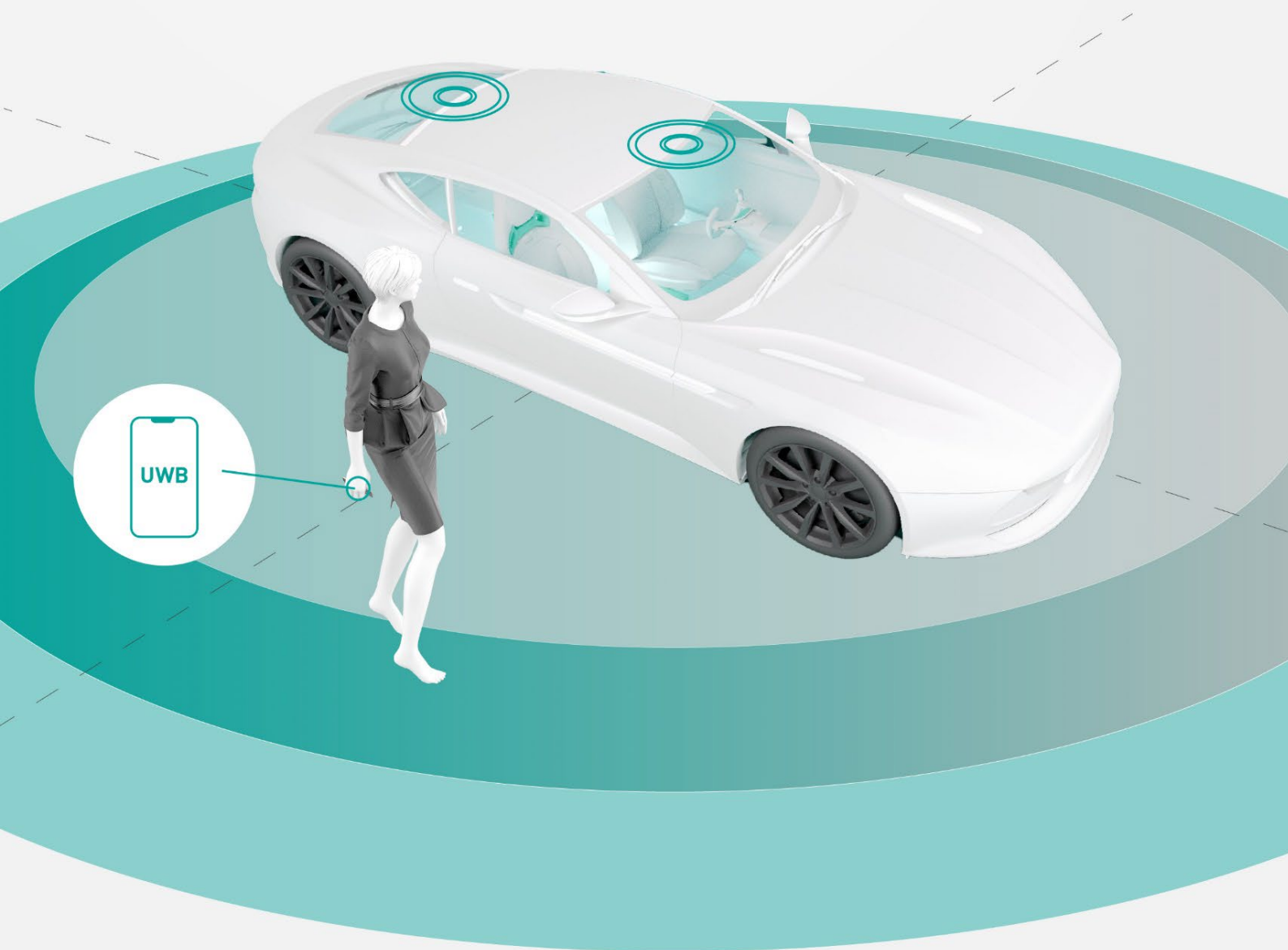# TECH PAPER | nAccess Digital Key

SAFETY, PRECISION, CONVENIENCE
Meet Innovation with JOYNEXT nAccess

UWB

▶ Foreword

The evolution of car keys has been a fascinating journey, mirroring advancements in automotive technology and responding to the increasing demands for convenience and security from vehicle owners.

