# Software Platform Design and SDK Development for ROS 2-based LG AI Companion Device

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## 1. LG AI Companion Device 'Q9'

Q9 was unveiled to the public at CES 2024 & IFA 2024



#### IFA 2024

TECH ADVISOR Tech Advisor's Best of IFA 2024 Awards





LG Electronics' Mobile Al Home Hub (code name: Q media at IFA 2024, Europe's largest consumer elect to the 10th. [Photo source = LG Electronics]

#### tech**radar**ð

Oh no, l might actually want LG's infuriatingly adorable Al robot smart hub





German Chancellor Olaf Scholz (second left), who visited the IFA 2024 LG Electronics Exhibition Hall on the 6th (local time), is listening to an explanation of LG Electronics' mobile Al home hub (Q9).

## 1. LG AI Companion Device – Use Case

Q9 can be a companion, a butler, a personal assistant, etc., and YOU name it!  $\rightarrow$  LGE is releasing Q9 SDK to robot developers today.

## 1. LG AI Companion Device – Open Platform Ecosystem

From the customer's perspective, we continuously add features tailored to various use cases, ultimately expanding the ecosystem of LG ThinQ UP 2.0 (upgradable home appliances powered by operating system and AI chipset) based on an open platform



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## 2. Software Architecture of Q9

Q9 uses LGE Robot SW Platform - based on ROS 2 on Yocto project

- supports multiple chipsets (including low-end ones) for multiple robot form-factors

- provides API and Software Development Kit (SDK) for robot developers  $\rightarrow$  You don't have to yocto-build it for yourself



## 2. Performance Enhancement - mmap-based Shared Memory

## Q9 uses mmap for larger than 1KB/s data , e.g., image data, transfer between processes

- mmap is a memory-mapped file I/O that maps files into specific locations in DRAM
- data is copied to Kernel Shared Memory (mmap) and only its file information, which is small, is transferred through a network interface (2,3) have to yocto-build it for yourself



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## 2. Performance Enhancement - mmap-based Shared Memory (Test Result)

- Large image data is reliably transported when the shared memory technique is applied
- > Also, note that BW is remarkably low because it only needs to transport the memory information (small) of the actual image data (large)



- Test setup details
  - 3 images from D435i camera : infra1, infra2, depth
  - image size : infra1/infra2 (1280\*720), depth(1280\*2\*720)
  - image frame rate : 15 fps
  - FastDDS in wired LAN

## 3. Software Development Kit (SDK) for Q9

Developers can freely make a new feature and deploy it into Q9

- Q9 SDK can be downloaded from Q9 developer site (<u>http://q9.developer.lge.com</u>)



## 3. Q9 API List

LGE provides the pre-defined APIs for smart home application

- They are in 8 categories and being continually updated

DISPLAY	<ul> <li>Facial expression</li> <li>Custom screen output</li> <li>Display control</li> <li>Pop-up message</li> </ul>	SENSOR	<ul> <li>Sensor data acquisition (from battery, thermostat)</li> <li>Headset/ hip sensor control</li> </ul>
SOUND	<ul> <li>Pre-defined sound play</li> <li>Custom sound addition</li> <li>Waiting for wake word</li> <li>STT/ TTS</li> <li>Mic. record/play</li> </ul>	MOTION	<ul><li>Get motion state</li><li>Start/stop pre-fined motions</li></ul>
NAVI	<ul> <li>Move forward/backward, Rotate</li> <li>Move to goal</li> <li>Return to charging station</li> <li>Come-here/Follow-me mode</li> </ul>	NETWORK	<ul> <li>ThinQ App Push</li> <li>ThinQ App Response</li> <li>Network connection</li> </ul>
RECOG NITION	<ul> <li>Person detection</li> <li>Face detection/recognition</li> <li>Emotion recognition</li> </ul>	SETTING	<ul> <li>Background application status check</li> </ul>

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## 3. Q9 API Simulator

- It is based on "Blockly" GUI Tool from Google

- Q9 APIs are the "code-blocks" and can be drag-and-dropped for easy programming

## 4. Overview on Q9 Developer Site (<u>http://q9.developer.lge.com</u>)

LGE Q9 developer site is **ready now** 

- You can build a development environment through SDK install without any knowledge on Yocto. (Installation is done within 5 minutes)

- ROS 2 nodes can be created using the regular "colcon build" and other external sources can also be created as an installation file with "make build"

# Q9 Demo @KBIS 2024

## **Use Electronics**

