GAODIMIC® DT228 Digital UHF Wireless System @Héritières Band, Quebec, Canada, May 23, 2025

Digital UHF vs Analog UHF TECH Comparison

GAODIMIC® 高德麦 & iweex® 未可思

infoSVC LLC, established in 2015, is a local high-tech company specializing in IT technology.

infoSVC boasts advanced R&D capabilities. Its core team comprises experienced R&D and technical personnel from leading manufacturers such as HUAWEI, ZTE, MTK, and CEC, bringing extensive product development experience.

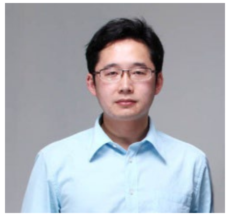
GAODIMIC® 高德麦

We are committed to the research and development and production of wireless digital audio products in the professional field of stage design, providing end-to-end solutions and professional engineering products for the audio engineering, sound engineering and broadcasting industries.

iweex® 未可思

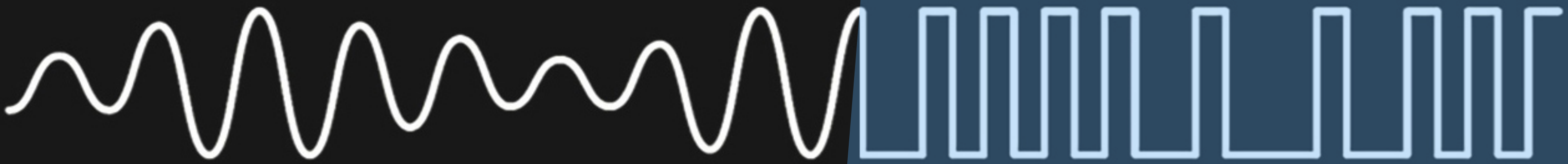
We are dedicated to the research and development and production of wireless digital audio products for government and enterprise sectors, providing end-to-end solutions, professional digital products, and comprehensive solutions for governments and enterprises. We also provide customized solutions and supporting software and hardware development to meet the individual needs of industry customers.

Lecturer Introduction



Philies.Xu (Phifee)

2002-2003 Hunan Unicom Zhuzhou Branch, Billing & Information Technology Department, Engineer
2003-2005 IBM Changsha Office, IGS Technical Engineer, AIX Systems Expert, p Series Systems Expert
2005-2008 ZTE India Engineering Services, Northeast India, Technical Director
2008-2011 ZTE India Mumbai Office, Head of Core Network Technology Solutions
2011-2016 ZTE Headquarters, LTC Business Opportunity Management Project Manager, Global Process Architecture Director, and Corporate Business Leader
2020-2024 Zhuzhou Times Plastics, Process Architecture and IT Consultant
2023-2024 Leader of the Key Project Management Advisory Group for the Huizhou Zhongkai District Government
2016- infoSVC Information Technology, Marketing Director



