

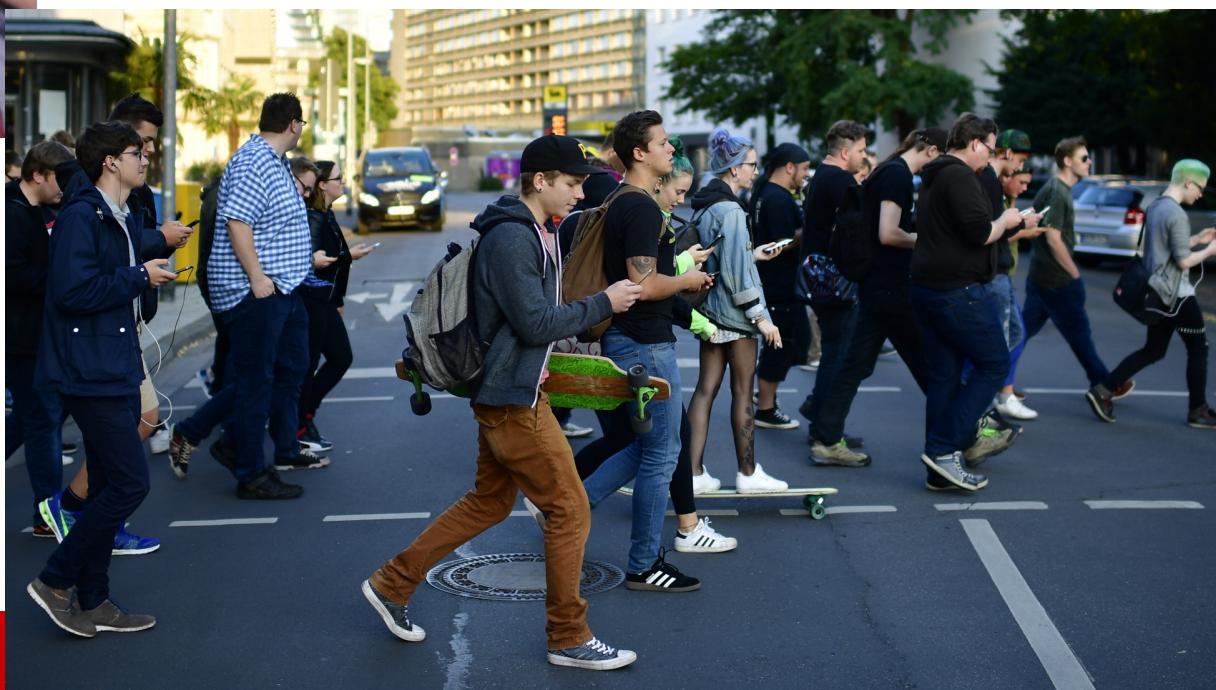
Mobile computing

Introduzione

Lezione 1

Perché è importante studiare mobile?

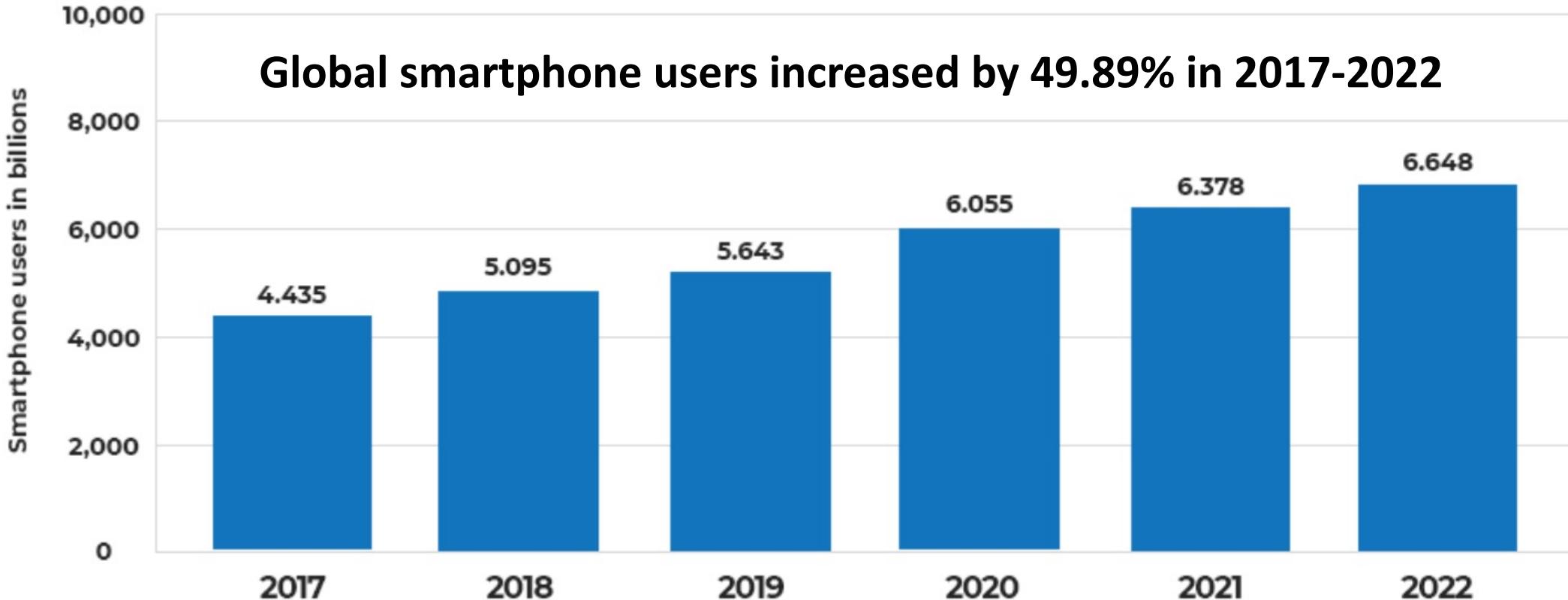
Perché è importante studiare mobile?





Number of Smartphone Users

Worldwide data from 2017 - 2022 in billions



Source: Statista

(Source: <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>)

How Many People Have Smartphones In The World?



6.92Billion

smartphone users in the world today



86.34%

of people have smartphones today

According to Statista, in 2023, the **current number of smartphone users in the world today is 6.92 billion**, meaning **86.34% of the world's population owns a smartphone**. This figure is up considerably from 2016, when only 3.668 billion users were 49.40% of that year's global population.

How Many People Have Mobile Phones In The World?



7.33Billion

mobile phone users in the world today



90.04%

of people own mobile phones today

In 2023, including both smart and feature phones, the **current number of mobile phone users is 7.33 billion**, which makes **90.04% of people in the world cell phone owners**. Feature phones are basic cell phones without apps and complex OS systems, which are more prominent in developing countries.

(Source: <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>)

How Many Mobile Connections Are There Worldwide?



11.093Billion

IoT cellular connections



8.014Billion

current world population

According to GSMA real-time intelligence data, there are **now over 11.093 Billion mobile connections worldwide**, which surpasses the **current world population of 8.008 Billion** implied by UN digital analyst estimates. This data means there are **3.085 billion more mobile connections than people worldwide**.

It's important to state that not every person in the world has a mobile device. We're talking mobile connections that come from people with multiple devices, and a fraction with dual SIM's or other integrated devices like cars.

(Source: <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>)

73.47% of people in the top 10 developed countries own a smartphone

According to the latest Newzoo statistics featured above, 26.53% of people in the top 10 developed countries don't own a smartphone, whether having a feature phone or nothing at all. Examples of countries included in this are the UK, UAE, United States, France, Spain, and Canada. [Source: 8. Newzoo](#)

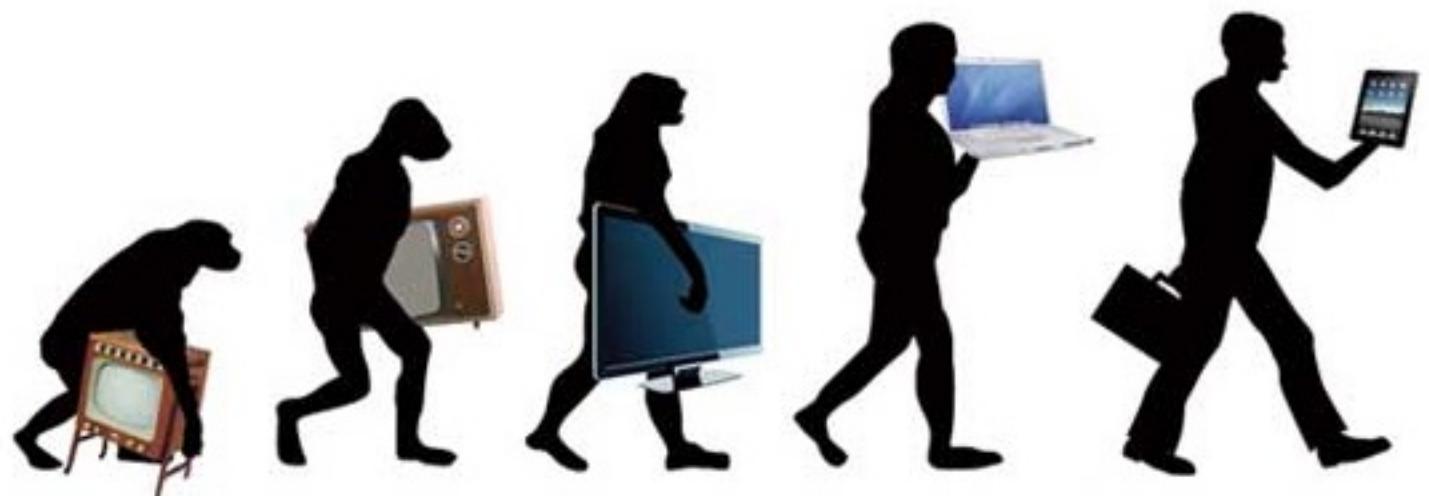
74.61% of people in the top 10 developing countries don't have a smartphone

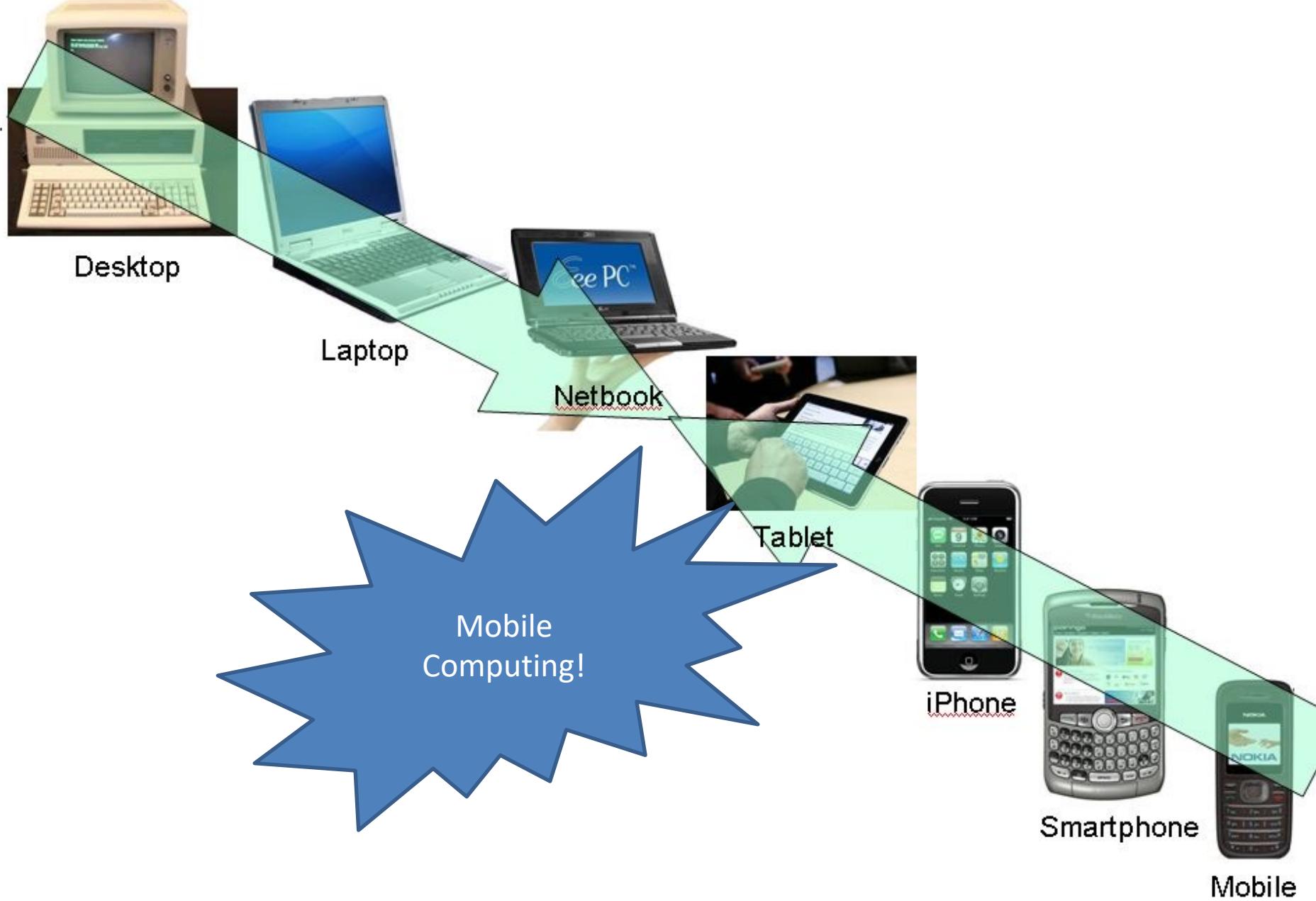
Another spin on the Newzoo data is that 25.39% of people in developing countries have a smart cell phone in their possession, leaving 74.61% of the population without one. Examples of countries included in this are Nigeria, Pakistan, Bangladesh, Indonesia, and India. [Source: 8. Newzoo](#)

(Source: <https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>)

Mobile computing

- Cerchiamo di capire
insieme la definizione

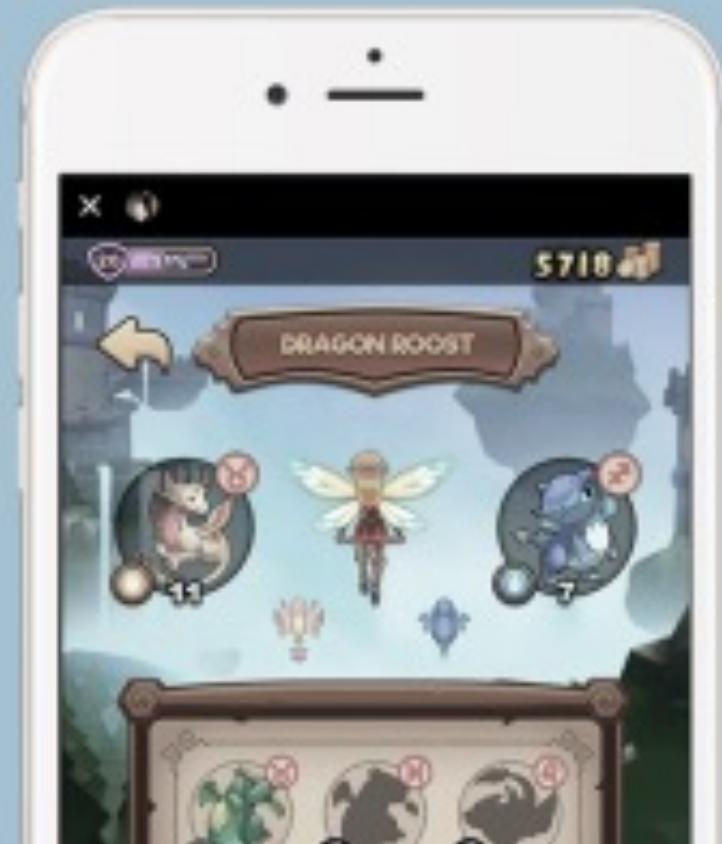




THEN



NOW





Evolution Of Mobile Computing Devices



SmartWatch



GPS System



LapTops



Gaming Console



Tablets



Phablets



PDA



Robots



E - Readres



Notebook



Smart Phone



Portable Media Player



Smart Glass



VR - Headset



AR - Headset



SemiSelf Driving Car

Mobile



mobile

/'məʊbɪl/

See definitions in:

All Police Military Computing

adjective

1. able to move or be moved freely or easily.

"he has a weight problem and is not very mobile"

Similar:

able to move

able to move around

moving

walking

ambulant



2. relating to mobile phones, handheld computers, and similar technology.

"the next generation of mobile networks"

Computing



computing

/kəm'pjju:tɪŋ/

noun

the use or operation of computers.