Car keys have progressed from traditional mechanical designs to chip-enhanced remotes and integrated smart keys, which allow for remote locking and unlocking—a significant leap forward in convenience and security.

Today, digital keys based on Ultra-Wideband (UWB) technology offer unprecedented levels of security, convenience, and precision. This tech paper explores the transformative journey of car keys, highlighting the enhanced user experiences enabled by UWB digital keys.

▶ Content

▶ UWB Technology Development Overview

› Concept of Ultra-Wideband (UWB)

UWB is a carrier-free communication technology that transmits pulses over extremely short intervals, covering a broad-spectrum range. It can achieve data transmission rates of several hundred Mbit/s up to 2 Gbit/s and is considered a key technology for future short-range wireless communications.
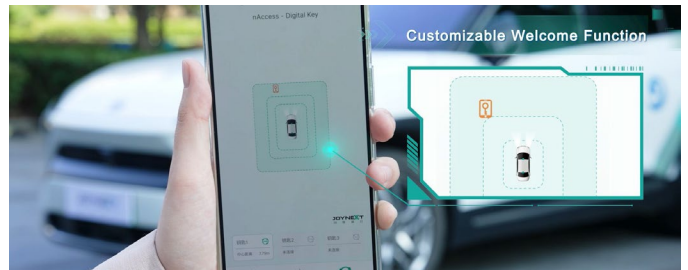
› Advantages of UWB technology

- High interference resistance
- High penetration capability
- High communication efficiency
- High security
- High precision positioning distance

› UWB applications in the automotive industry
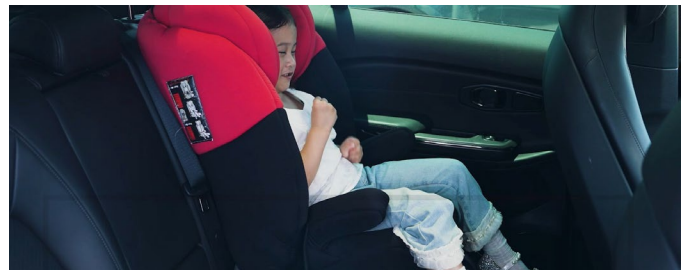
01 Digital Key

A key with no physical form, it can be activated simply by approaching the vehicle with a smartphone or smart wearable device.

02 Living Radar

A radar used to detect living organisms monitors human vital signs, such as breathing and heartbeat, while enabling the function of Child Presence Detection (CPD).
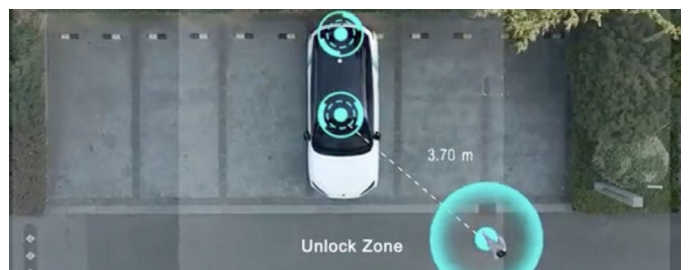

03 Kicking Detection

Accurately detects kicking motions to automatically open the vehicle's trunk.