ANALOG AUDIO

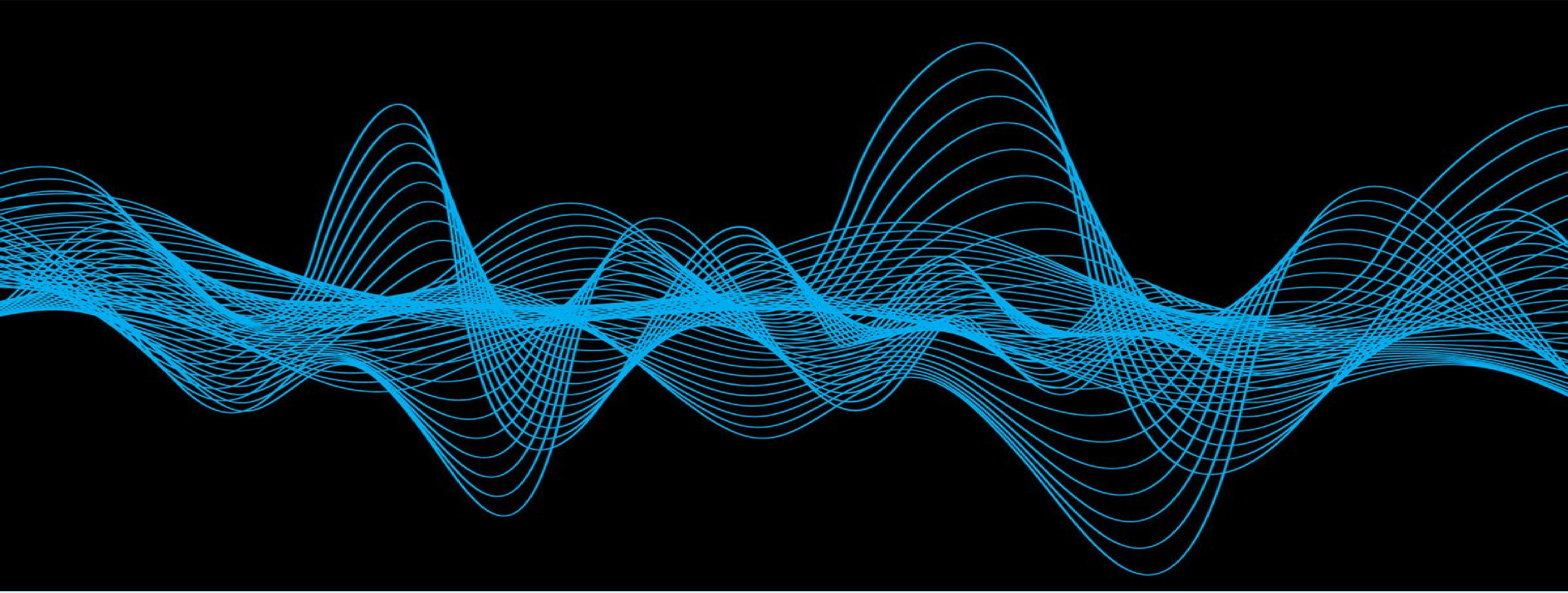
FM MODULATION
RADIO WIRELESS TECH

DIGITAL AUDIO

AD/DA + FSK/QSK MODULATION
MOBILE COMMUNICATION WIRELESS TECH

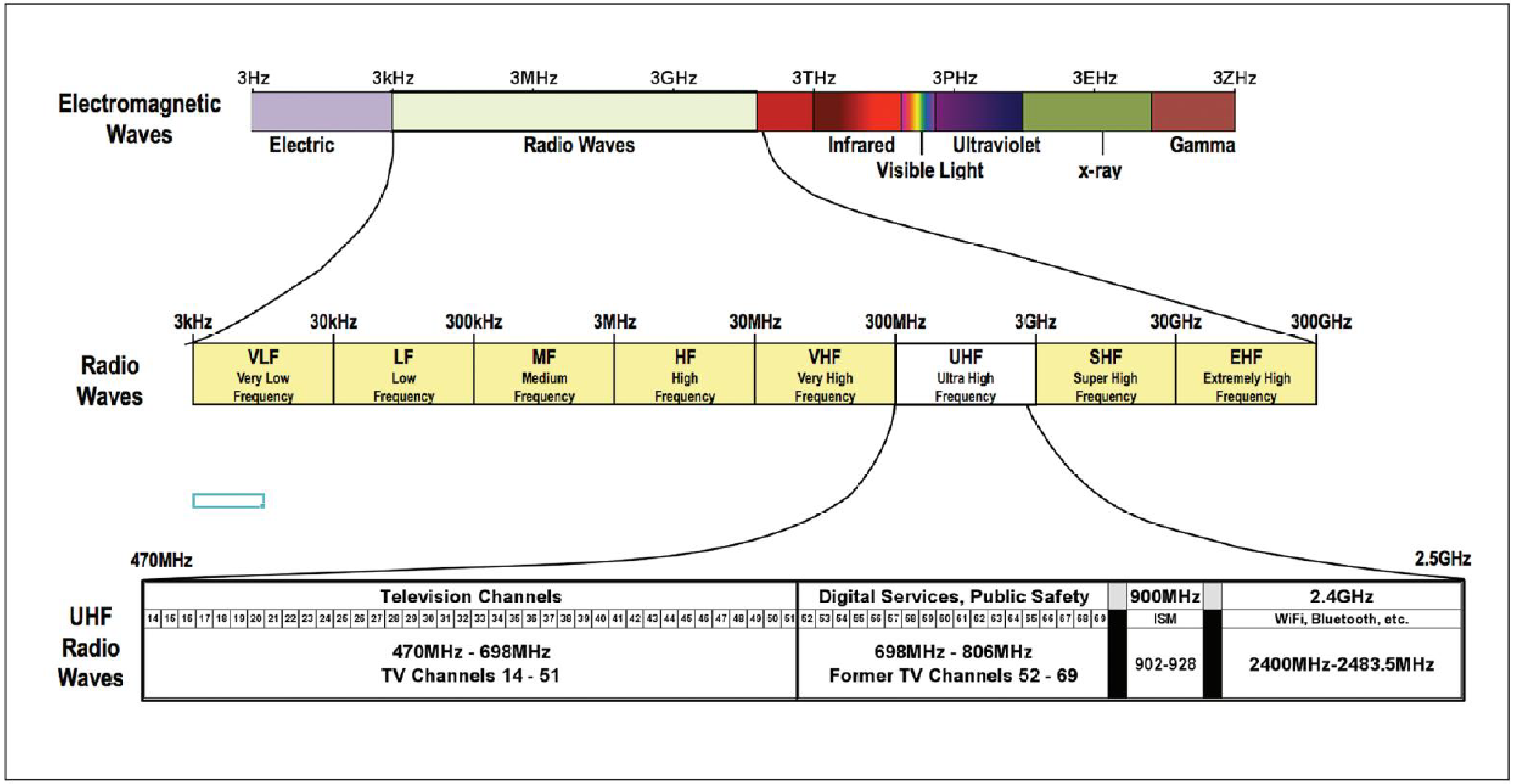
THE WIRELESS AUDIO INDUSTRY WILL INEVITABLY EVOLVE TOWARD DIGITAL COMMUNICATION TECHNOLOGY.

DIGITAL UHF (470MHZ TO 900MHZ) IS THE ULTIMATE TECHNICAL SOLUTION.



UHF Wireless Frequency Band Discussion

UHF WIRELESS FREQUENCY BAND INTRODUCTION



Radio waves have frequencies ranging from 3 kHz to 300 GHz in the electromagnetic spectrum.

Professional wireless microphones operate in the ultra-high frequency range of radio waves.

Sharing with TV channels is a key consideration for overseas applications.

UHF WIRELESS FREQUENCY BAND INTRODUCTION

Distribution of civilian wireless frequency bands in selected countries around the world (400 MHz to 1 GHz).