"developments in mathematics and computing"

- Adding more details
 - Computing is the process of using computer technology to complete a given goal-oriented task. Computing may encompass the **design** and **development** of software and hardware systems for a broad range of purposes - often structuring, processing and managing any kind of information - to aid in the pursuit of scientific studies, making intelligent systems, and creating and using different media for entertainment and communication

Mobile computing



- Tante definizioni.. Per esempio:
 - Il Mobile Computing consiste in tecniche/tecnicologie che permettono a utenti in movimento di utilizzare device portatili di eseguire applicazioni e di connettersi ad applicazioni remote
 - Il Mobile Computing è una tecnologia che consente la trasmissione di dati, voce e video tramite un computer o qualsiasi altro dispositivo abilitato wireless senza dover essere collegato ad un collegamento fisico fisso
- IMPORTANTE: Permette l'accesso a servizi in ogni luogo (**anywhere**) e in ogni momento (**anytime**)



L'importanza di essere «Mobile»



Permette la connettività ovunque e in qualsiasi momento



Permette di portare computer communication in aree senza infrastruttura preesistente



Permette di sfruttare il concetto di mobilità e di locazione (es. GPS)



Permette di sviluppare nuove applicazioni (es. AR e VR)



Un'area di ricerca incredibilmente in sviluppo!

Fattori chiavi



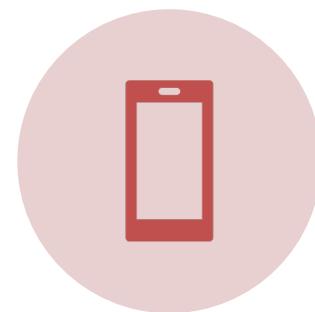
MINIATURIZZAZIONE
E PORTABILITÀ



CONNELLITIVITÀ



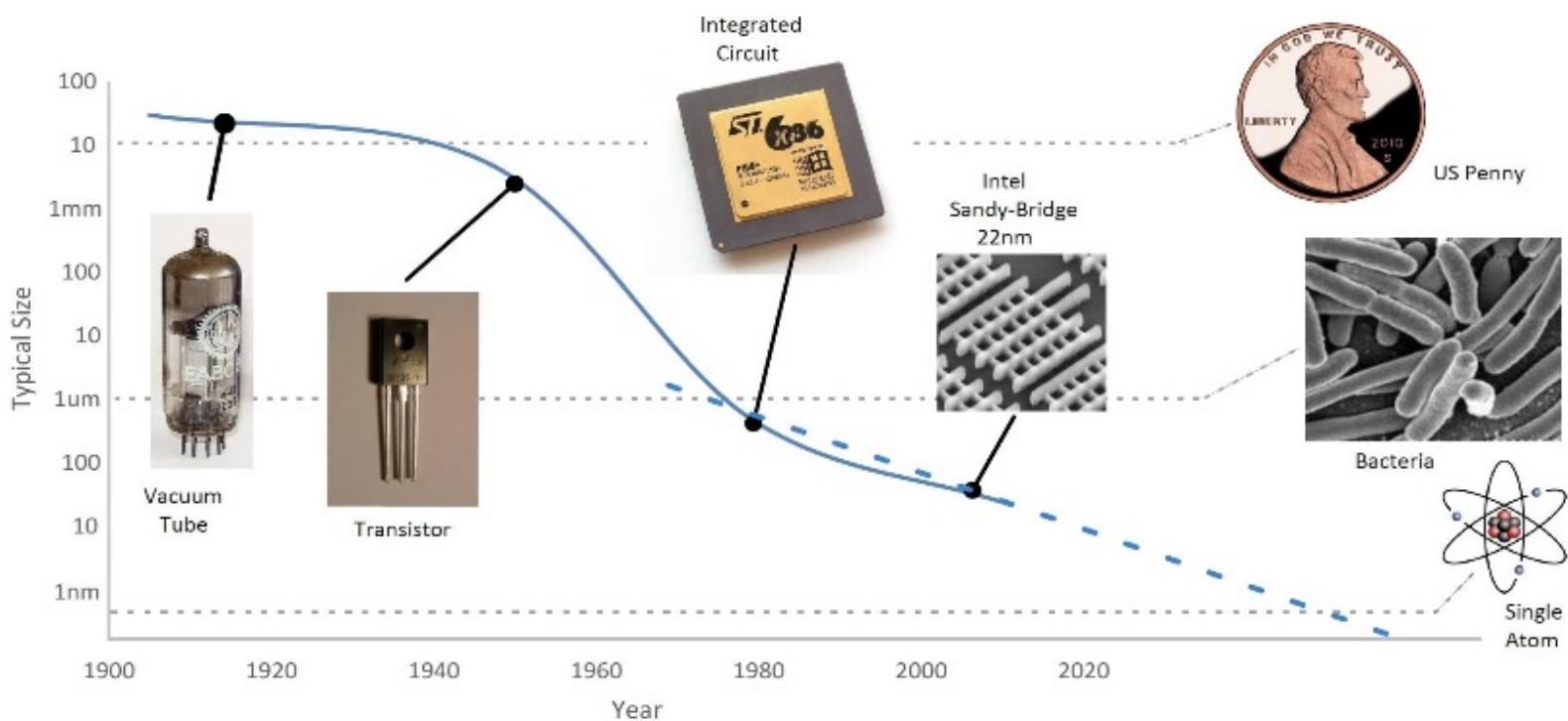
CONVERGENZA VS
DIVERGENZA



APPS

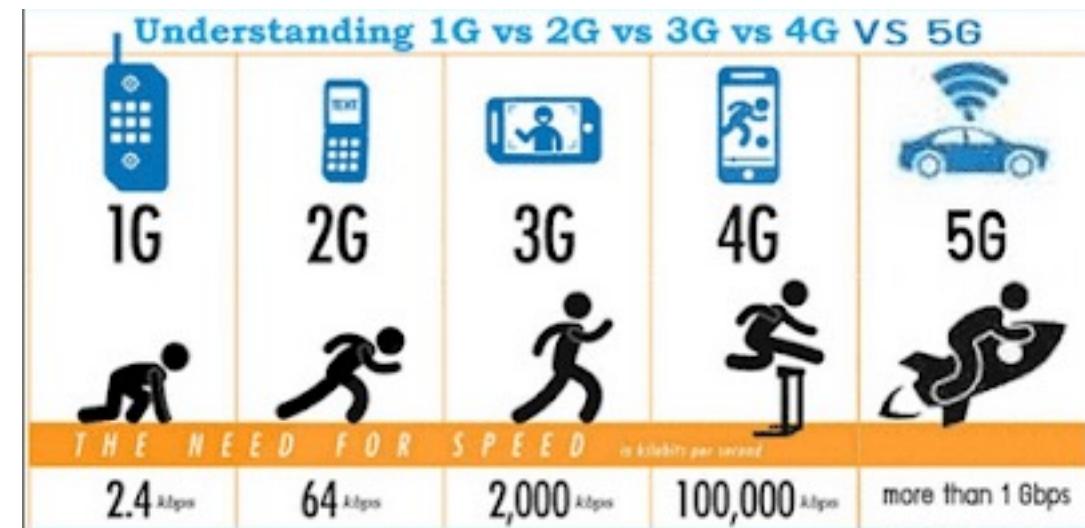
Miniaturizzazione → Portabilità

- Sviluppare componenti hardware sempre più piccoli e potenti



Connettività

- Sviluppare device e applicazioni che permettono all'utente di essere online e di comunicare via wireless data network mentre in movimento



Mobile communications: from 1G to 5G

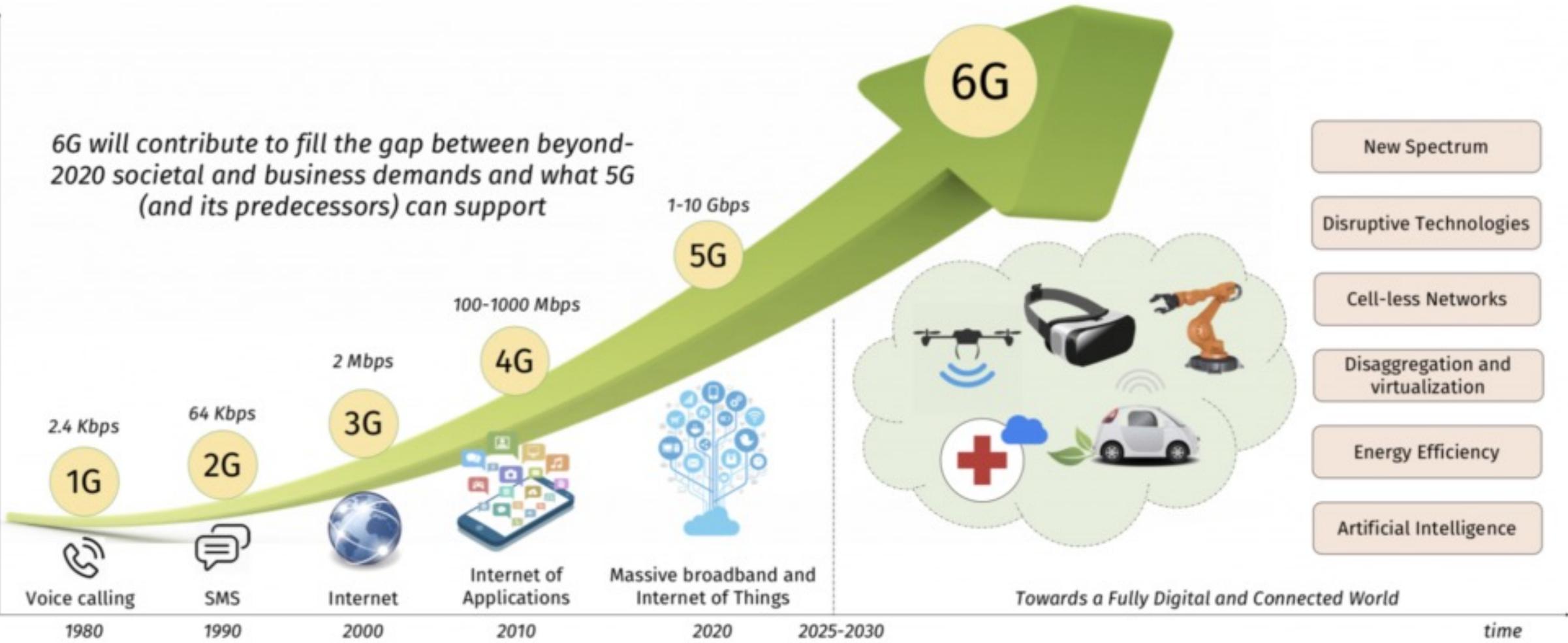
Generation	Device	Specifications
1G		
2G		
3G		
4G		



5G is about Communication, Storage, Processing...

5G

- La prossima grande novità nella connettività mobile è il 5G
- Il 5G consentirà nuovi entusiasmanti servizi e applicazioni, tra cui:
 - banda larga mobile più veloce e un'esperienza più coerente in aree congestionate con un numero molto elevato di dispositivi
 - applicazioni industriali, consentendo alle aziende di migliorare la propria produttività, ad esempio attraverso la manutenzione predittiva e l'analisi in tempo reale
 - Servizi Internet of Things (IoT), molti dei quali aiuteranno i comuni e le aziende a fornire servizi in modo più efficiente, tra cui:
 - trasporti e logistica: pacchi connessi e tracking della flotta
 - assistenza sanitaria e sociale
 - monitoraggio ambientale: sensori che monitorano in tempo reale la qualità dell'aria e l'inquinamento dell'acqua
 - agricoltura intelligente e allevamento intelligente di animali, vendita al dettaglio intelligente
 - auto connesse e autonome: consentono alle auto di comunicare tra loro, con gli altri utenti della strada e persino con l'infrastruttura stradale.



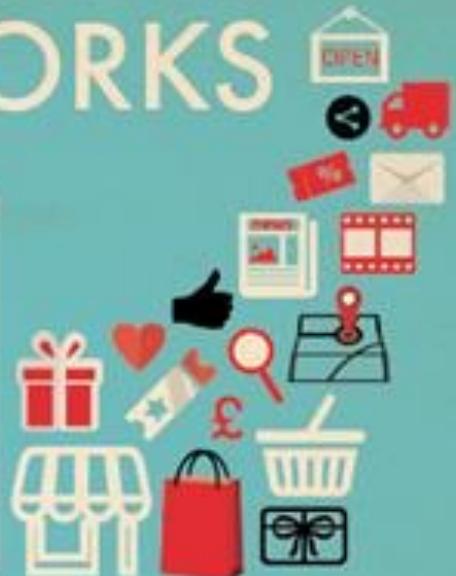
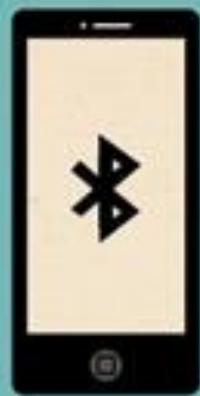
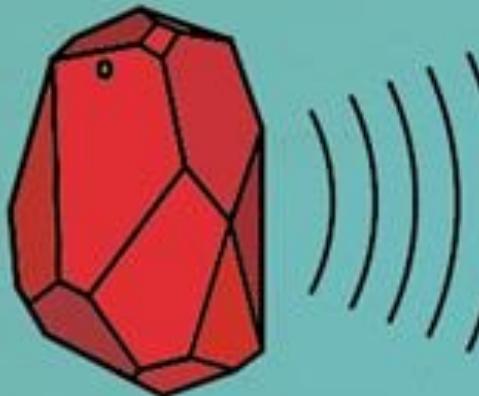
Bluetooth Low Energy

- Bluetooth Low Energy (Bluetooth LE, colloquially BLE, formerly marketed as Bluetooth Smart) is a wireless personal area network technology designed and marketed by the Bluetooth Special Interest Group (Bluetooth SIG) aimed at novel applications in the healthcare, fitness, beacons, security, and home entertainment industries
- The original specification was developed by Nokia in 2006 under the name Wibree, which was integrated into Bluetooth 4.0 in December 2009 as Bluetooth Low Energy
- Bluetooth Low Energy technology operates in the same spectrum range (the 2.400–2.4835 GHz ISM band) as classic Bluetooth technology, but uses a different set of channels
- Compared to Classic Bluetooth, Bluetooth Low Energy is intended to provide considerably **reduced power consumption** and cost while maintaining a similar communication range.

BLE Beacon

- Bluetooth beacons are hardware transmitters that broadcast their identifier to nearby portable electronic devices
- Bluetooth beacons use **Bluetooth low energy proximity sensing** to transmit a universally unique identifier picked up by a compatible app or operating system
- The technology enables smartphones, tablets and other devices to perform actions when in **close proximity** to a beacon
 - The identifier and several bytes sent with it can be used to determine the device's physical location (indoor positioning system), track customers, or trigger a location-based action on the device such as a check-in on social media or a push notification

HOW BEACON TECHNOLOGY WORKS



Retailers strategically place beacons around their store.

The Beacons connect to a customer's Bluetooth enabled smartphone app.

It sends a signal to the phone and the app is opened.

The retailer can provide the customer with a wealth of information.

The Hitchhikers Guide to iBeacon Hardware.