04 Near-Field Positioning

Based on precise positioning, it facilitates intelligent location services such as battery swapping, payment, automated parking, and other functions.
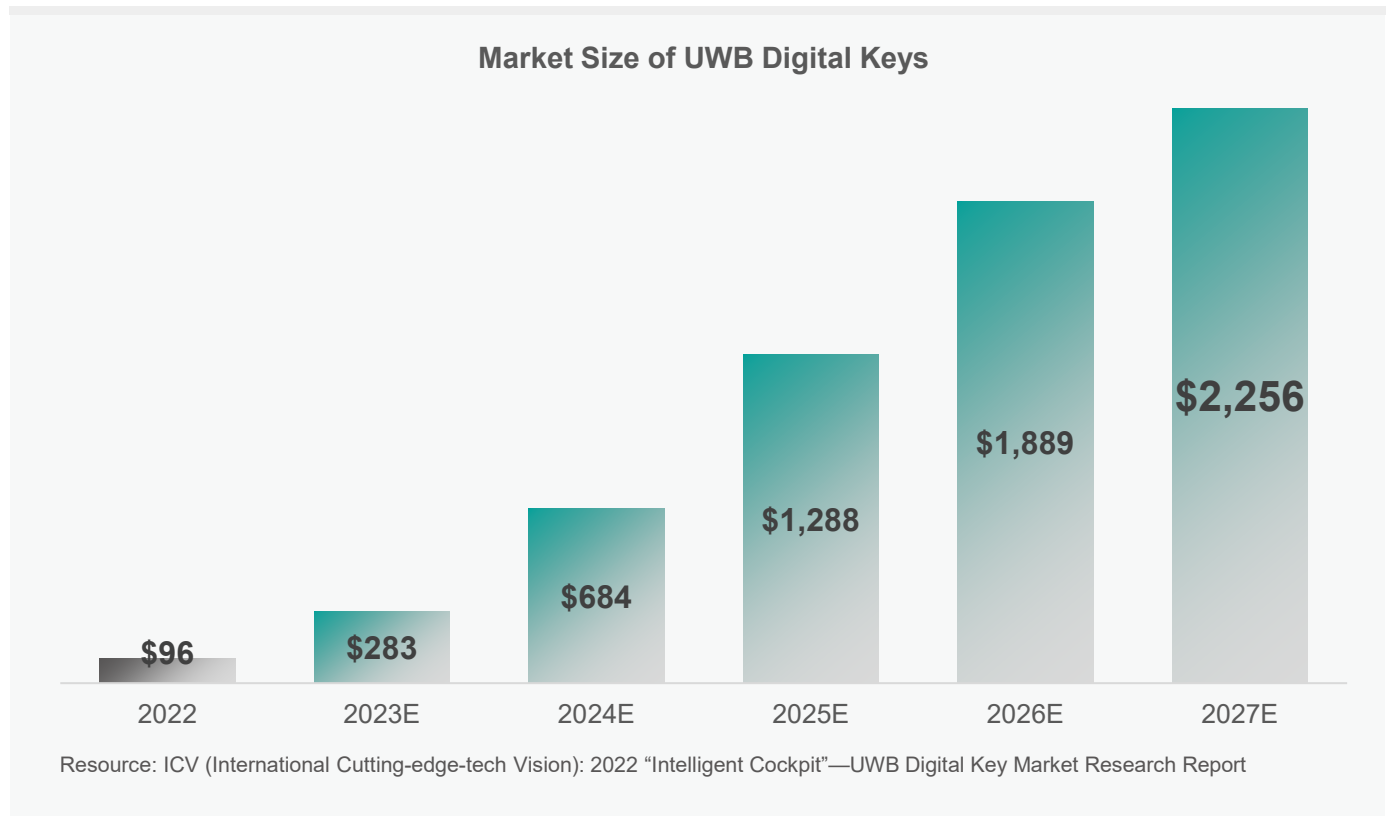
Market Trends in UWB Digital Key

Global market applications and trends for UWB digital keys

With the rapid development of intelligent connected vehicles, Bluetooth digital keys have gradually become standard devices for cars. Comprising the new generation of digital keys that offer a better user experience, UWB digital keys will bring more differentiated features.

Comparison of digital key technology

	UWB	BLE	NFC
Communication distance	0.2-40 m (Enough for key)	20-200 m	10 cm
Positioning accuracy	<10 cm	1-3 m	10 cm
Security	High (Prevents relay attacks)	Low	Mid
Chip cost	High (gradually decrease)	2-5 $	2.5 $
Smartphone coverage	Mid (Apple, Google, Samsung, etc)	High	High
Power consumption	10-50 mA (Needs to work with Bluetooth)	20 mA	10 mA

Global OEMs began implementing UWB digital key solutions as early as 2022; due to cost factors, they were mostly used in high-end models. By the end of 2022, their penetration rate was only 2.1%.

However, with improvements in UWB technology and its related regulations, and with the decrease in cost, particularly with the rapid increase in the integration of UWB chips in smartphones, the penetration rate of UWB digital keys is expected to steadily increase, exceeding 50% in 2027, when the market size of UWB digital keys is expected to reach $2.25 billion.