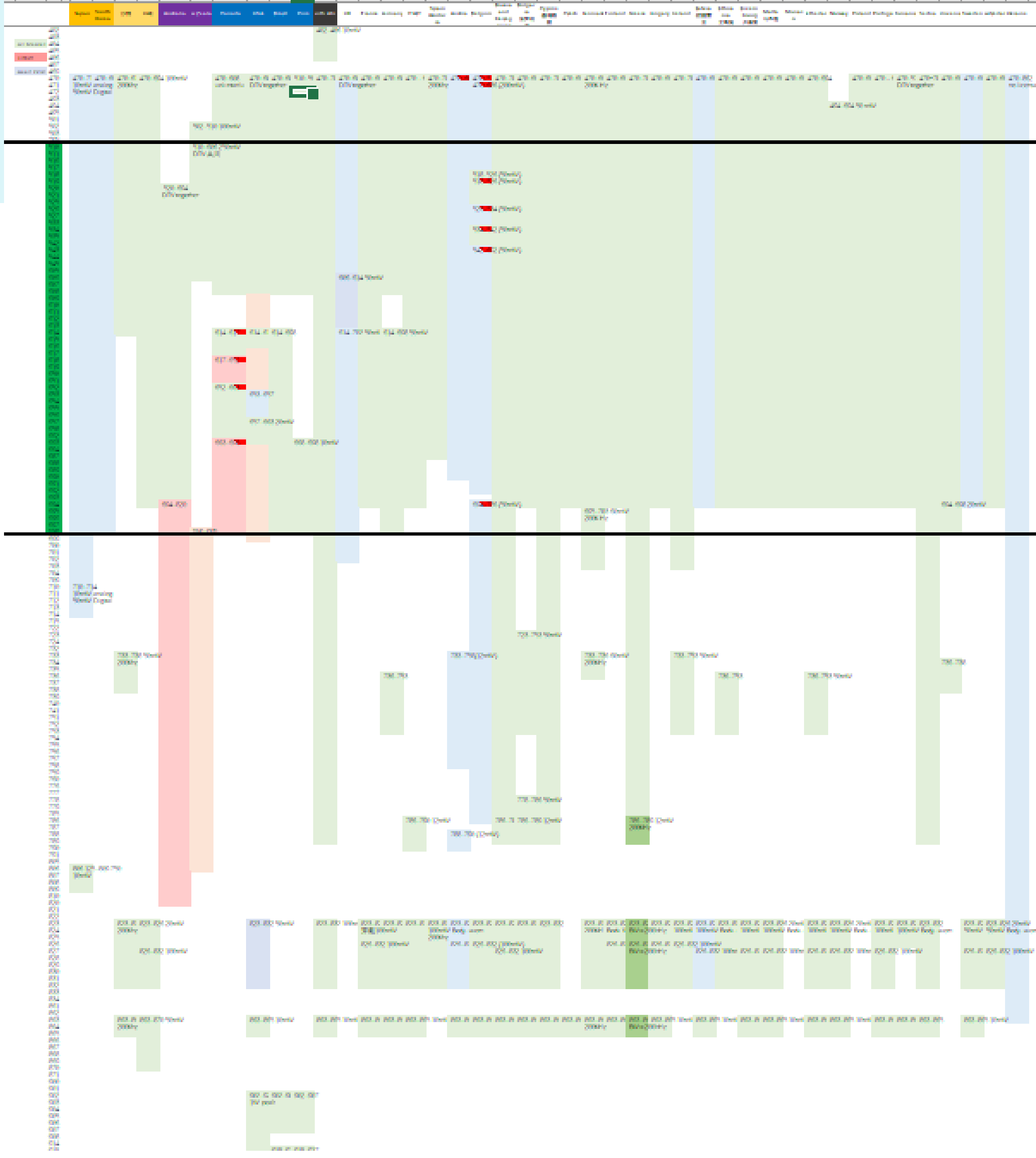
Low Interference Potential Devices (LIPD)

Program Making & Special Events (PMSE)

CEPT/ECO provides a frequency database called "EFIS":

https://efis.cept.org/

The Chinese government has reclaimed the 700 MHz wireless frequency band.



UHF BAND WAVELENGTH ADVANTAGE

The wavelength is very related to the antenna size.

The length of an antenna is typically determined by the wavelength of its central operating frequency. The higher the frequency, the shorter the wavelength, and the shorter the antenna can be.

Antennas are often designed with a length ratio of one-quarter (1/4λ) or five-eighth (5/8λ) of the wavelength. This design optimizes the antenna's radiation efficiency and reception performance. A quarter-wavelength antenna, through array adjustment, can achieve an ideal standing wave ratio and performance while also saving installation space. However, antennas of this length typically have low gain and cannot meet the requirements of certain high-gain transmission scenarios. In these cases, a half-wavelength antenna is often used.

UHF BAND WAVELENGTH ADVANTAGE

GAODIMIC® 高德麦 | iweex® 未可思

The wavelength is very related to the antenna size.

1. Long-wave antennas: Extremely long-distance communications, such as long-wave navigation systems.
2. Short-wave antennas: Long-distance communications, leveraging the reflection properties of the ionosphere for beyond-line-of-sight communications and amateur radio.
3. Medium-wave antennas: Broadcast services, capable of covering large geographic areas, are particularly suitable for national broadcast networks.
4. Microwave antennas: Satellite communications, point-to-point wireless links, radar detection, and other fields.

Antenna specifications are the primary consideration in the early stages of wireless device development.
This explains the origins of 2.4GHz and 5.8GHz planning.
The 2.4GHz wavelength is approximately 0.125 meters, so a typical 2.4GHz Wi-Fi antenna is approximately 3 centimeters long (or 1/4 wavelength).
A 600MHz wavelength is 0.5 meters, a 5/8 antenna is 0.3125 meters long, and a 1/2 wavelength is 0.25 meters.

UHF BAND WAVELENGTH ADVANTAGE

GAODIMIC® 高德麦 iweex® 未可思

The relationship between wavelength and radio propagation.

1. Diffraction and wall penetration
2. Reflection, refraction, diffraction, scattering, and multipath
3. Attenuation
4. Free-space propagation loss

$$L_{bf} = 32.4 + 20\lg(f_{MHz}) + 20\lg(d_{km})$$

f is the operating frequency (MHz), and d is the propagation distance (km). The above formula shows that when the frequency or distance doubles, the free-space path loss increases by 6dB, respectively (because $20\log^2 \approx 6$). Similarly, reducing the wavelength also increases the path loss.

6dB represents a 4x increase in power (in the power domain, such as signal strength and acoustics).

6dB represents a 2x increase in power (in the voltage/current domain).

UHF BAND WAVELENGTH ADVANTAGE

GAODIMIC® 高德麦 | iweex® 未可思

400-900Mhz UHF

VS

Comparison of 2.4G and 5.8G infrared bands (0.3THz~400THz, 0.76-1000 microns)

UHF offers unparalleled advantages over all civilian frequency bands.

The communications industry's "golden frequency band"