A Comprehensive Report by Aislelabs



Accent Systems



April Brother



Bluecats



Blue Sense



Bkon



Estimote



EMBC01



Gelo



Gimbal Series 10



Gimbal Series 21



Gliworm



HM-10 Dev Kit



Kontakt.io



KS Technologies



Lightcurb



Motorola Mpact



Minew MS63/i3



Minew i5



Minew MS54V3



Roximity



Radius Networks



RECO Beacon



RedBear



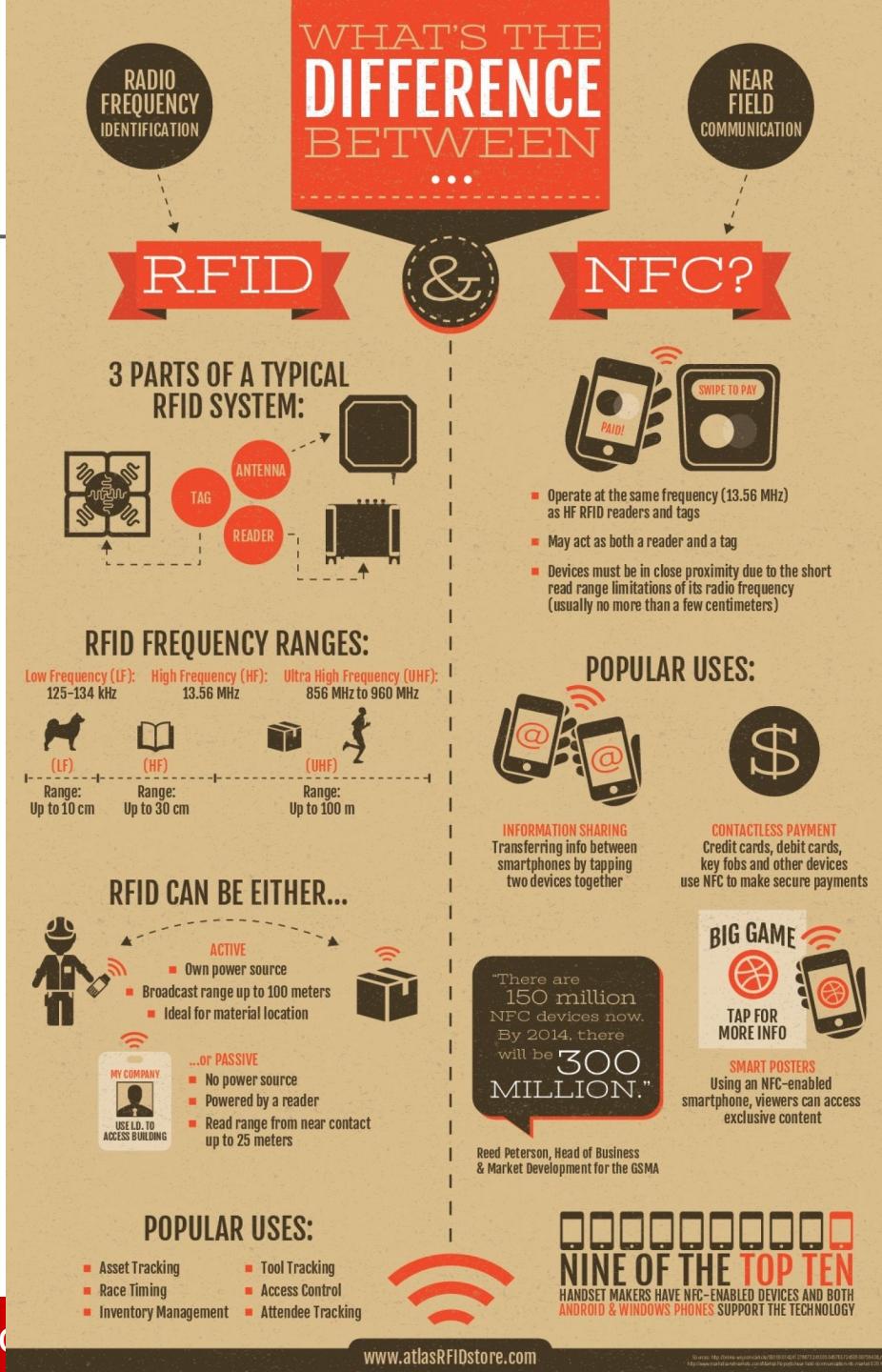
Sensorberg



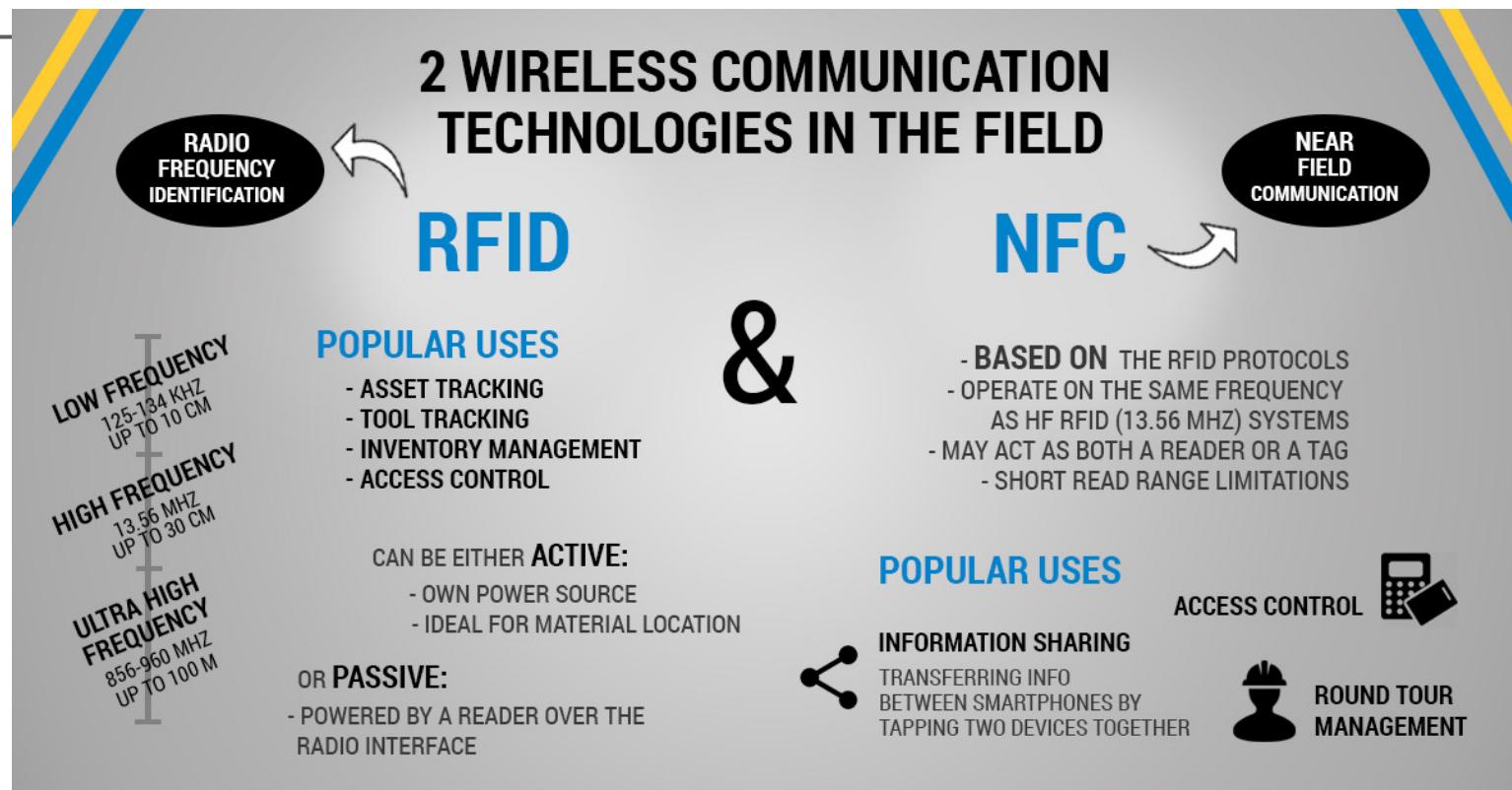
SensorTag



Tod



RFID and NFC



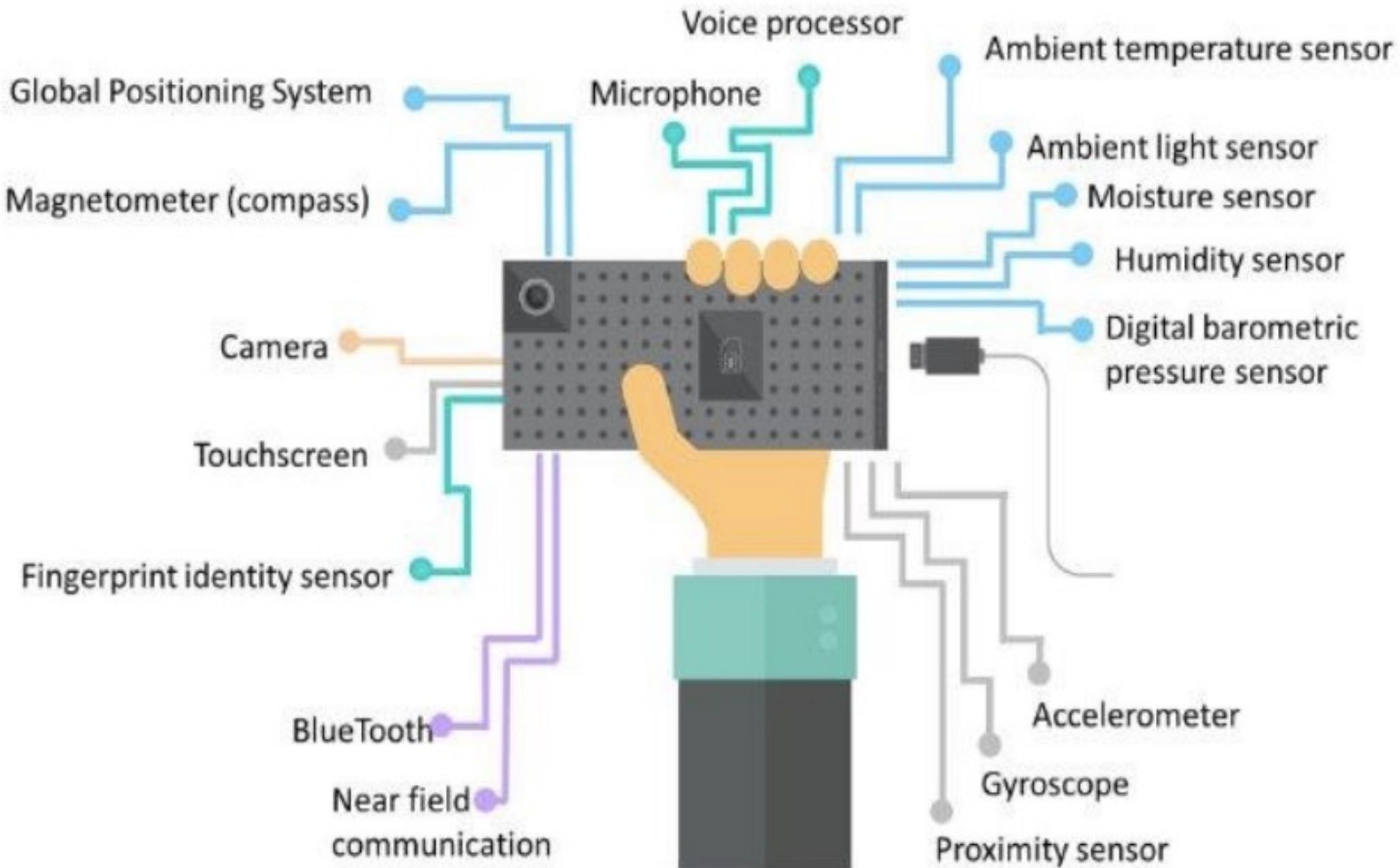
A really nice infographic: https://assets-global.website-files.com/5aa16619a72260001c19c3b/5c98f775f5786d7f95a53ce0_RFID-VS-NFC-Infographic.pdf



Convergenza

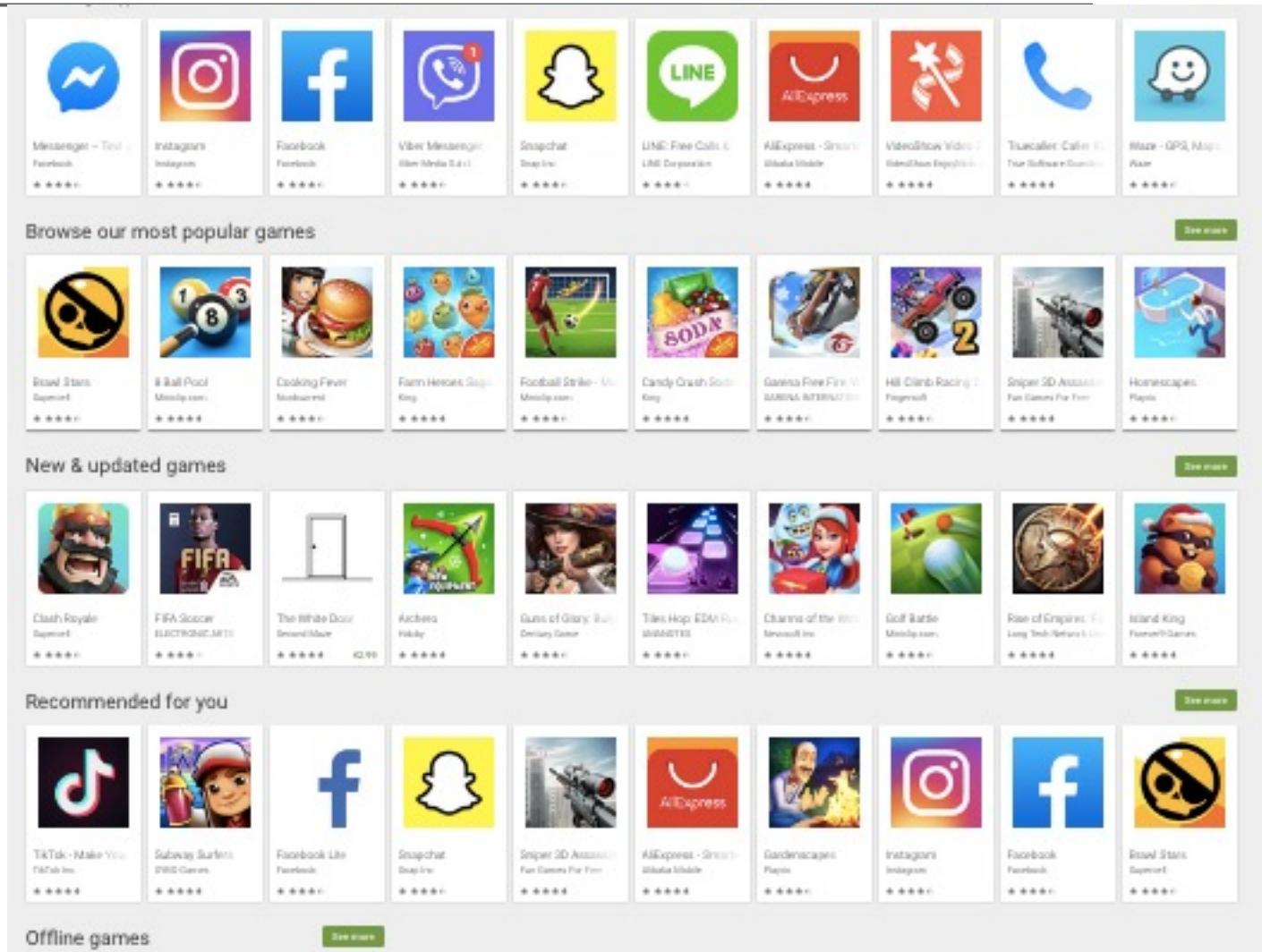
- L'idea di sviluppare device in grado di fare «tutto»
 - Personal Digital Assistants (PDAs), mobile phones, music players, cameras, games, ecc





App (applicazioni mobile)

- Applicazioni software che permettono di accedere ai più svariati servizi, contenuti interattivi e dinamici, giochi, contenuti di lavoro, ecc...



Apps



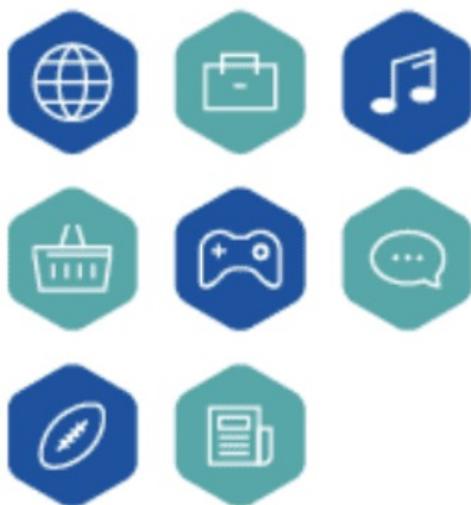
Key Mobile App Statistics

- Mobile apps are expected to generate over **\$935 billion** in revenue by 2023.
- The Apple App Store has **1.96 million apps** available for download.
- There are 2.87 million apps available for download on the Google Play Store.
- **21% of Millennials** open an app 50+ times per day.
- 49% of people open an app **11+ times each day**.
- 69% of all **US digital media time** comes from mobile apps.
- The **average smartphone owner** uses 10 apps per day and 30 apps each month.

<https://buildfire.com/app-statistics/>

HOW MANY APPS DO WE USE?

On average, a person now has more than **80 apps** installed on their phone



The average person uses...