Market Size of UWB Digital Keys

2022	2023E	2024E	2025E	2026E	2027E
$96	$283	$684	$1,288	$1,889	$2,256

Resource: ICV (International Cutting-edge-tech Vision): 2022 "Intelligent Cockpit"—UWB Digital Key Market Research Report

▶ Market Trends in UWB Digital Key

❯ Factors driving the development of UWB digital keys

Regulatory-driven

According to statistics from the National Highway Traffic Safety Administration (NHTSA), nearly 40 children die from heat stroke in cars every year in America. As a result, hot car regulations have been in place since 2019. In many countries, leaving children unattended in a car may be tantamount to abandonment.

The United Nations Decade of Action goal is to reduce road casualties by at least 50% by 2030. NCAPs throughout the world (including Euro NCAP, China NCAP, etc.) have also introduced detecting requirements for Child Presence Detection (CPD).

2019 **United States**
Oral announcement
"H.R. 3164 – Hot Cars Act"

2023 **ENCAP-CPD**
Recommended
installation, reward stars

2025 **ENCAP-CPD**
Added Scenario 3
United States
Forced installation3

2021-2022 **United States**
President signs the law II.J
ENCAP
Written announcement

2024 **CNCAP**
Recommended
installation, reward stars

Comparison of CPD technology

	UWB	Millimeter wave radar	Camera	Ultrasound
Privacy protection	yes	yes	no	yes
Penetration of obstacles (seats, etc)	yes	Risk (hard to penetrate seat)	no	no
Jamming stability (light, vibration, etc.)	high	high	low	no
Recognition of micro-movements (sleep, etc.)	yes	yes	no	no
Band compliance	yes	Risk (some countries don't support 60G)	yes	yes

Market demand-driven

The enhancement of global industry standards and tech development ecosystems consistently advances UWB technology in vehicles, creating a technology that offers safety, efficiency and convenience.

Consumer demand-driven

Global consumer surveys show that while safety, battery life, and driving performance remain key, demand for comfort and convenience is rising. UWB technology-based digital keys enhance convenience, comfort, and safety.

JOYNEXT nAccess – Digital Key Solution

› Features

Cost-effective solution: Dual-anchor performance rivals that of 4-6 anchor schemes.
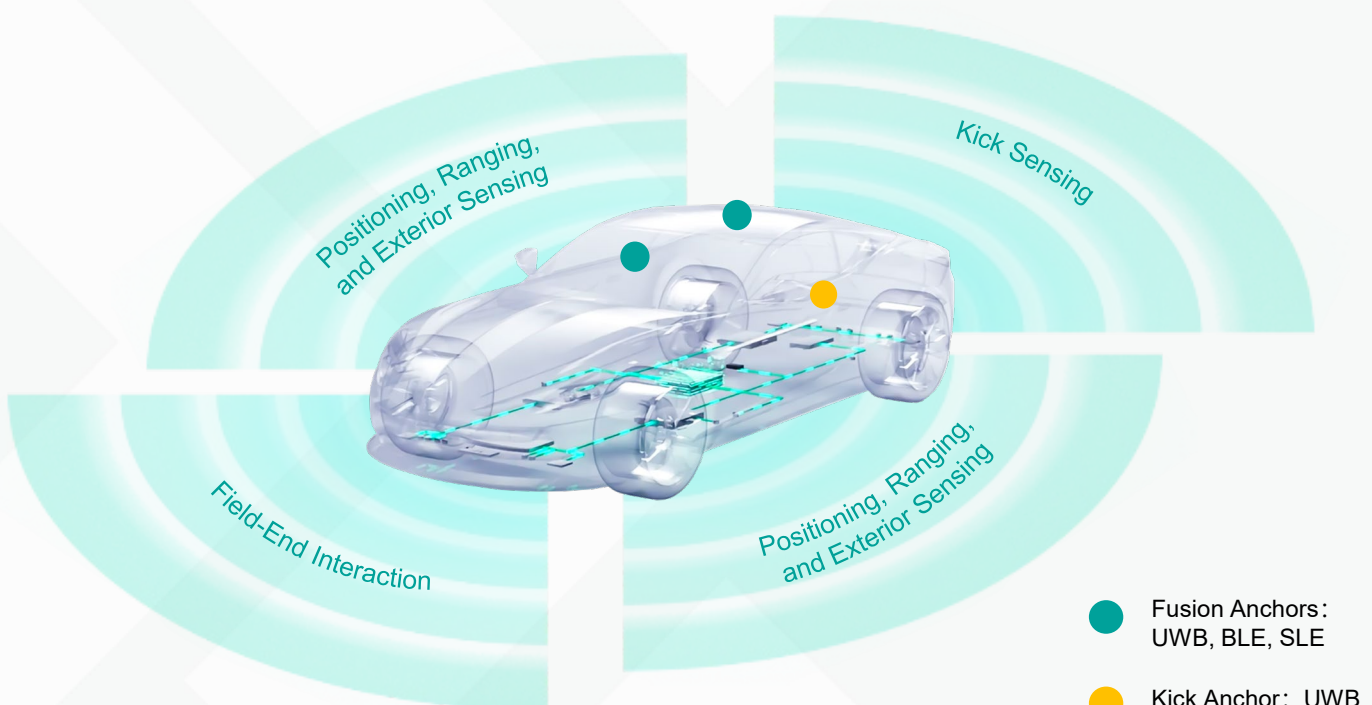
- **Integrates the Telematic Module** solution to reuse both software and hardware
- Digital key anchors can **integrate nSensor** (JOYNEXT UWB Sensing Solution), **including as CPD and kick detection**
- Supports the system's expansion to accommodate future scenarios such as **multimodal interaction and on-site positioning**