GAODIMIC® 高德麦 | iweex® 未可思

GAODIMIC® Digital UHF Wireless System

@Changsha LANGLANG Piano Recital, October 23, 2021

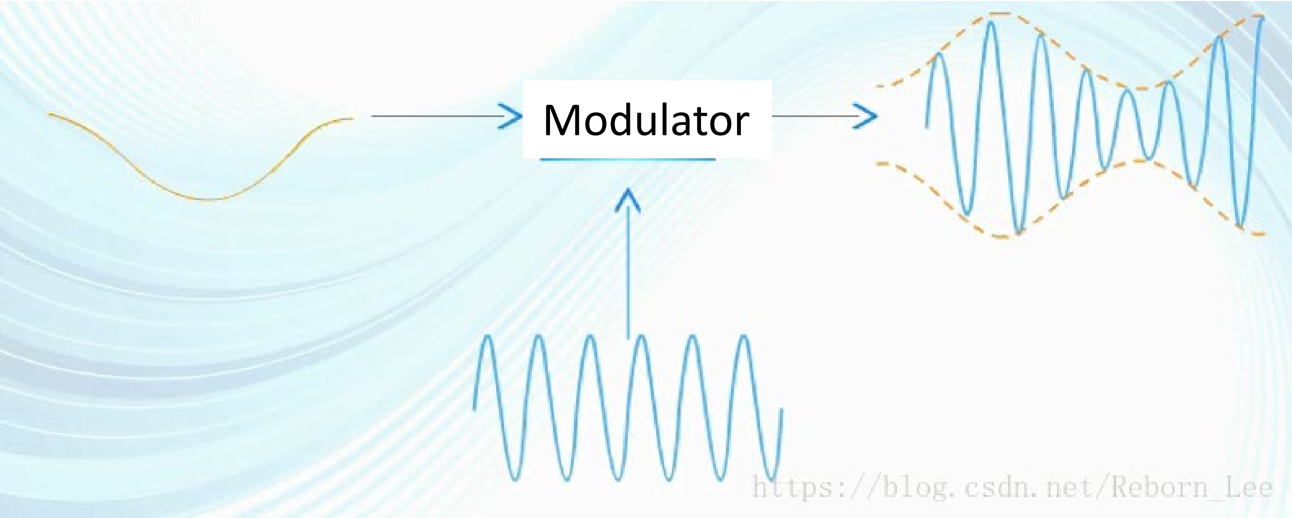
Digital wireless communications VS Analog wireless communications

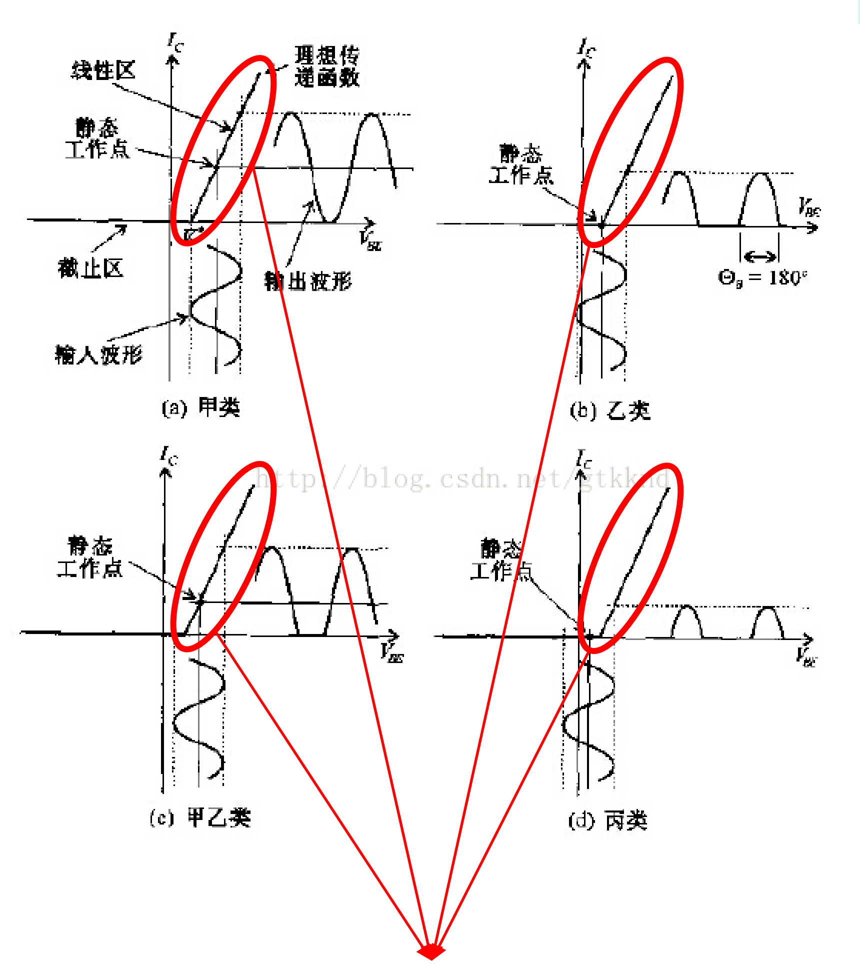
DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

Principles of Modulation and Demodulation

Simulate wireless communications.

Essentially, the A, B, C, and D amplifier circuits establish a linear relationship between the audio and the carrier.
However, due to device limitations, this linear relationship cannot be achieved across the entire frequency band.





This ideal linear relationship isn't actually achievable in practice.

It can only be achieved within a certain frequency range.(Often it's not flat)

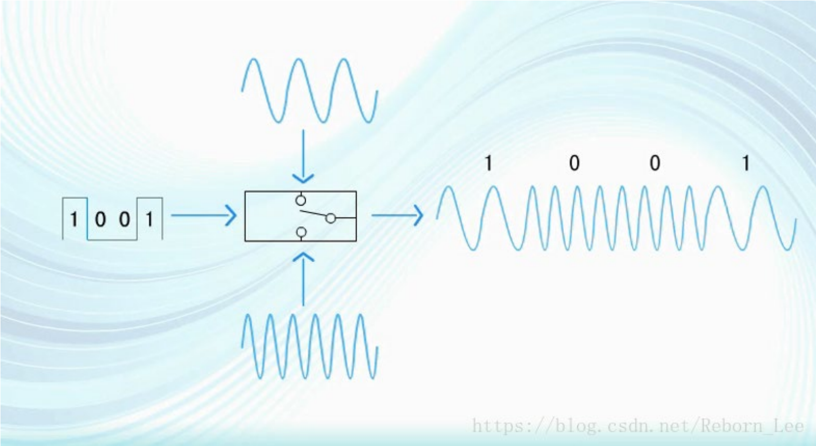
This is where the term frequency response comes in.