9

mobile apps on a daily basis and

30

apps every month

Mobile computing

- Ci sono tre «attori» principali:
 - **Mobile communication**
 - **Hardware mobile**
 - **Software mobile**

Mobile communication

- È l'infrastruttura creata per garantire una comunicazione continua e affidabile per lo scambio di dati e voce utilizzando reti wireless
 - Es. protocolli, servizi, formato dato, larghezza di banda e portali necessari per facilitare e supportare i servizi dichiarati
- Le reti wireless utilizzate nella comunicazione sono reti IR (*InfraRed*), Bluetooth, W-LAN, cellulari, W-Packet Dat
- L'infrastruttura è radio wave-oriented
 - i segnali vengono trasportati nell'aria ai dispositivi che sono in grado di ricevere e inviare tipi di segnali simili



Hardware mobile

- Dispositivo di elaborazione portatile con la capacità di recuperare ed elaborare i dati
 - Esempi: **smartphone**, tablet, dispositivi indossabili (wearable devices)
 - Questi dispositivi hanno un sistema operativo e permettono la trasmissione dati full duplex (sono in grado di inviare e ricevere segnali contemporaneamente), hanno la capacità di operare su reti wireless (come IR, WiFi e Bluetooth) e sono spesso dotati di sensori





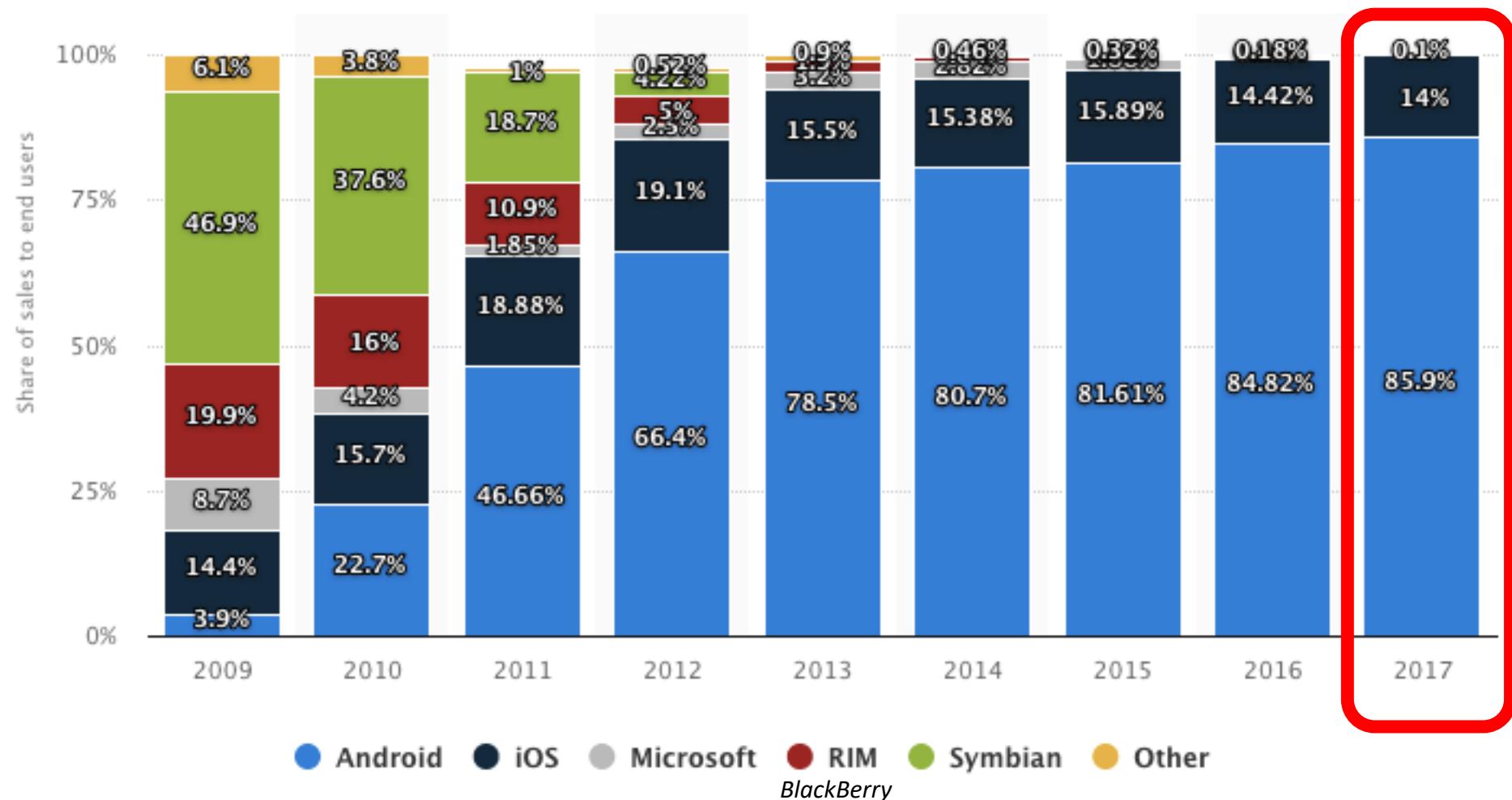
- Interessante link!
<https://www.webdesignerdepot.com/2009/05/the-evolution-of-cell-phone-design-between-1983-2009/>

Software mobile

- Mobile Software è il programma software che è stato sviluppato specificamente per essere eseguito su hardware mobile
=> sistema operativo (SO) nei dispositivi mobili
- Questi sistemi operativi offrono funzionalità quali touchscreen, connettività cellulare, Bluetooth, Wi-Fi, navigazione mobile GPS, fotocamera, videocamera, riconoscimento vocale, registratore vocale, lettore musicale, comunicazione near field e sensori



Smartphone platform market share

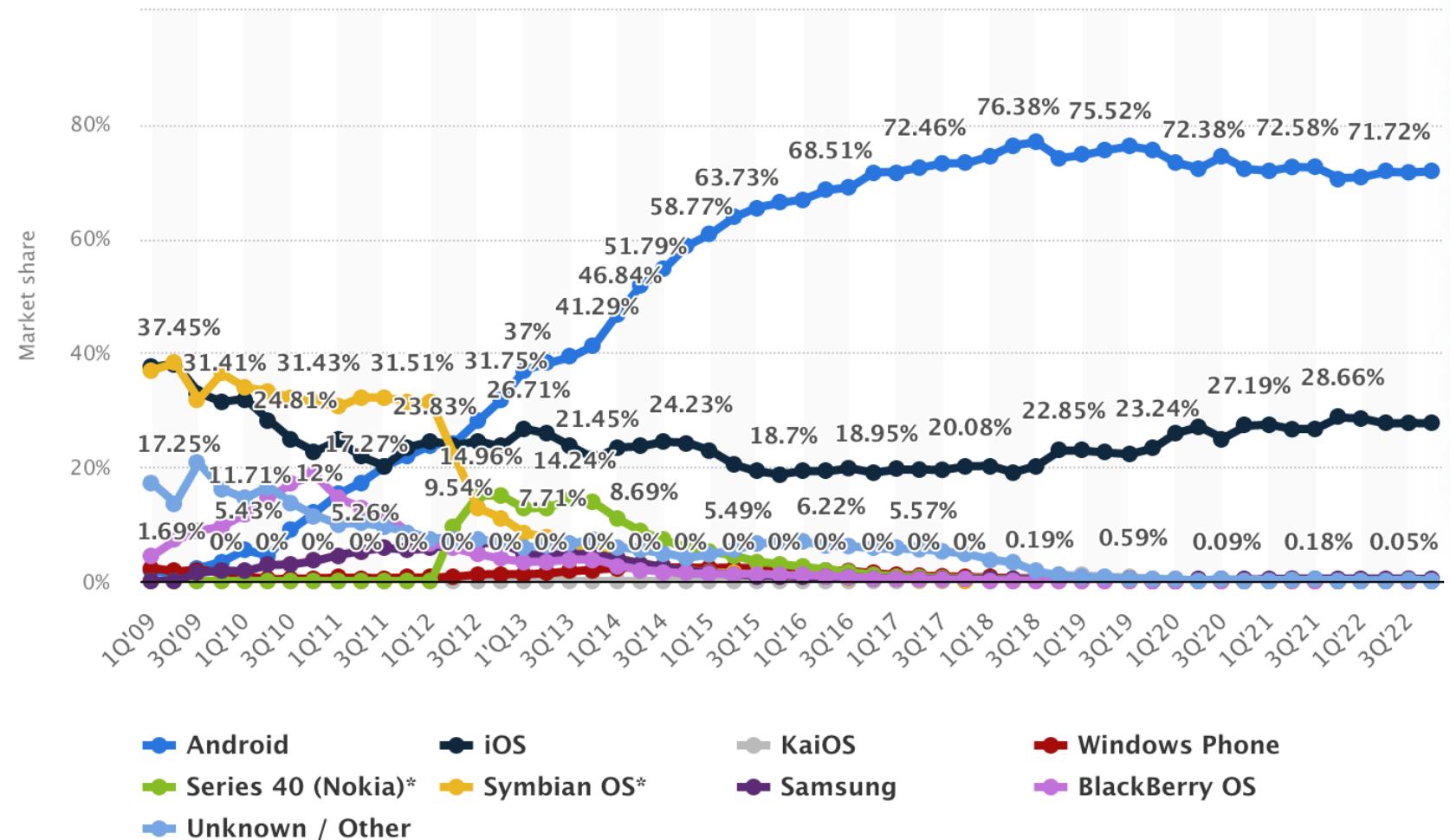


<https://www.statista.com/statistics/263453/global-market-share-held-by-smartphone-operating-systems/>

Software mobile

- Qual è la situazione oggi??

- Il grafico presenta la **quota di mercato** globale detenuta dai principali sistemi operativi per smartphone nelle vendite agli utenti finali dal 2009 al 2022

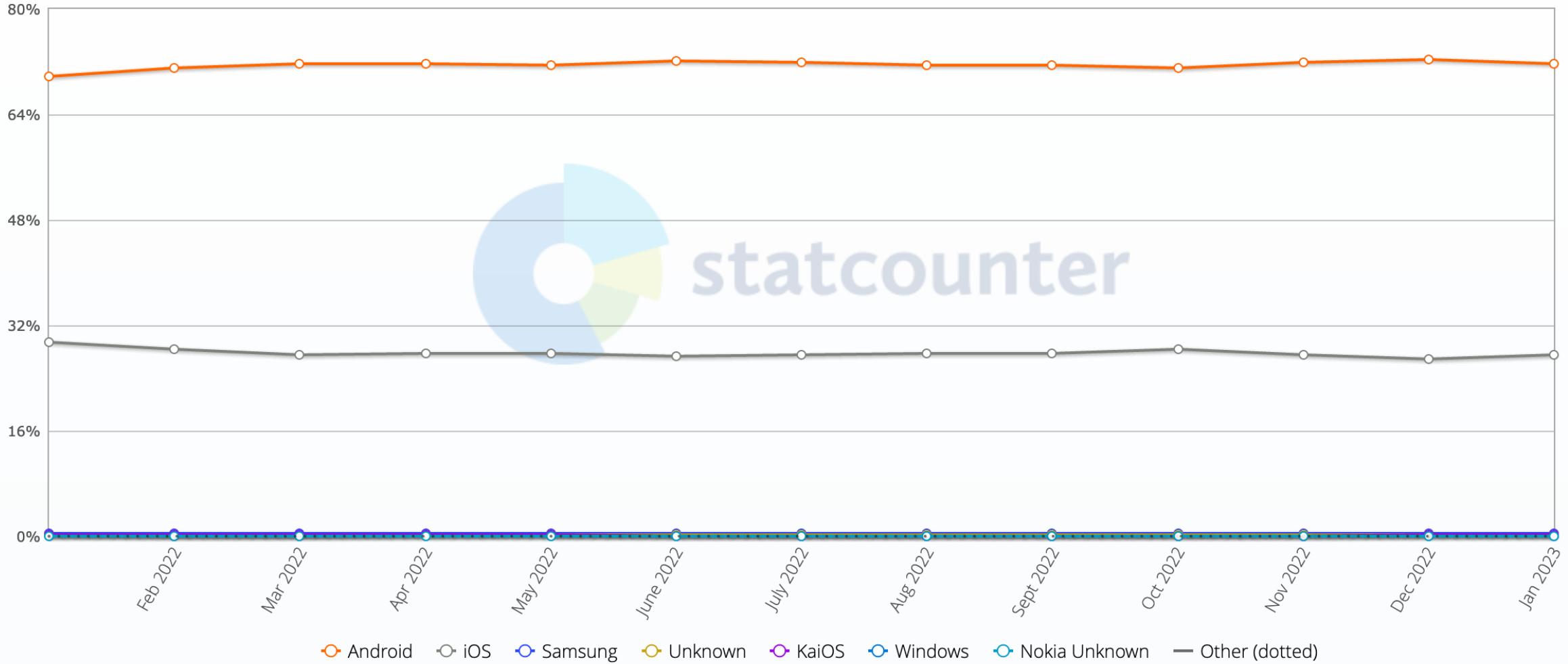


Source: <https://www.statista.com/statistics/272698/global-market-share-held-by-mobile-operating-systems-since-2009/>

Mobile Operating System Market Share Worldwide

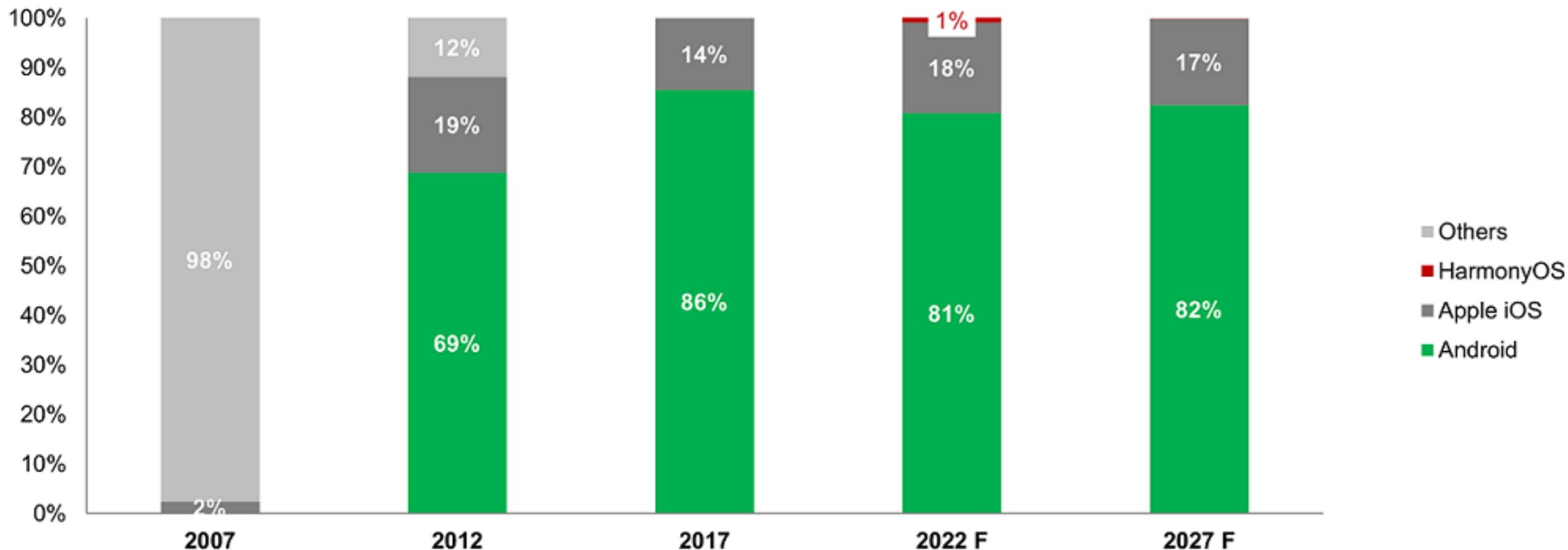
Edit Chart Data

Jan 2022 - Jan 2023



<https://gs.statcounter.com/os-market-share/mobile/worldwide>

GLOBAL SMARTPHONE SALES BY OPERATING SYSTEM : % OF TOTAL



Source: Wireless Smartphone Strategies (WSS)

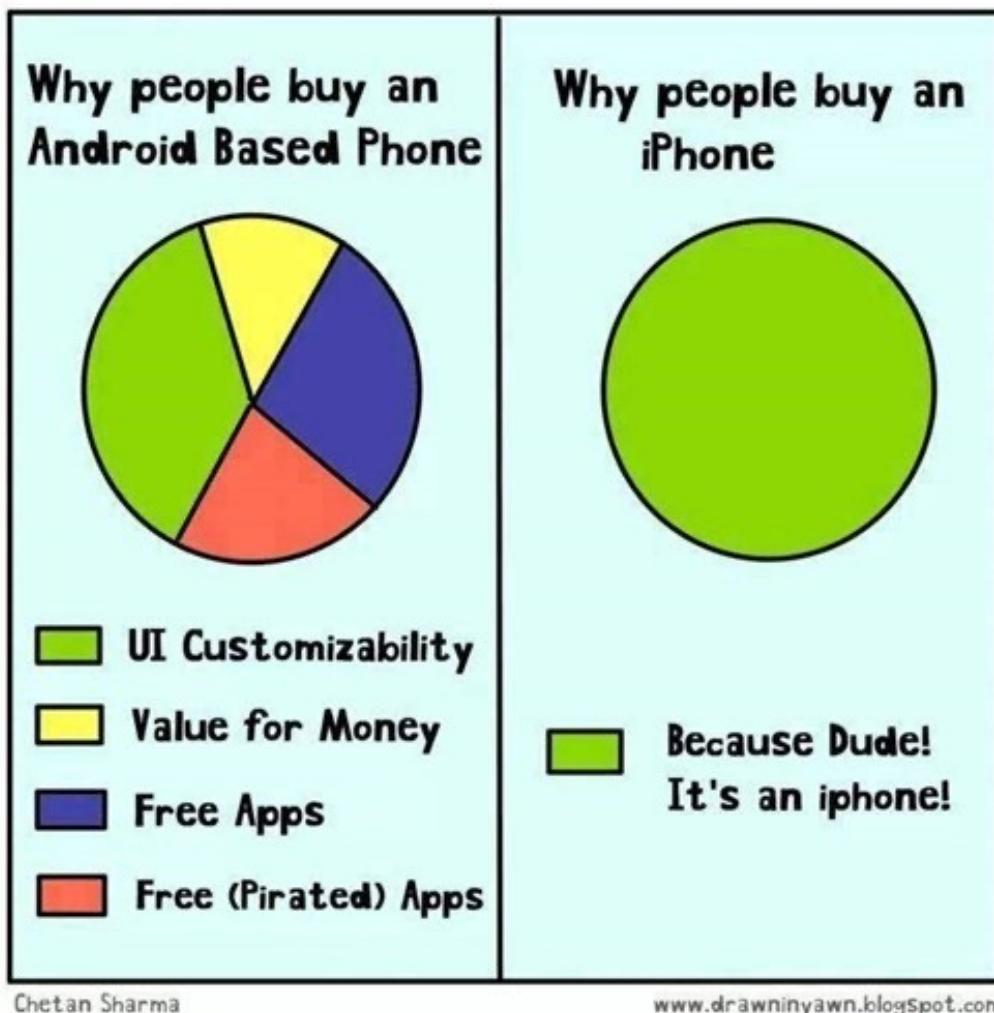
I due principali attori



I due principali attori



Android VS iPhone





Is Like a Serviced Apartment

Fully-furnished (works right out of the box) and convenient access to shops & facilities (well-integrated ecosystem). Low maintenance but expensive.