Full-stack services: providing flexible, rapid mass production solutions

- A variety of combined solutions and distributed algorithms meet the needs of different customers and provide a better user experience
- Supports cloud, vehicle, cell phone, key, and other multi-terminal solutions to provide total user-friendly product services
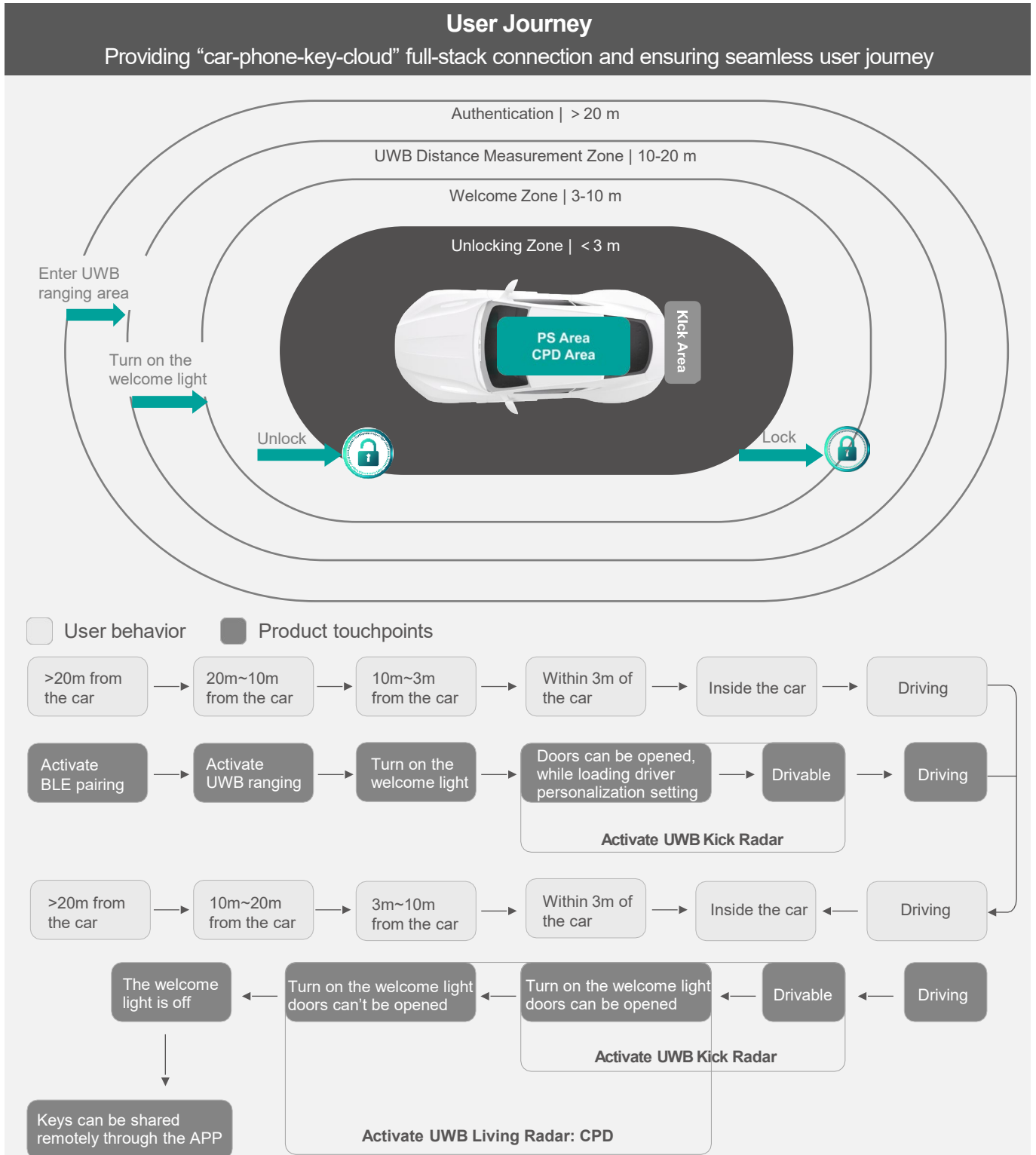
› Technical details