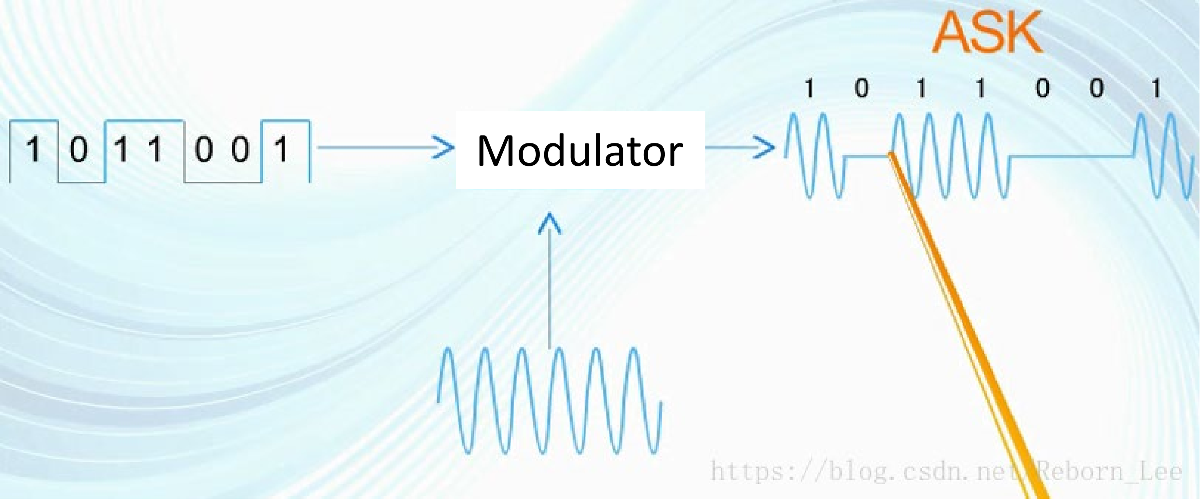
DIGITAL WIRELESS COMMUNICATIONS VS. ANALOG WIRELESS COMMUNICATIONS

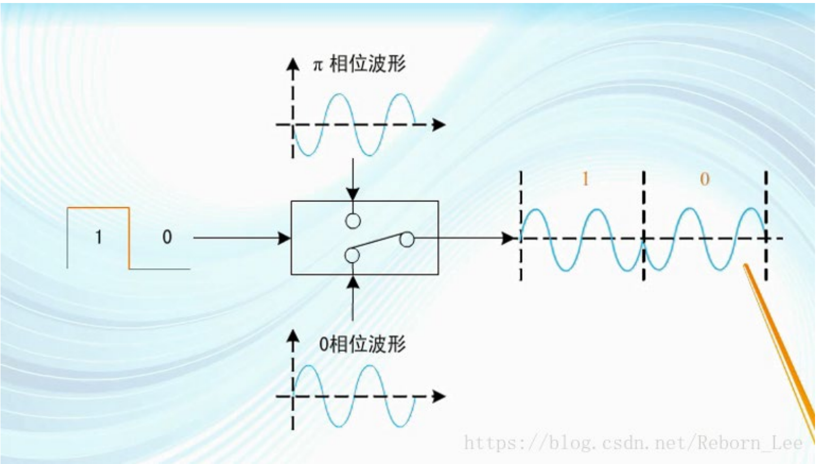
The principle of modulation and demodulation

Digital audio wireless communication.

It essentially transmits 1s and 0s, without requiring a linear relationship between the signal and the carrier.







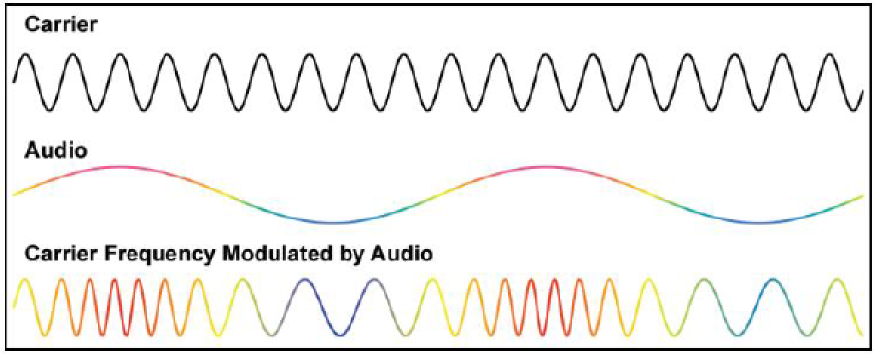
DIGITAL WIRELESS COMMUNICATIONS VS. ANALOG WIRELESS COMMUNICATIONS

GAODIMIC® 高 德 麦 | iweex® 未 可 思

Signals transmitted via port A (air port)

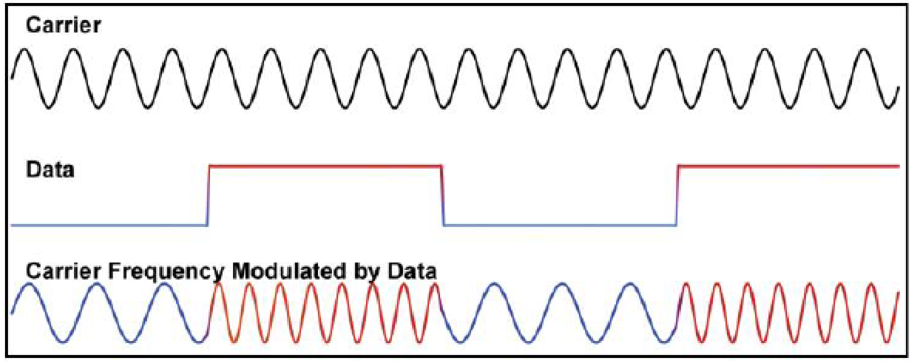
Analog audio Wireless Communication

The most common method for transmitting analog audio is frequency modulation (FM). The radio frequency being transmitted is called a carrier wave. The frequency of this carrier wave is modulated up and down based on the amplitude of the audio.



Digital audio wireless communication.

There are many different technologies for transmitting digital audio, but they all share the principle that the frequency (and sometimes the phase) of a carrier wave is altered according to the data being transmitted. Transmitting digital signals ("1s" and "0s") uses a form of frequency modulation called frequency shift keying (FSK). The carrier frequency is shifted to represent each bit of data, as shown in the figure.