More user friendly.

Better backup service.

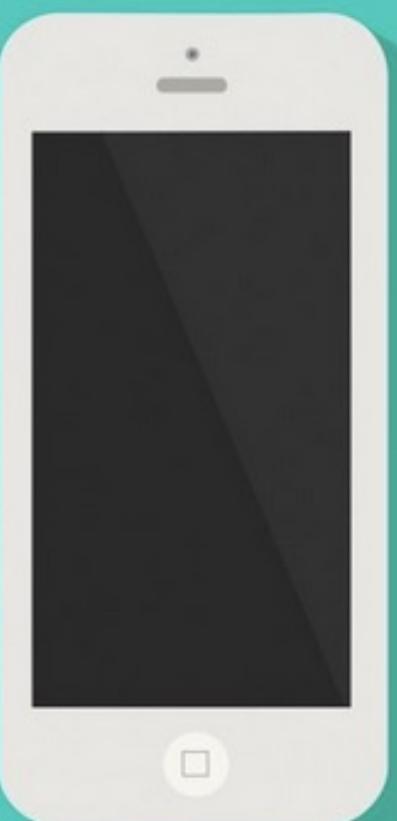
Better security & privacy control.

Slightly more & better built apps.

Best camera overall for now.

Better parental control

Better customer support



Is Like a House

More freedom to design & furnish your house (customizable), but requires more maintenance. Could be a huge mess or look really good, depends on the owner.



More customizable.

Do things your way

Ability to add widgets & customize home screen.

Ability to change default apps.

Accessible file system.

Most phones have expendable storage.

Most phones have removable and/or extended batteries



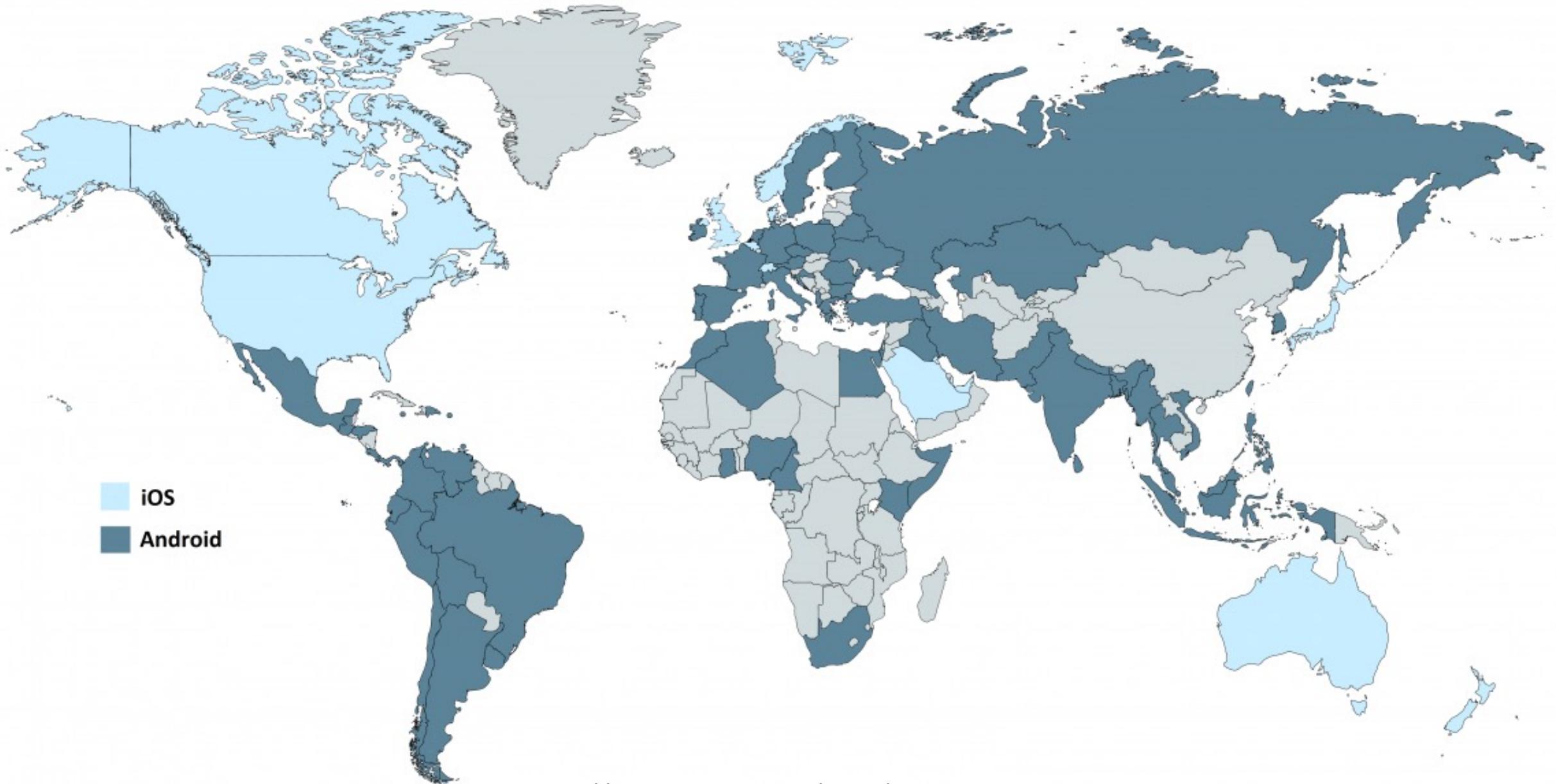
Best For

Those who want phones that just works & works well, tech illiterate users, hippies, iSheeps.

Best For

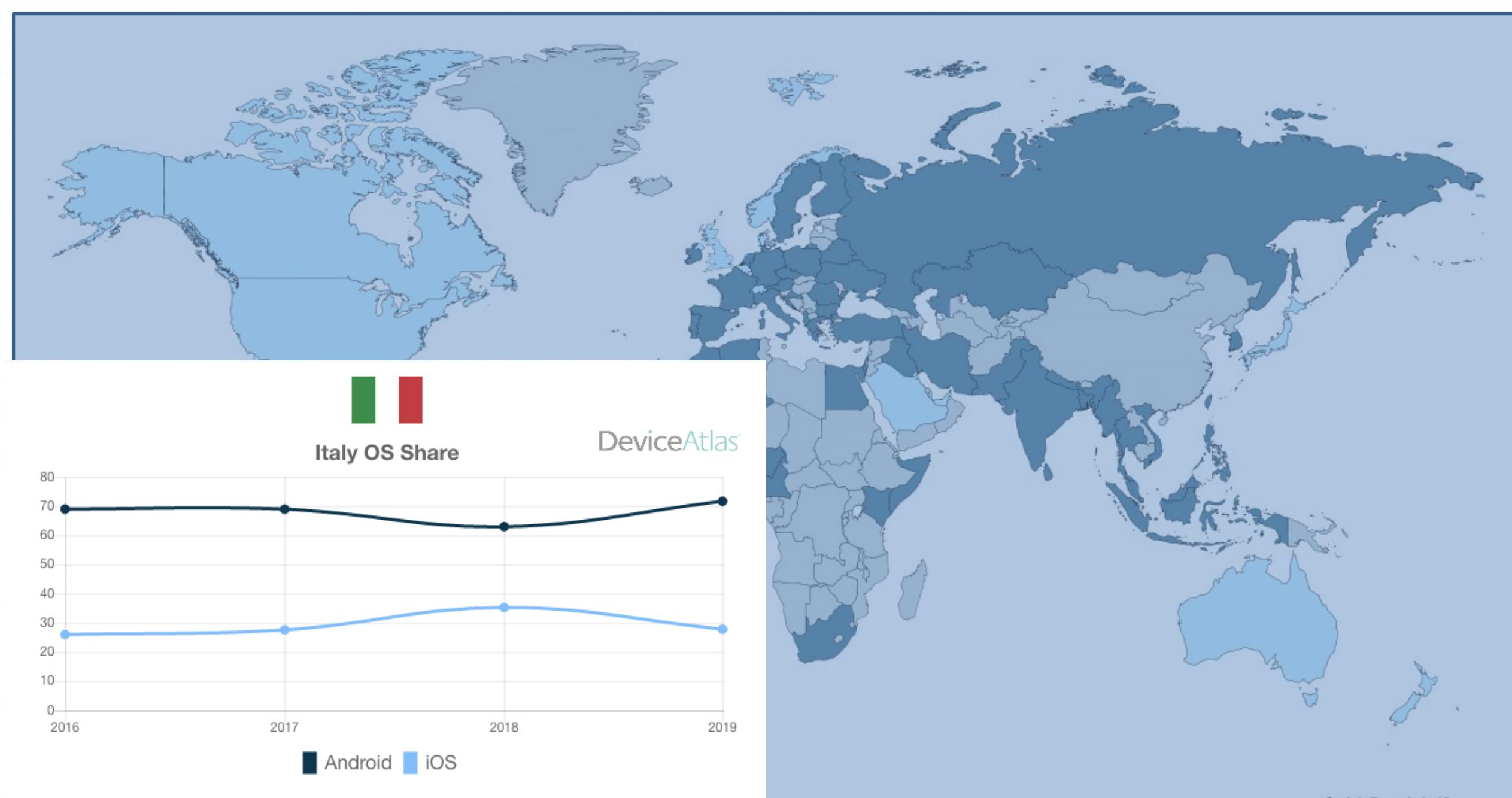
Lower-budget users, tinkerers, tech-savvy users.

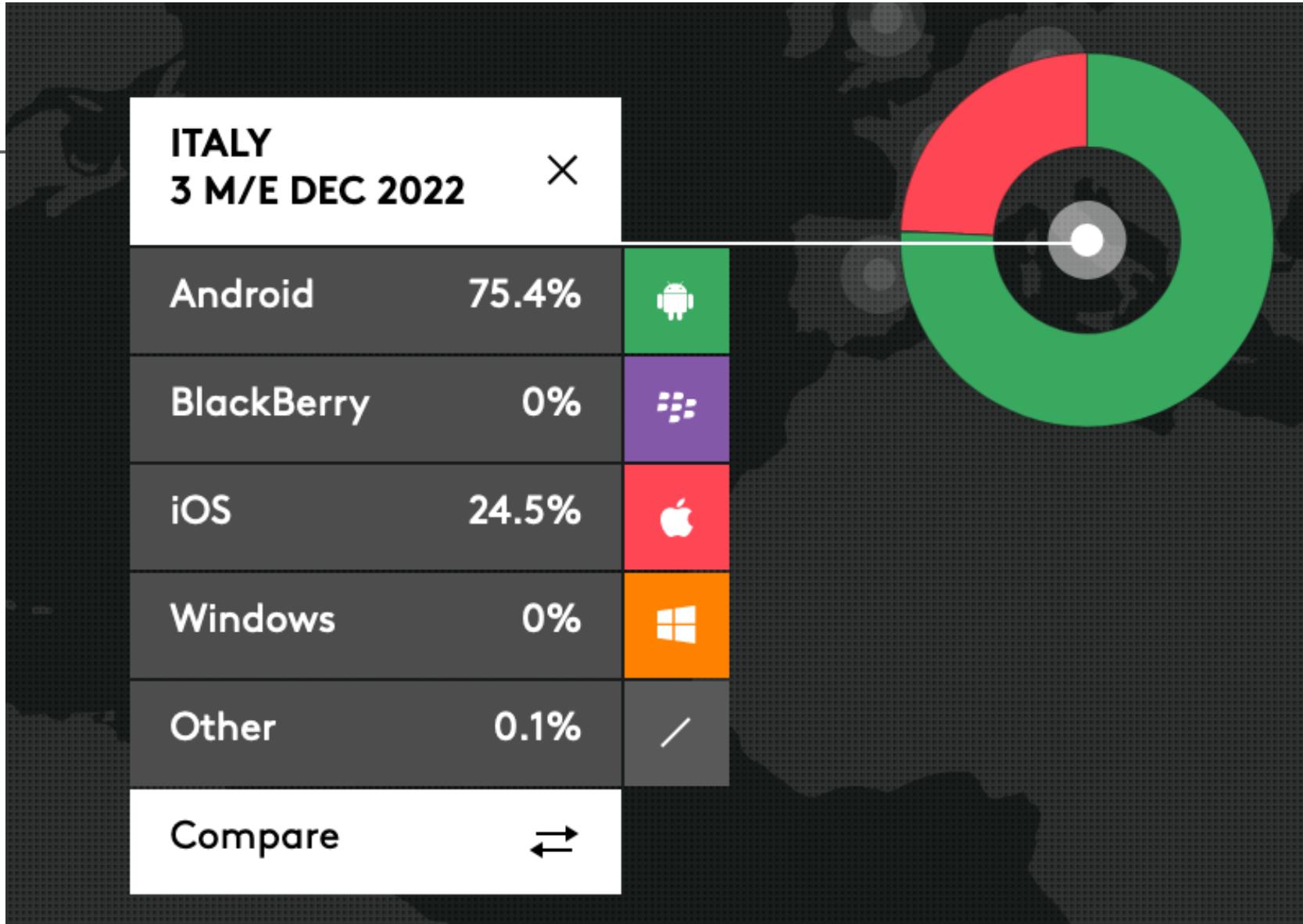
[LINK](#)
[Infografica](#)



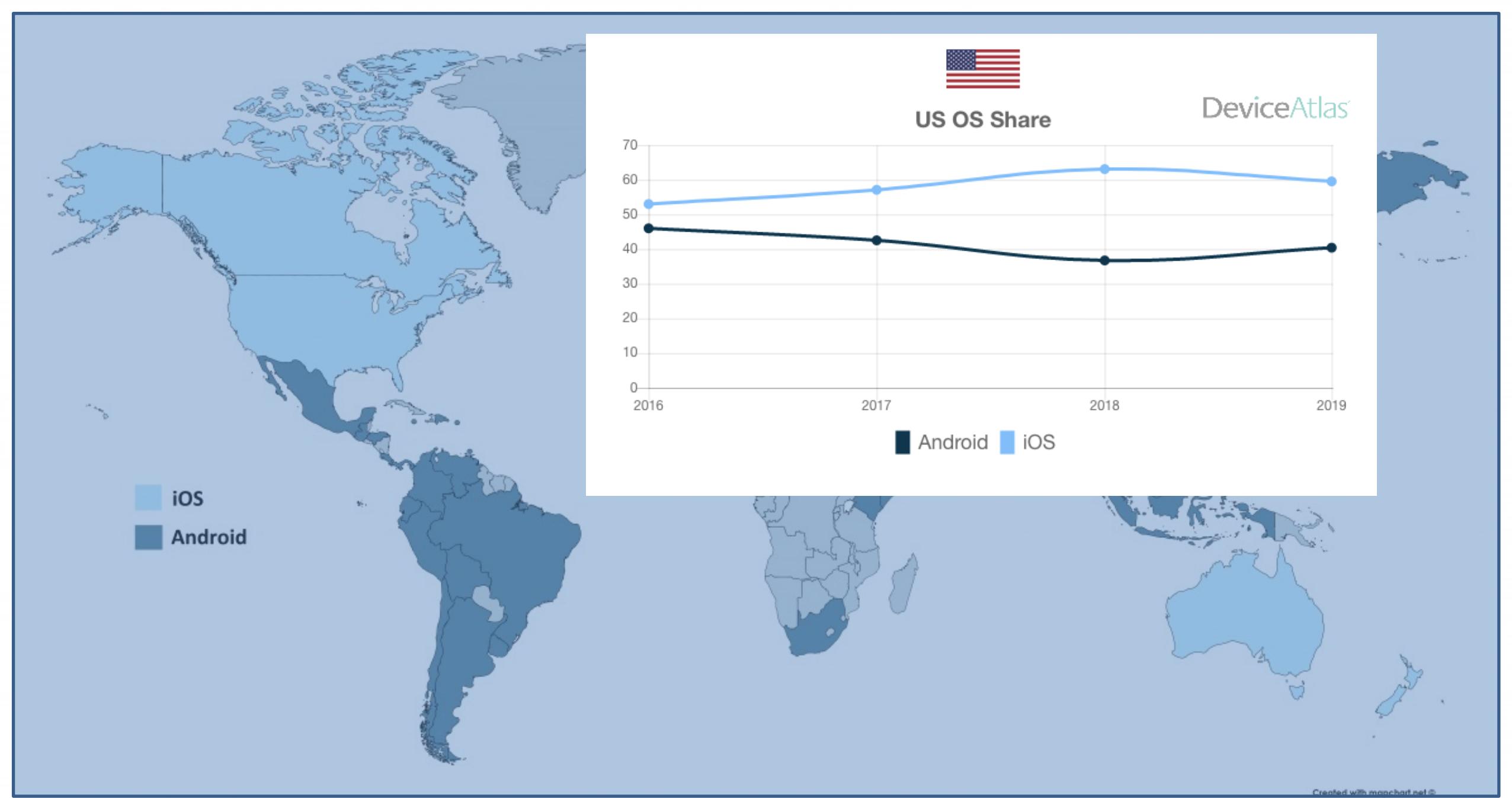
<https://deviceatlas.com/blog/android-v-ios-market-share>

