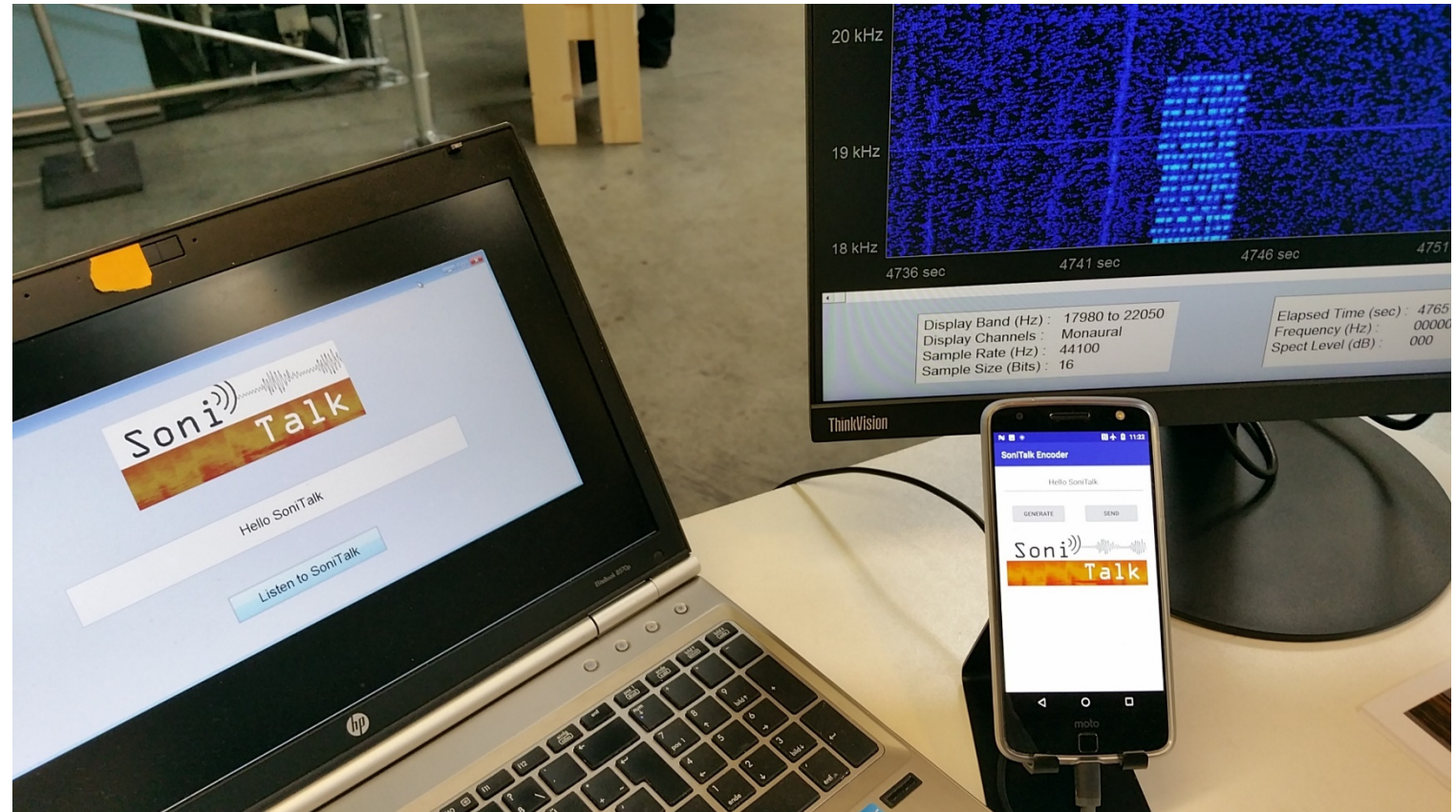
- To date:
 - No free protocol / sdk
 - No standardized protocol
 - No compatibility between technologies
 - No privacy protection integrated







- State of the research
 - Protocol Specification
 - Error Checking
 - Encoding & Sending (Android)
 - Receive & Decoding (Matlab)
- Next steps
 - Decoder in Android
 - Permission system
 - SDK development & release



More information:

<https://sonitalk.fhstp.ac.at>

Latest news:



SoniTalk prototype for Android is working !
Getting close to the most important milestone (27.11.2018)

Förderjahr 2017 / Project Call #12 / ProjektID: 2110 / Projekt: **SoniTalk**

These past months we were working on the SoniTalk prototype for Android, composed of an Encoder app to send messages and a Decoder app to receive them. Both components are now able to communicate with each other !

After implementing the Encoder app for Android, we focused on the decoding part. We presented a first version at Ars Electronica, developed with Matlab, and we now have the Android equivalent... Performing even better ! Our first tests exchanging data between two smartphones were successful up to 12m, transmitting the text "netidee rocks !".

Our next steps will be to fine tune the decoding process, to make it fully parameterizable, and to merge both encoding and decoding into a library that everyone can then use in their own app.



Applications of Ultrasound Communication

Security

Additional side channel for:
Authentication,
Verification,
Payments,
Key exchange (RSA /
Blockchains)

Data Exchange

Local and offline
exchange of sensitive
data

Location-based Services

Indoor Navigation, NFC

Networking

Device
synchronization,
Device pairing,
Adhoc networking,
Mesh networks

IoT / Industry 4.0

Device tracking
Device sync.

Multimedia

Second screen,
Smart home
automation



**Common and Secure
Communication Layer**





FLORIAN TAURER

Developer



PETER KOPCIAK

Developer



KEVIN PIRNER

Developer



ALEXIS RINGOT

Developer

Thank you for your attention!



sonitalk.fhstp.ac.at



sonicontrol.fhstp.ac.at

Contact:

matthias.zeppelzauer@fhstp.ac.at



FLORIAN TAURER

Developer



PETER KOPCIAK

Developer



KEVIN PIRNER

Developer



ALEXIS RINGOT

Developer

All code & results publicly available



<https://git.nwt.fhstp.ac.at/m.zeppelzauer/SoniControl>

Contact:

matthias.zeppelzauer@fhstp.ac.at