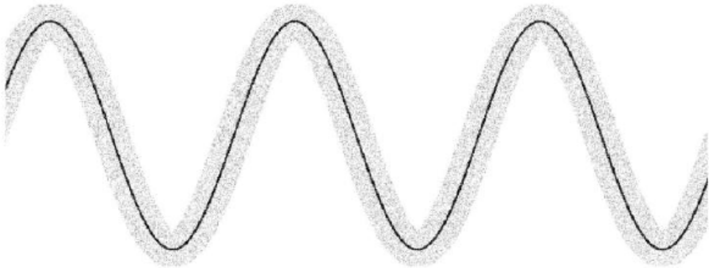


DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

GAODIMIC® 高德麦 | iweex® 未可思

The signal after interference

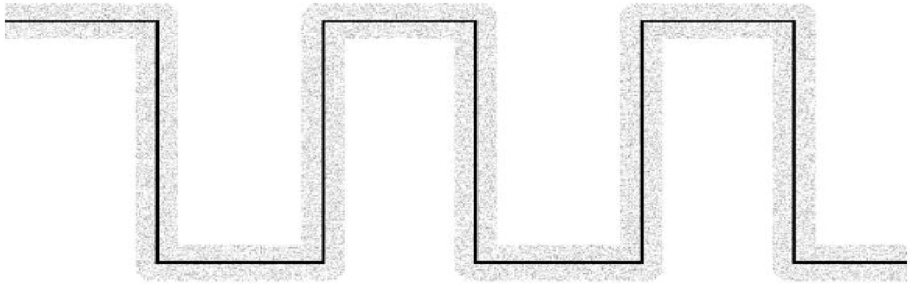
Analog audio Wireless Communication



Noise cannot be filtered out.

This is where the noise comes from.

Digital audio wireless communication.



It's still easy to distinguish between 1s and 0s. regardless of the effects of noise.

The advantage of digital transmission is that it can include additional information to help the receiver determine whether the data is correct. This is called error detection and correction bits.

GAODIMIC® 高德麦 iweex® 未可思

Dynamic Range

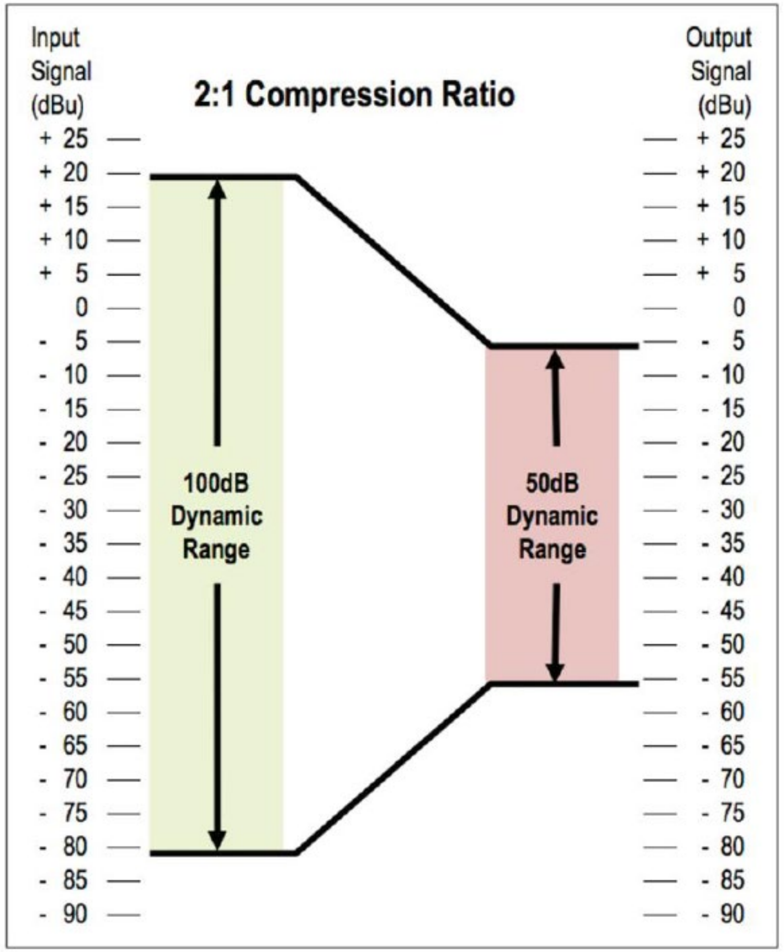
Dynamic range is defined as the difference in loudness (in decibels or dB) between the weakest and loudest signals in a system.

Analog audio Wireless Communication

The typical dynamic range of an unprocessed audio signal transmitted via frequency modulation (FM) is approximately 50dB.Audio dynamic range is proportional to the amount of frequency modulation that can be applied to the carrier, which is limited so as not to overlap adjacent frequency bands.

To achieve a dynamic range of 100dB (the minimum requirement for high quality), analog wireless microphones use companding, a technique that compresses the 100dB input dynamic range by a 2:1 ratio, keeping it within 50dB. This is achieved by a "VGA" (variable gain amplifier), which reduces the level of a louder signal and increases it for a quieter one, thus reducing the overall dynamic range.

"Acoustic artifacts" and "breathing" sounds

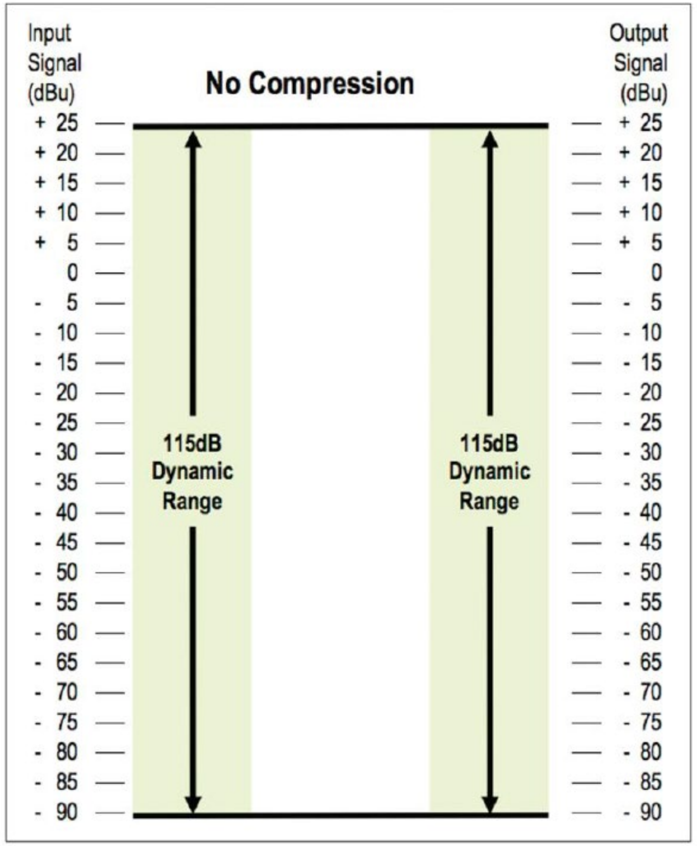


Dynamic Range

Dynamic range is defined as the difference in loudness (in decibels or dB) between the weakest and loudest signals in a system.