Created with mapchart.net ©





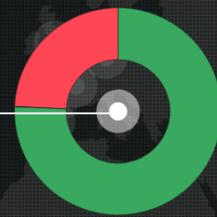
<https://www.kantarworldpanel.com/global/smartphone-os-market-share/>



Android vs. iOS

Read our expert's latest commentary
Google Pixel Celebrates a Record Global Quarter

ITALY 3 M/E DEC 2022	
Android	75.4%
BlackBerry	0%
iOS	24.5%
Windows	0%
Other	0.1%



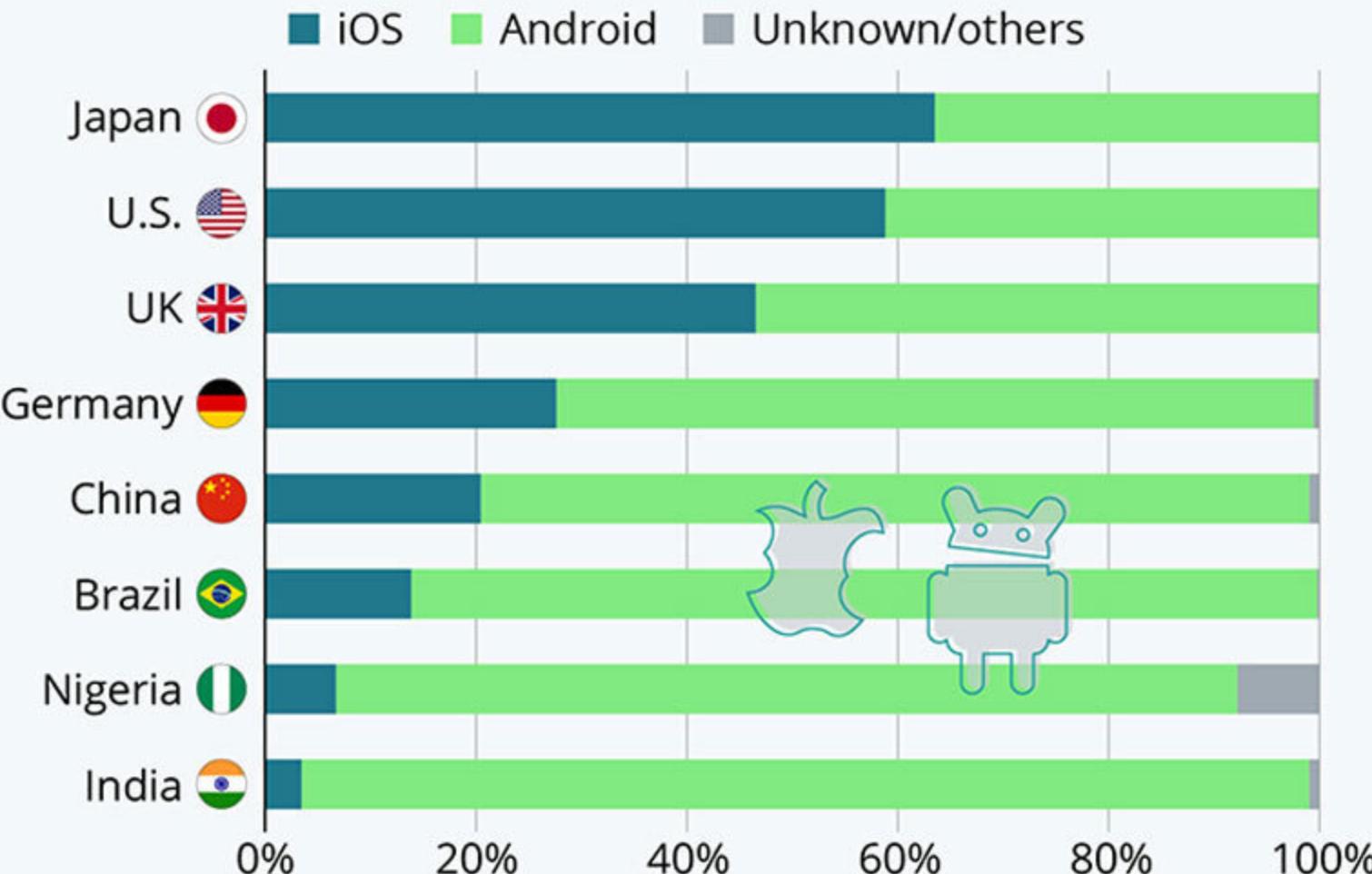
USA 3 M/E DEC 2022	
Android	46.3%
BlackBerry	0%
iOS	53.4%
Windows	0%
Other	0%



<https://www.kantarworldpanel.com/global/smartphone-os-market-share/>

Apple or Android Nation?

Mobile operating systems market share in selected countries (as of July 2020)



Source: StatCounter

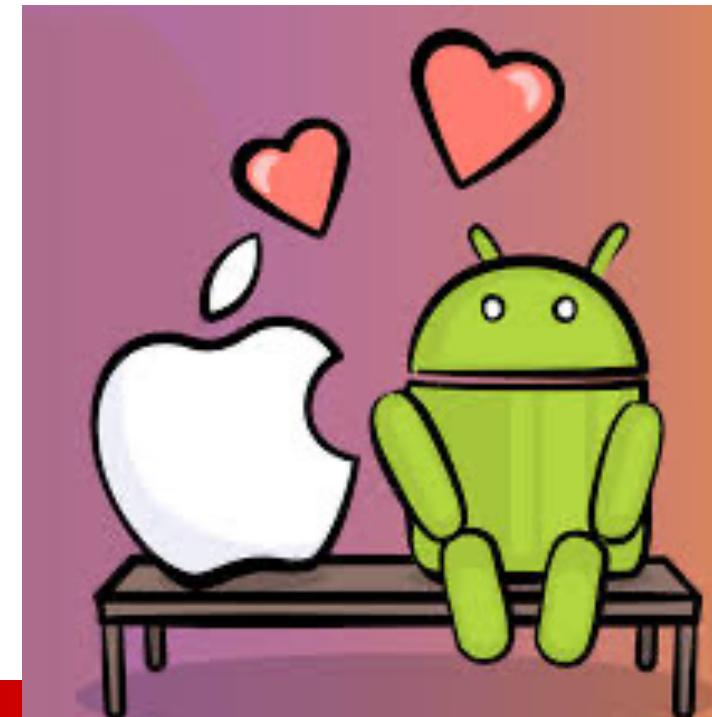


statista

PC
PCMAG.COM

Entrambe le piattaforme!

- Perché in questo modo si riesce a coprire l'intero mercato!
- Altra motivazione molto importante per sviluppo iOS
 - Ad oggi, le persone con disabilità visive preferiscono utilizzare iPhone, il motivo è che la componente di accessibilità (ovvero lo screen reader) è molto ben sviluppata garantendo una buona accessibilità anche con le altre app iOS che devono essere approvate prima di poter essere pubblicate nello store



Sfide nel contesto mobile computing

- I dispositivi mobile sono «resource-constrained»
- La connettività mobile è altamente variabile in termini di prestazioni e affidabilità
- I dispositivi mobili sono intrinsecamente meno sicuri, inoltre nuove problematiche dovute alla privacy

Resource-constrained

- I dispositivi dipendono dalla durata della batteria
 - L'uso dell'energia dipende da:
 - Computazione (CPU/processori)
 - Display
 - Comunicazione
 - Uso sensori
- Vincoli dovuti alla capacità di memoria

Connettività mobile

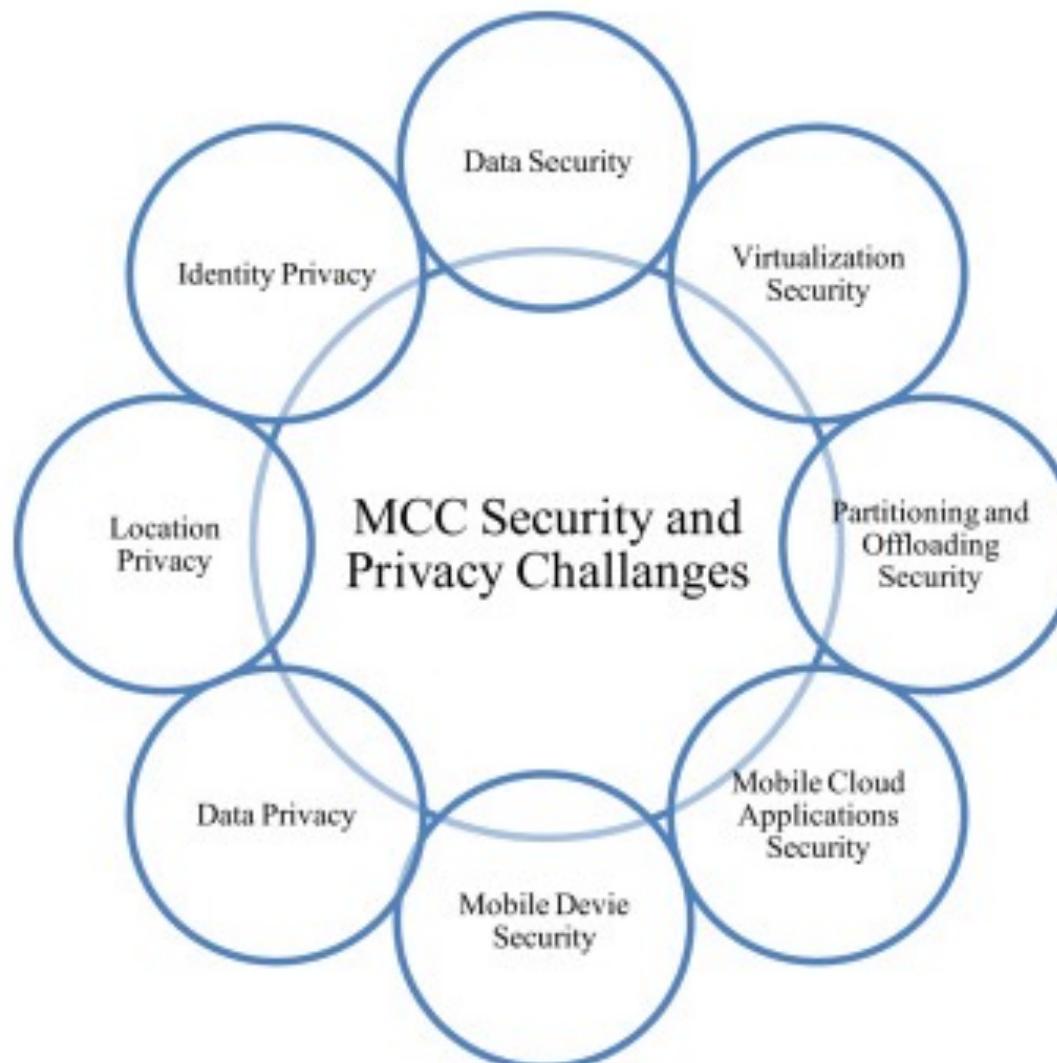
Wired	Wireless
High bandwidth	Low bandwidth
Low bandwidth variability	High bandwidth variability
Can listen on wired (CSMA/CD)	Hidden terminal problem
High power machines	Low power machines
High resource machines	Low resource machines
Need physical access (security)	Need proximity
Low delay	High, variable delay
Connected operation	Disconnected operation

Connettività mobile

- Vari tipi di connettività
 - Cellulare (data connection)
 - GSM, 3G, 4G, 5G, 6G (new!)
 - WiFi
 - Bluetooth e Bluetooth Low-Energy (BLE), esempio tecnologia iBeacon
 - Near Field Communication (NFC)
- Vincoli dovuti a
 - Problemi di copertura
 - Trade-offs: energy consumption, throughput, costo

Sicurezza e privacy

- I dispositivi mobile per loro natura sono meno sicuri (connessione wireless - everywhere, portabili - everytime)
- Privacy
 - Oggi giorno i dispositivi mobile permettono di raccogliere, inviare e memorizzare una quantità inimmaginabile di informazioni, incluse informazioni molto personali (es. impronta digitale)
 - Le app, a loro volta, richiedono di accedere a molte risorse, non sempre davvero necessarie



Security and privacy challenges in mobile cloud computing: Survey and way ahead
<https://www.sciencedirect.com/science/article/pii/S1084804517300632>

App e permessi: uno studio

Privacy Perception when using Smartphone Applications

Marco Furini · Silvia Mirri · Manuela Montangero · Catia Prandi

https://cris.unibo.it/retrieve/handle/11585/753253/789043/privacy_furini.pdf

Received: date / Accepted: date

Abstract Our smartphone is full of applications and data that analytically organize, facilitate and describe our lives. We install applications for the most varied reasons, to inform us, to have fun, for work, for necessity, but, unfortunately, we often install them without reading the terms and conditions of use. The result is that our privacy is increasingly at risk. Considering this scenario, in this paper, we analyze the user's perception towards privacy while using smartphone applications. In particular, we formulate two different hypotheses: 1) the perception of privacy is influenced by the knowledge of the data used by the installed applications; 2) applications access to much more data than they need. The study is based on two questionnaires (within-subject experiments with 200 volunteers) and on the lists of installed apps (30 volunteers). Results show a widespread abuse of data related to location, personal contacts, camera, Wi-Fi network list, running apps list, and vibration. An in-depth analysis shows that some features are more relevant to certain groups of users (e.g., adults are mainly worried about contacts and Wi-Fi connection lists; iOS users are sensitive to smartphone vibration; female participants are worried about possible misuse of the smartphone camera).

4.2 Data and Results

Participants have few common applications: Whatsapp (87% of the participants has it on their smartphone), Telegram (68%), Facebook (60%), Spotify (60%), Instagram (60%), Dropbox (41%) and Skype (36%). In general, only 16% of the analyzed apps are installed on more than one smartphone, whereas 84% of the apps are used by a single volunteer. In details, the analysis of authorization requests by the 843 apps reveal an alarming scenario:

- **Contacts.** 24% of the installed apps access to this data and 39% of them violate the user's privacy;
- **Location:** 36% of the installed apps access to this data and 28% of them violate the user's privacy;
- **ID Telephone:** 8% of the installed apps access to this data and 68% of them violate the user's privacy;
- **SMS:** 7% of the installed apps access to this data and 37% of them violate the user's privacy;
- **Multimedia storage:** 56% of the installed apps access to this data and 29% of them violate the user's privacy;
- **Microphone:** 12% of the installed apps access to this data and 38% of them violate the user's privacy;
- **Wi-Fi connections list:** 33% of the installed apps access to this data and 52% of them violate the user's privacy;
- **Vibration:** 37% of the installed apps access to this data and 22% of them violate the user's privacy;
- **Running apps list:** 7% of the installed apps access to this data and 58% of them violate the user's privacy;

https://www.linkedin.com/posts/marco-furini-118904196_privacy-research-security-activity-6728224328023904256-6qtd

Sviluppare applicazioni

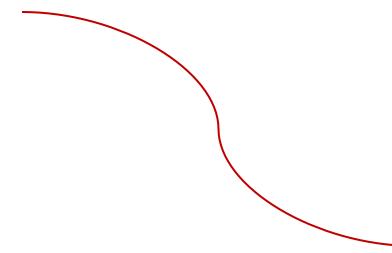
- Prima domanda da farsi..

Nativa o ibrida?

Sviluppare applicazioni

- Prima domanda da farsi..

Nativa o ibrida?



Dipende!