- **Supports mainstream chips** both domestically and internationally: UWB uses NXP and NewRadioTech; BLE/SLE uses NXP, HiSilicon, TI, and others
- Supports **UWB+BLE+SLE+NFC solutions**, adaptable to proprietary, ICCE, and CCC protocols, with support for using smartphones as keys
- The software algorithm supports **multi-source data position filtering and intelligent multi-anchor** coordination to offer dynamically optimal choices
- **High performance**: 1-3 anchors can cover all customer needs

Positioning, Ranging, and Exterior Sensing

Kick Sensing

Field-End Interaction

Positioning, Ranging, and Exterior Sensing

● Fusion Anchors：
UWB, BLE, SLE

● Kick Anchor：UWB

JOYNEXT nAccess – Digital Key Solution

Highlights of JOYNEXT nAccess digital key

- Dual-anchor digital key solution performs equivalently to multi-anchor solutions (4-6 anchors).
- Integrates CPD functionality, meeting NCAP's requirements of direct detection.

User Journey

Providing "car-phone-key-cloud" full-stack connection and ensuring seamless user journey

▶ JOYNEXT nAccess – Digital Key Solution

❯ Customer case

Project: ENCAP-compliant CPD product for OEM, in the process of mass production

Key Features	
Detection	• **Objects:** Children under 6 years old (sleeping and limb movement) • **Areas:** Covering at least two rows of seats and footwells • **Scenarios:** Children forgotten in locked vehicles / children enter an unlocked car and and become trapped inside
Warning	• **Initial warning** • **Escalation warning**
Intervention	• **Proactive intervention** • **Passive intervention**

▶ About JOYNEXT

❭ Company introduction

JOYNEXT is a leading AutoTech company and is the Automotive Connectivity BU of Joyson Electronics. Our 1,600+ employees work across 7 R&D centers, 3 global manufacturing locations, and 7 customer centers located in Germany, Poland, France, the U.S., Mexico and Japan.

For more than two decades, JOYNEXT has been working as a development partner and system supplier for renowned car manufacturers and has established long-term partnerships with a number of well-known OEMs.

Our intelligent cockpit and smart connectivity products can now be found in millions of vehicles worldwide and are complemented by our capabilities in developing autonomous driving technologies and software products. These lay a solid foundation for cockpit and driving fusion in the era of Central Computing Units.

We are committed to contributing to the industry transformation together with our eco-partners, such as HUAWEI, Qualcomm, Horizon Robotics, Black Sesame, Oritek, QNX, Elektrobit, Microsoft, and Autobrains, to deliver a smarter driving experience for end users.

▶ Contact Us

Thank you very much for taking the time to read our **TECH PAPER: SAFETY, PRECISION, CONVENIENCE. Meet Innovation with JOYNEXT nAccess – Digital Key Solution**.

For any suggestions or questions, please scan the following QR code to contact us.
Email: contact@joynext.com

Contact us via website   **Follow us via LinkedIn**