Digital audio wireless communication.

It receives audio signals directly without any compression, limiting, or pre-/de-emphasis. It also accommodates a wider input dynamic range without the need for level control. As a result, the input signal is accurately reproduced at the receiver.



DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

GAODIMIC® 高德麦 | iweex® 未可思

Distortion

Analog audio Wireless Communication

The very nature of the compandor introduces nonlinearities, which can increase distortion. Furthermore, high-level signals can cause overmodulation distortion.

Most analog wireless systems specify their total harmonic distortion (THD) at a level where the compandor is stable and does not overmodulate. Under these conditions, THD specifications are typically 0.1% to 0.5%.

Digital audio wireless communication.

In digital wireless systems, distortion is a function of the overall system linearity. Without a compandor, there's no possibility of audio overmodulation.

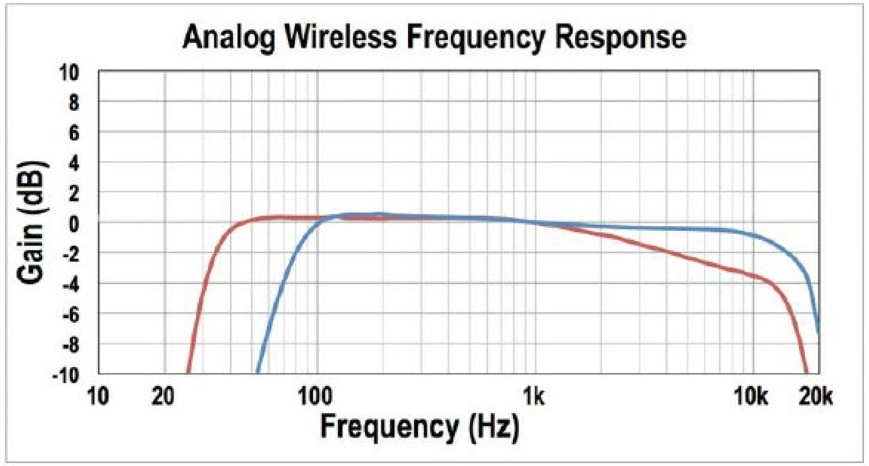
The typical total harmonic distortion specification is 0.03%.

DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

GAODIMIC® 高 德 麦 | iweex® 未 可 思

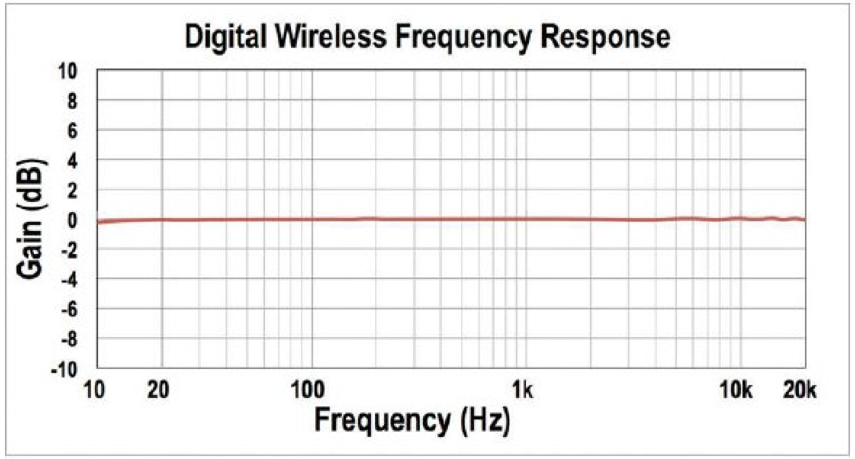
Frequency response

Analog audio Wireless Communication



At low frequencies, it's necessary to roll off frequencies that might interfere with the companding circuitry. For example, a frequency of 20 Hz is low enough to cause the gain to vary with each cycle of the waveform. Therefore, low frequencies are filtered out. High frequencies are limited by analog FM technology, which is generally unable to generate frequencies above 15 kHz.

Digital audio wireless communication.



The low and high frequency response are a function of the sampling rate, not any aspect of the RF transmission.

DIGITAL WIRELESS COMMUNICATIONS VS. ANALOG WIRELESS COMMUNICATIONS

GAODIMIC®
高 德 麦

iweex®
未 可 思

Frequency Hopping (FHSS & AFH)

This is a key technology for automatically configuring and managing frequencies, and for automatically avoiding interference.

It also serves as an encryption technology.

FHSS Freq. Hopping Spread Spectrum

AFH Adaptive Freq. Hopping

Analog audio Wireless Communication

Relying on discrete analog technology to find a commercial solution is impossible.FM has digital circuit solutions, which are theoretically feasible, but the sound quality is poor, and no one in the domestic industry has developed the technology.

Digital audio wireless communication.

From FHSS to AFH, both are now available.

GAODIMIC has implemented AHF technology for calls.

Noise Floor

Analog audio Wireless Communication

Line noise floor + transmission interference noise floor of port A.

Digital audio wireless communication.

Device-local noise.

GAODIMIC DT228 series achieves a 6uV noise floor voltage

Monitoring level.

DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

GAODIMIC®
高 德 麦
iweex®
未 可 思

Application of True Diversity

Analog audio Wireless Communication

Dual antennas + dual circuits + switching channels.

Digital audio wireless communication.

Dual antennas + dual-band channels
Instead of switching audio, the system compares digital data from the two receivers and uses the one with the fewest detected errors. Because data is received and buffered at both receivers, the receivers can continuously decide which data to use without interrupting audio due to switching.
The significance of circuit diversity.

Neither mobile phones nor Bluetooth devices have the concept of true diversity.