Applicazioni native

- Applicazioni sviluppate appositamente per un Sistema operativo, utilizzando il suo linguaggio di sviluppo
- Applicazioni Android (native)
 - (Android Studio +) Java / Kotlin
- Applicazioni iOS (native)
 - (X-code +) Swift (linguaggio object-oriented, completamente interoperabile con Objective-C)
 - NB: Apple raccomanda lo sviluppo nativo → Apple revisiona e approva tutte le applicazioni prima di distribuirle nel suo App Store

Sviluppare applicazioni native

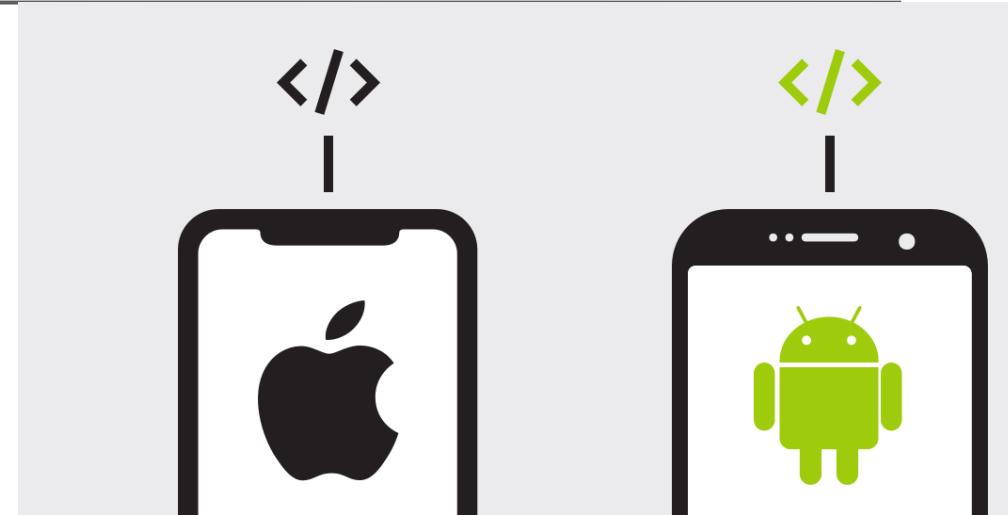
- Vantaggi:
 - Poder accedere direttamente alle funzionalità del sistema operativo, e non necessita di livelli di astrazione o middleware aggiuntivi
 - Rappresentano l'opzione più sicura per garantire all'utente l'esperienza migliore possibile, con accesso e integrazione completa con le funzioni hardware del dispositivo e le API native, tempi di risposta molto più rapidi e utilità completa senza connessione ad Internet
 - Spesso richiede un investimento iniziale più alto, ma si ottiene un'app con esperienza utente eccellente e prestazioni ottimali

Sviluppare applicazioni native

- Svantaggi:
 - COSTO e TEMPISTICHE: prevede un budget per lo sviluppo in iOS, uno per lo sviluppo in Android e anche un terzo in comune per la progettazione dell’interfaccia (con piccole differenze e aggiustamenti per ogni sistema operativo) e il *backend*
- Nel caso non sia possibile gestire quel costo, si opta per una soluzione ibrida

Applicazioni native

- PRO
 - High performance
 - Sicurezza
 - Personalizzazione (UX)
 - Forte compatibilità con altre app
 - Assoluta compatibilità con API fornite dal OS
- CONTRO
 - Costo di sviluppo
 - Tempo



Sviluppo ibrido

- Quando il budget è limitato e i requisiti del progetto non sono ben definiti la soluzione ibrida è la più indicata
- Lo sviluppo di app ibride ha i suoi pro e contro, sicuramente tra i lati positivi c'è un risparmio di tempo notevole e la compatibilità multi-piattaforma (iOS, Android)
 - Le app sono in realtà siti Web «impacchettati» in un contenitore che lo fa sembrare un'app nativa
 - (solitamente) accedono effettivamente al sito Web utilizzando un mini-browser noto come WebView
 - Generalmente sono costruite con HTML5, Javascript e CSS
- Esempi: Ionic, NativeScript, React Native, Xamarin, PhoneGap, Apache Cordova, Flutter, ecc.

Sviluppo ibrido

- Quando il budget è limitato e i requisiti sono ben definiti la soluzione più adatta è l'**sviluppo ibrido**. Durante il corso ci sarà un seminario su **React Native** ed uno su **Flutter!**
- Lo sviluppo di app ibride ha molti vantaggi: i lati positivi c'è il supporto multi-piattaforma.
 - Le app sono più leggere e sembrano un'app nativa (solitamente attraverso un contenitore che lo fa funzionare come Webview)
 - Generalmente sono costruite con HTML5, Javascript e CSS
- Esempi: Ionic, NativeScript, React Native, Xamarin, PhoneGap, Apache Cordova, Flutter, ecc.

Sviluppo ibrido

- PRO
 - Sviluppo più veloce
 - Cross-platform
 - Costo minore di sviluppo
- CONTRO
 - (solitamente) necessitano Internet connection
 - UX meno curata
 - Capacità limitate (plug-in per accedere alle varie funzionalità native)



Native App	Hybrid App
Programming languages required (Java for Android, Objective-C or Swift for iOS)	HTML, CSS, JavaScript
A separate code for each platform	Single codebase
High performance	Lower performance
Requires more time, money, and expertise	Faster, cheaper and easier to develop
Great user experience	Good user experience
Enhanced security	Good security
Easy to customize	Poor customizability
Direct access to native device features	Requires specific plugins
Easier to test and debug	Simpler to maintain

Hybrid
app



PWA



Responsive
Website



Native
app



Mobile computing e..

- Pervasive computing
 - Indica come la tecnologia può essere pervasiva nella vita di tutti i giorni
- Ubiquitous computing
 - Descrive come la tecnologia è diventata universalmente accessibile e compatibile, computazione ovunque
 - Idea di dispositivi invisibili
- Termini spesso usati in modo intercambiabile

Pervasive/Ubiquitous computing

- I dispositivi hanno la capacità di ottenere informazioni dall'ambiente in cui essi sono inseriti e di adattare il loro funzionamento (comportamento) selezionando differenti modalità di elaborazione
 - Adattabilità
 - Comunicazione
 - elaborazione locale
- Nell'ubiquitous computing si ha una combinazione di grande mobilità ed elevata integrazione nell'ambiente

Pervasive vs Ubiquitous Computing



- **Pervasive computing** refers to the ability to access computing and information technologies at any time, in any place.
- **Ubiquitous computing** goes beyond pervasive computing to the point where *computing is a part of the environment* (and maybe unnoticed.)

Ubiquitous computing

“The most profound technologies are those that disappear.”

Mark D. Weiser

- Mark D. Weiser (1952 – 1999) è stato informatico e chief technology officer (CTO) presso Xerox PARC
- Weiser è ampiamente considerato il padre dell'ubiquitous computing, termine che ha coniato nel 1988.
- All'interno della Silicon Valley, Weiser era ampiamente considerato un visionario e un pioniere dei computer e le sue idee hanno influenzato molti dei principali scienziati informatici del mondo

<https://www.cs.cmu.edu/~jasonh/courses/ubicomp-sp2007/papers/02-weiser-computer-21st-century.pdf>

Context-Aware Computing

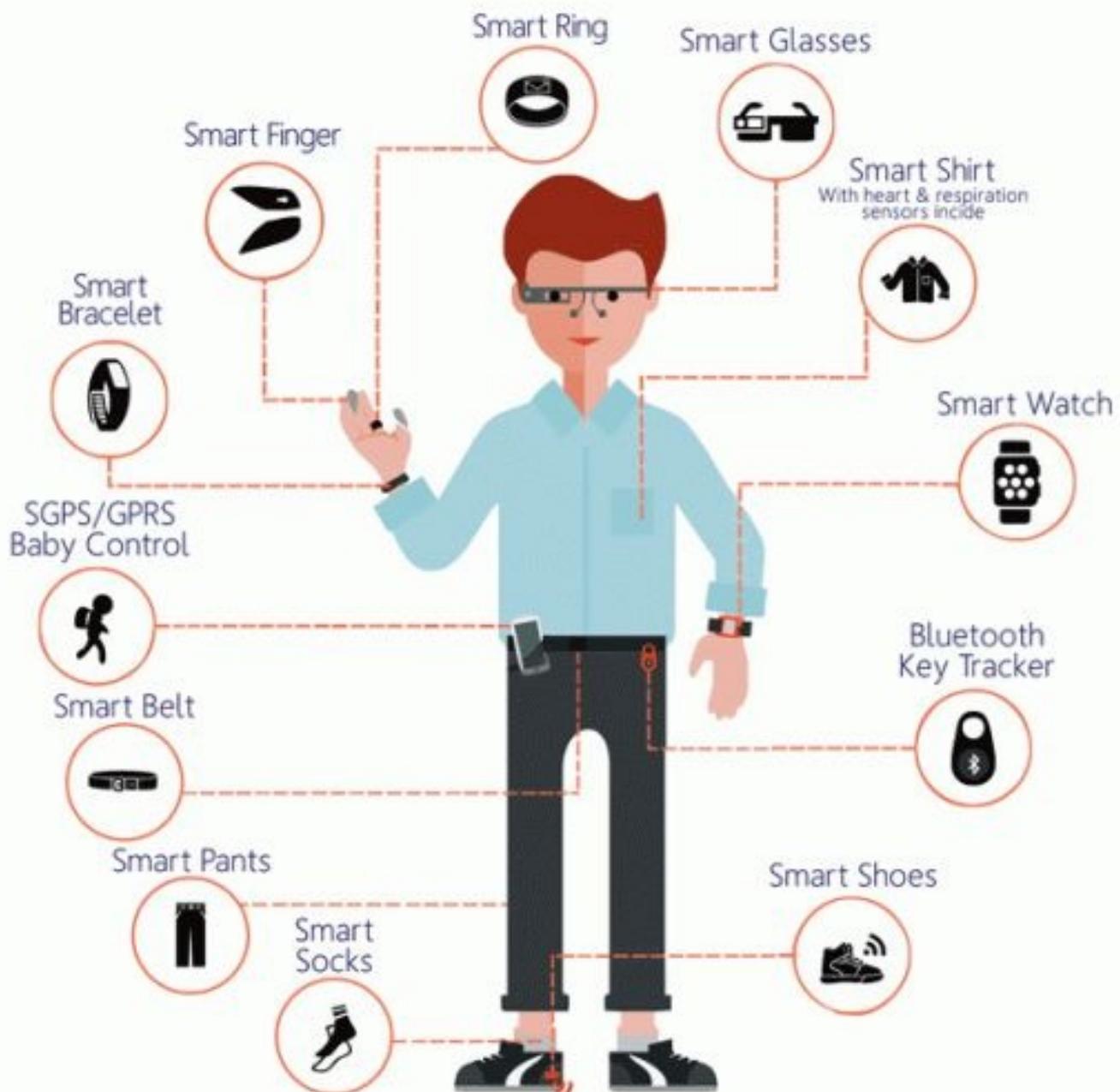
- L'idea di avere servizi che si contestualizzano in base al contesto/ambiente in cui si trovano
- Le indicazioni relative al contesto e all'ambiente sono usate per anticipare i bisogni dell'utente e offrire proattivamente contenuti, funzionalità ed esperienze



Wearable devices

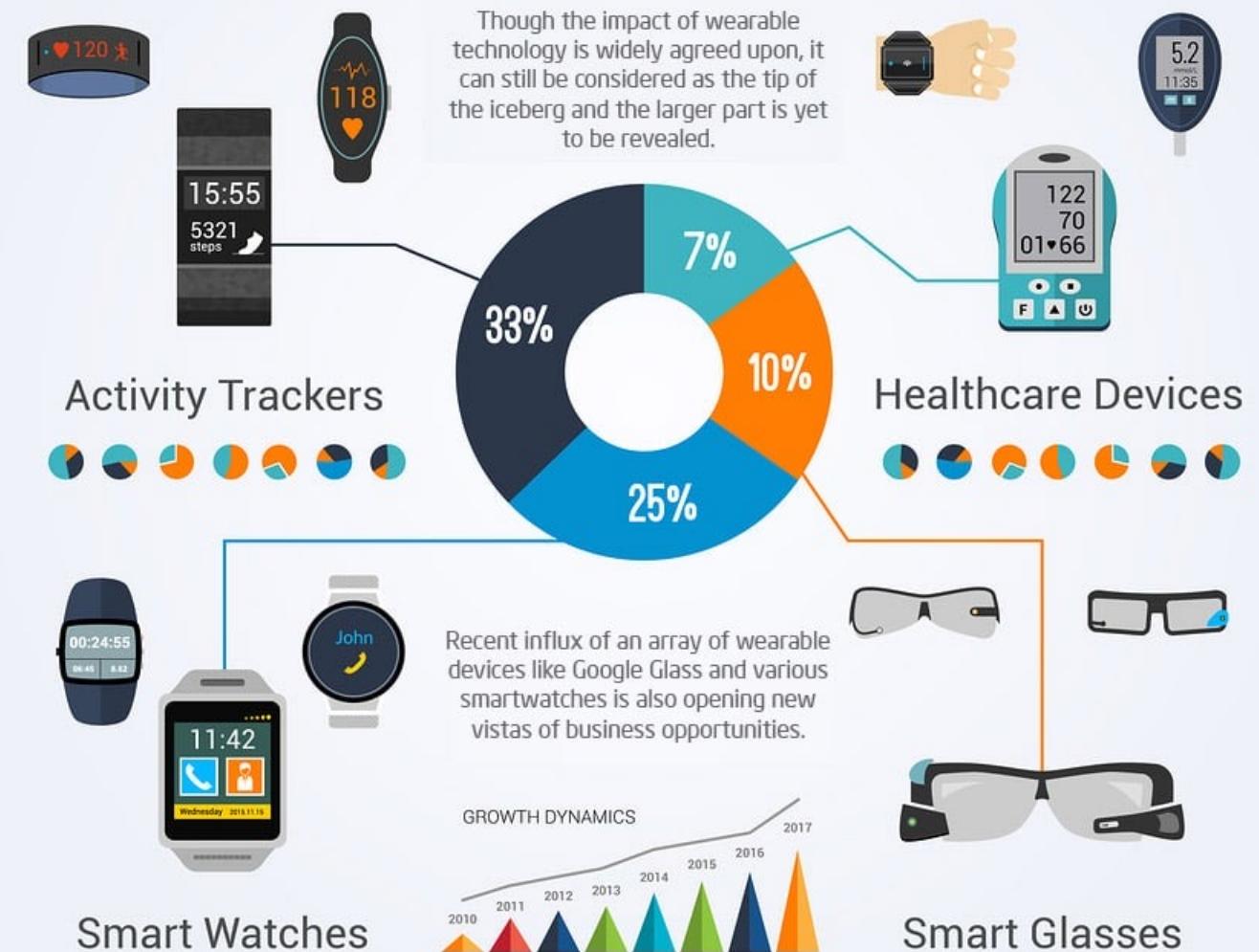


Smart Jewelry
Fashion Jewelry meet Technology



Nuovi trend

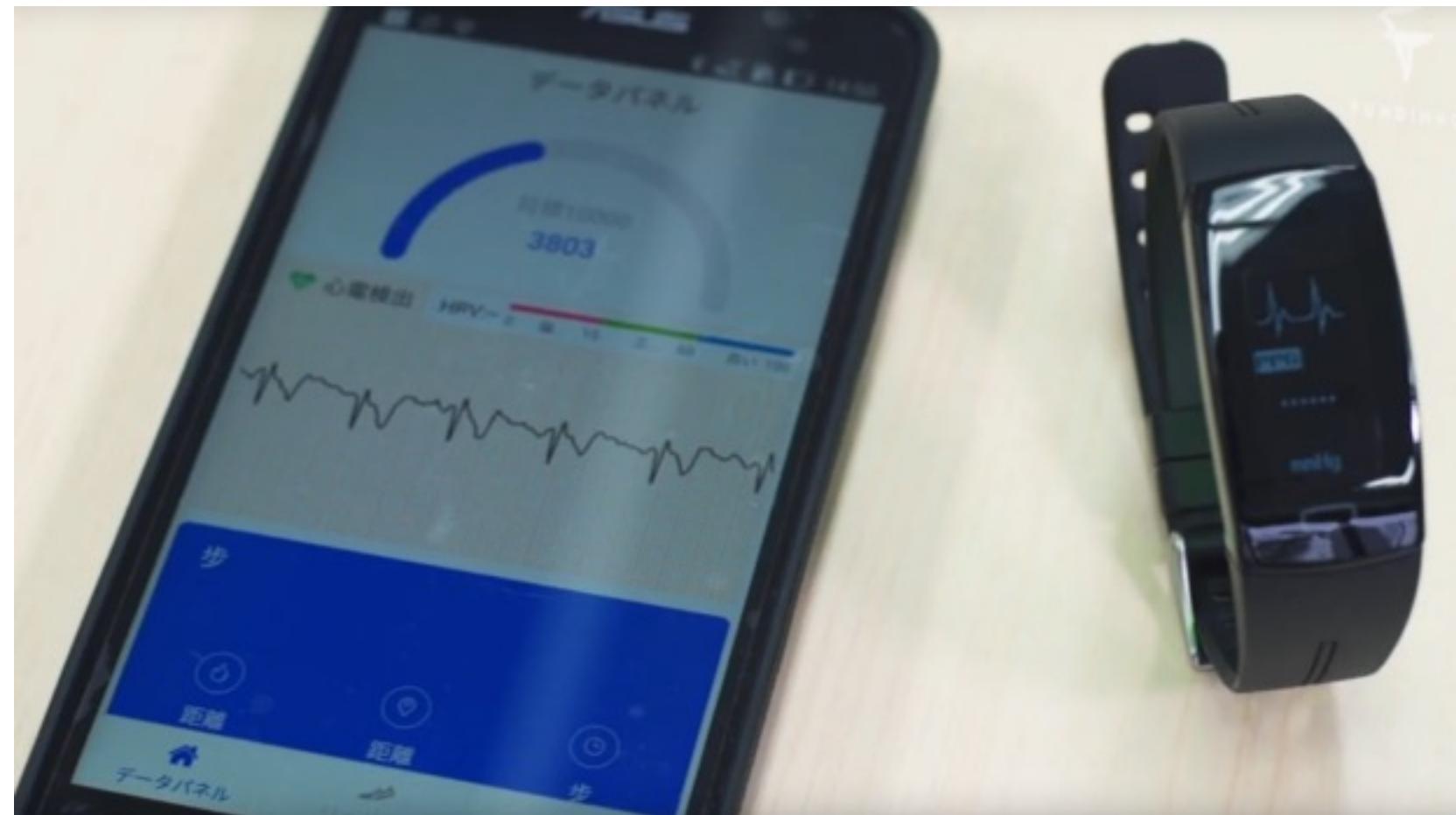
WEARABLE TECHNOLOGY INFOGRAPHICS



Wearable Technology Is The New Businesses

Nuovi trend

- Monitor del glucosio non invasivo in grado di fornire una misurazione continua dei livelli di zucchero nel sangue



Nuovi trend

- Permette di effettuare interazione senza tocco per musica, gestione delle chiamate e notifiche tramite gesti delle dita e segnali neurali



Nuovi trend

- Smart Jewellery



Looks like a normal watch, but it has a heart rate monitor and a small display to show your stats and notifications



including a body temperature sensor that is sensitive enough to be used to track a menstrual cycle



track your activity, stress level, mindfulness, and sleep.

Nuovi trend

- **Digital Jewellery**



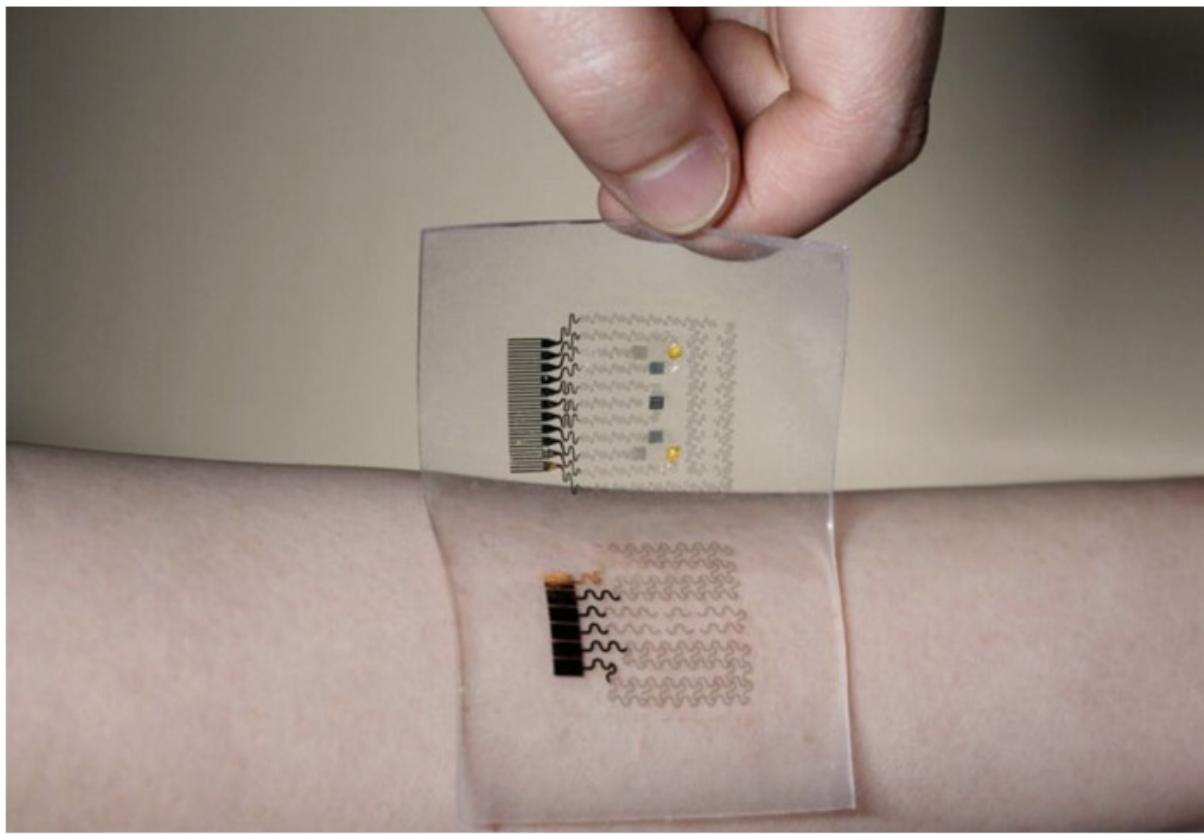
Nuovi trend

- Smart Swimming Caps
- Samsung 'Blind Cap' Uses Vibrations to Connect Blind Swimmers and Coaches
- <https://www.trendhunter.com/trends/swimming-caps>

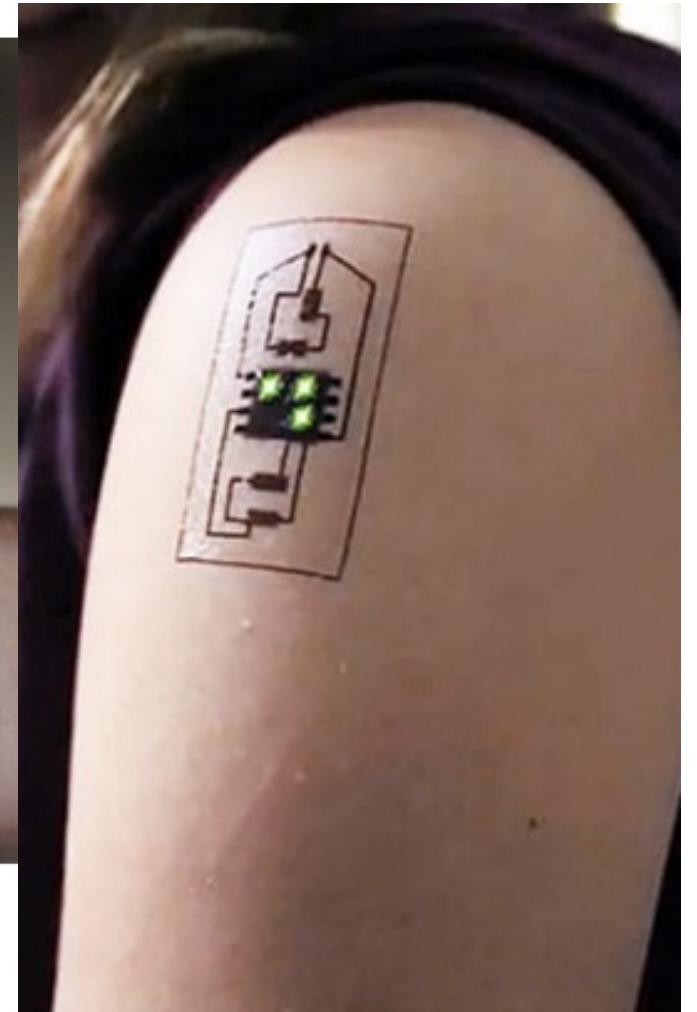


Nuovi trend

Digital tatoo



Source: www.engadget.com



<https://medicalfuturist.com/digital-tattoos-make-healthcare-more-invisible/>

Nuovi trend

- **Sensori per animali**



A Smart Health Monitoring System for Animal



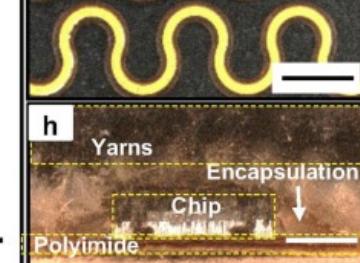
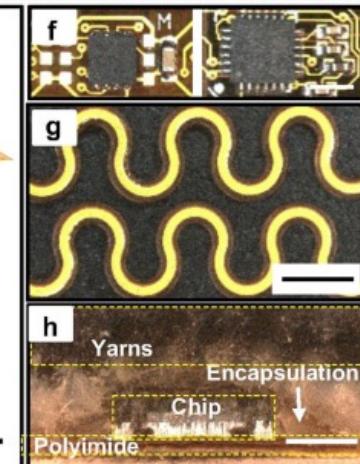
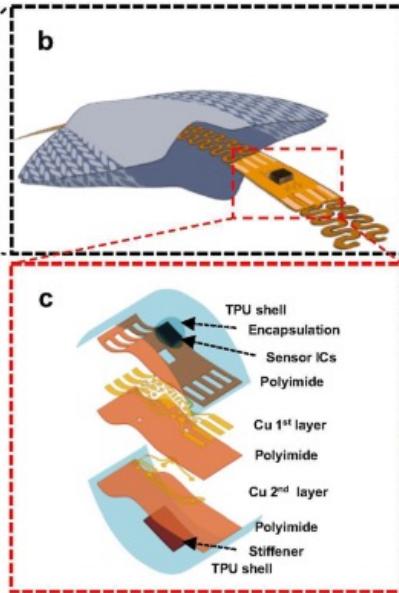
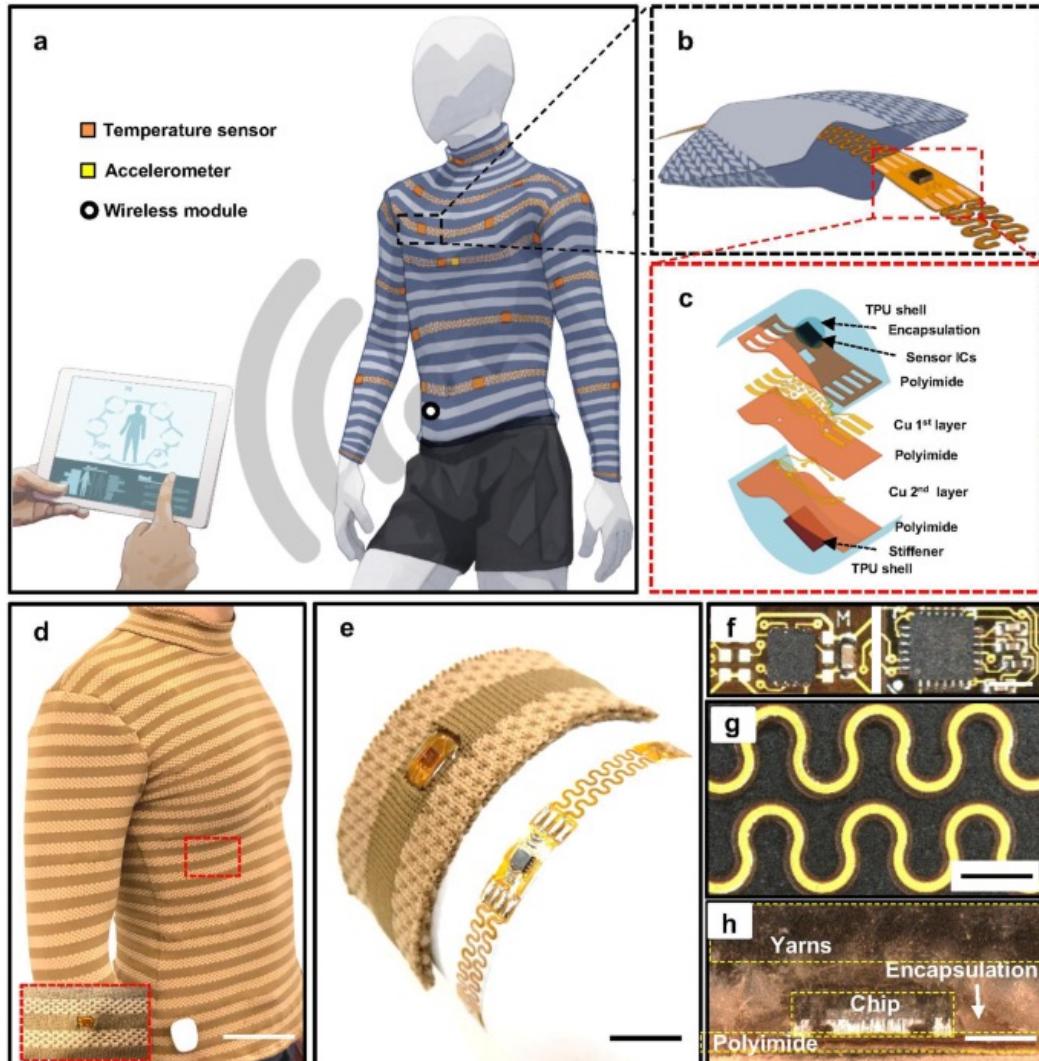
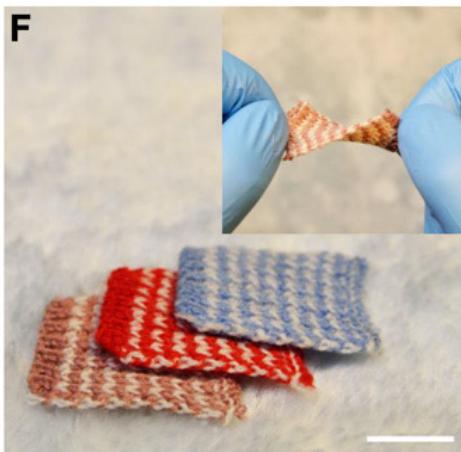
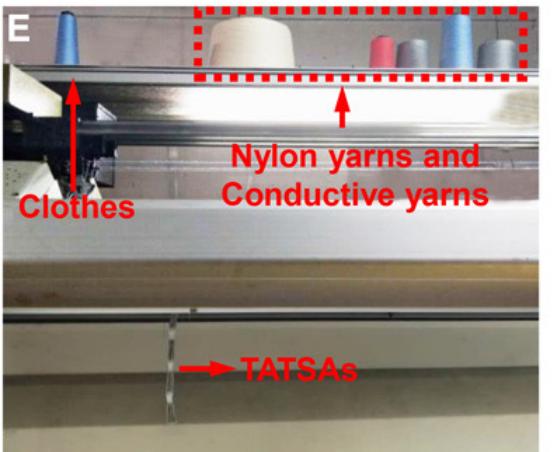
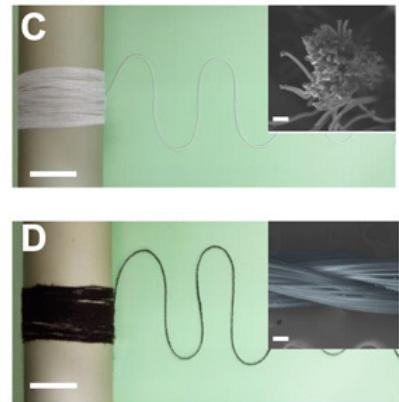
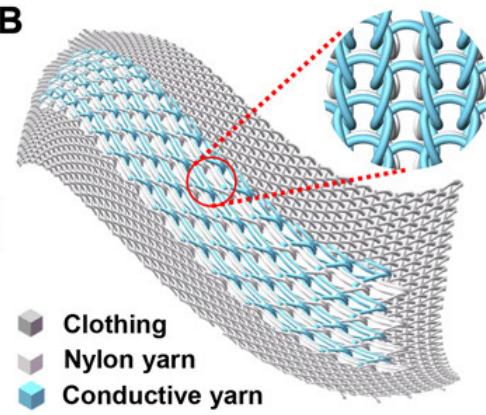
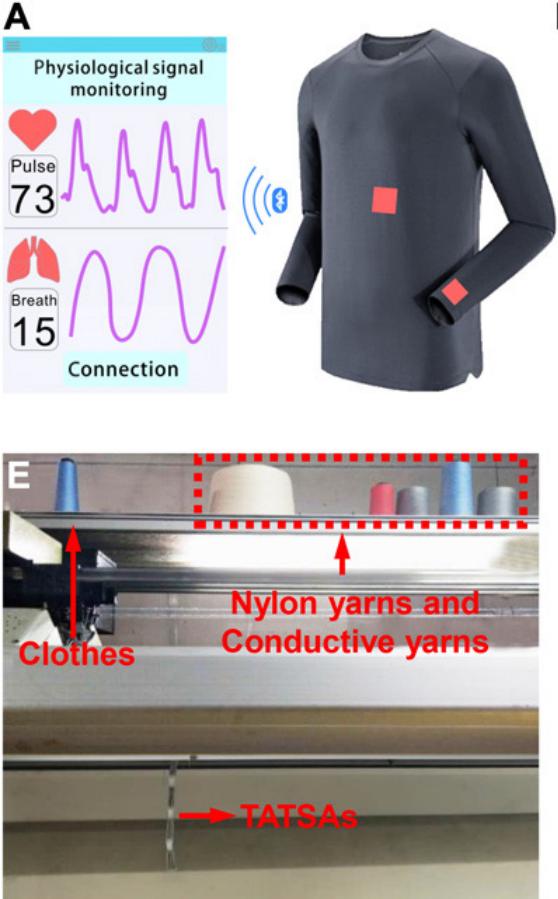
AI per riconoscere
le emozioni
dei tuoi cuccioli



Nuovi trend



Nuovi trend



Nuovi trend

- Smart glasses and AR



VUZIX NGSG | NEXT GEN SMART GLASSES



VUZIX M4000



Nuovi trend

- Augmented Reality



Nuovi trend (?)

5G + virtual reality



Nuovi trend (?)



Nuovi trend



Domande?