DIGITAL WIRELESS COMMUNICATIONS
VS.
ANALOG WIRELESS COMMUNICATIONS

Frequency drift caused by aging

Analog audio Wireless Communication

Limited by the aging of discrete components.
This can easily cause frequency drift.
This is the cause of aging noise.
This is why old black-and-white TVs produce snow every time they turn on, requiring re-adjustment.
Also, capacitors need to be fine-tuned every time.

Digital audio wireless communication.

Almost non-existent.

DIGITAL WIRELESS COMMUNICATIONS VS. ANALOG WIRELESS COMMUNICATIONS

GAODIMIC® 高 德 麦 | iweex® 未 可 思

Protocol, signaling, and control

Analog audio Wireless Communication

There is no agreement and it cannot be achieved.

Digital audio wireless communication.

Signaling and protocols have evolved from this. This is the essence of digital communication.

Protocols are essential for wireless, automated, and algorithmic control.

TCP/IP, UDP

Wi-Fi, Bluetooth

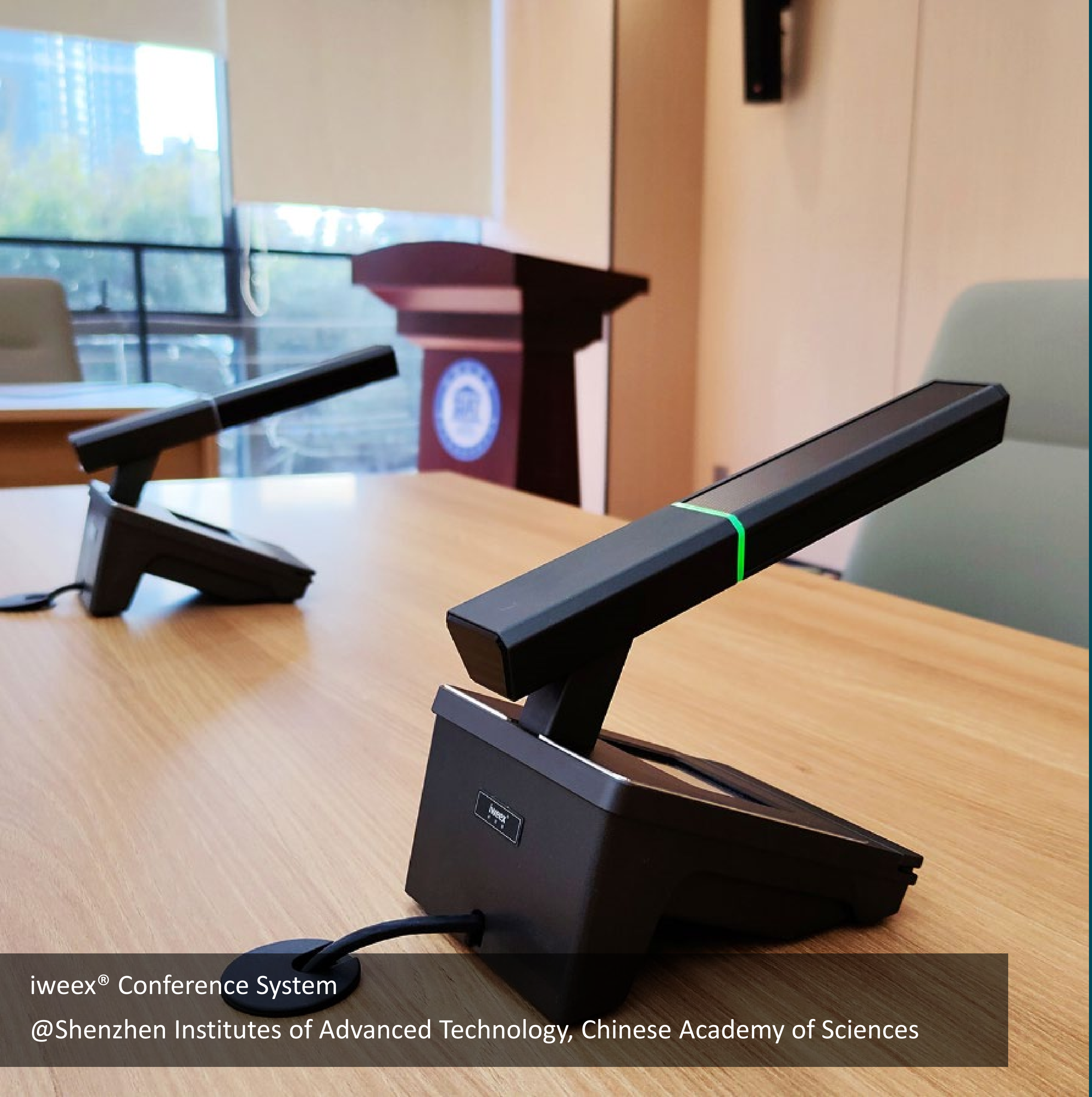
Issue: Latency

Network protocols and mobile communication protocols don't prioritize latency.

DIGITAL WIRELESS COMMUNICATIONS VS. ANALOG WIRELESS COMMUNICATIONS

Latency

Analog audio Wireless Communication	Digital audio wireless communication.
Excellent.	2ms
	4ms
	10~40ms Bluetooth
	100ms Network



Digital Wireless Communications Development Trends

TDMA TECH

The sampling theorem gave rise to the concept of "time slots" in digital wireless communications.

Top brands are already using TDMA technology with a 6 MHz bandwidth, enabling 42 channels of two-way audio communication.

This technology is very common in the mobile communications industry, having been popularized as early as the 2G mobile communications era. Within a communication cycle, 32 time slots (communication channels) can be allocated, allowing 30 users to use them simultaneously, plus two management channels.

5G mobile communication technology

It's possible.

The most critical resource for wireless communications is radio frequency resources, and the vast majority of these resources are held by telecom operators. To completely solve the wireless transmission issues facing audio devices in the future, we must leverage these frequency resources.5G mobile communications, through edge computing technology and core network switching network sinking, can theoretically achieve low latency.

In the future, wireless microphones, mixers, and audio processors will all require SIM or UIM cards, just like mobile phones.

The business issue: how will billing be implemented?

THANKS!

GAODIMIC® 高 德 麦 | iweex® 未 可 思

聆听世间美妙声音

Listen to the Beautiful Sounds from the World

Facebook @GAODIMIC；Sales@infosvc.biz
www.gaodimic.com / www.iweex.cn
infoSVC LLC