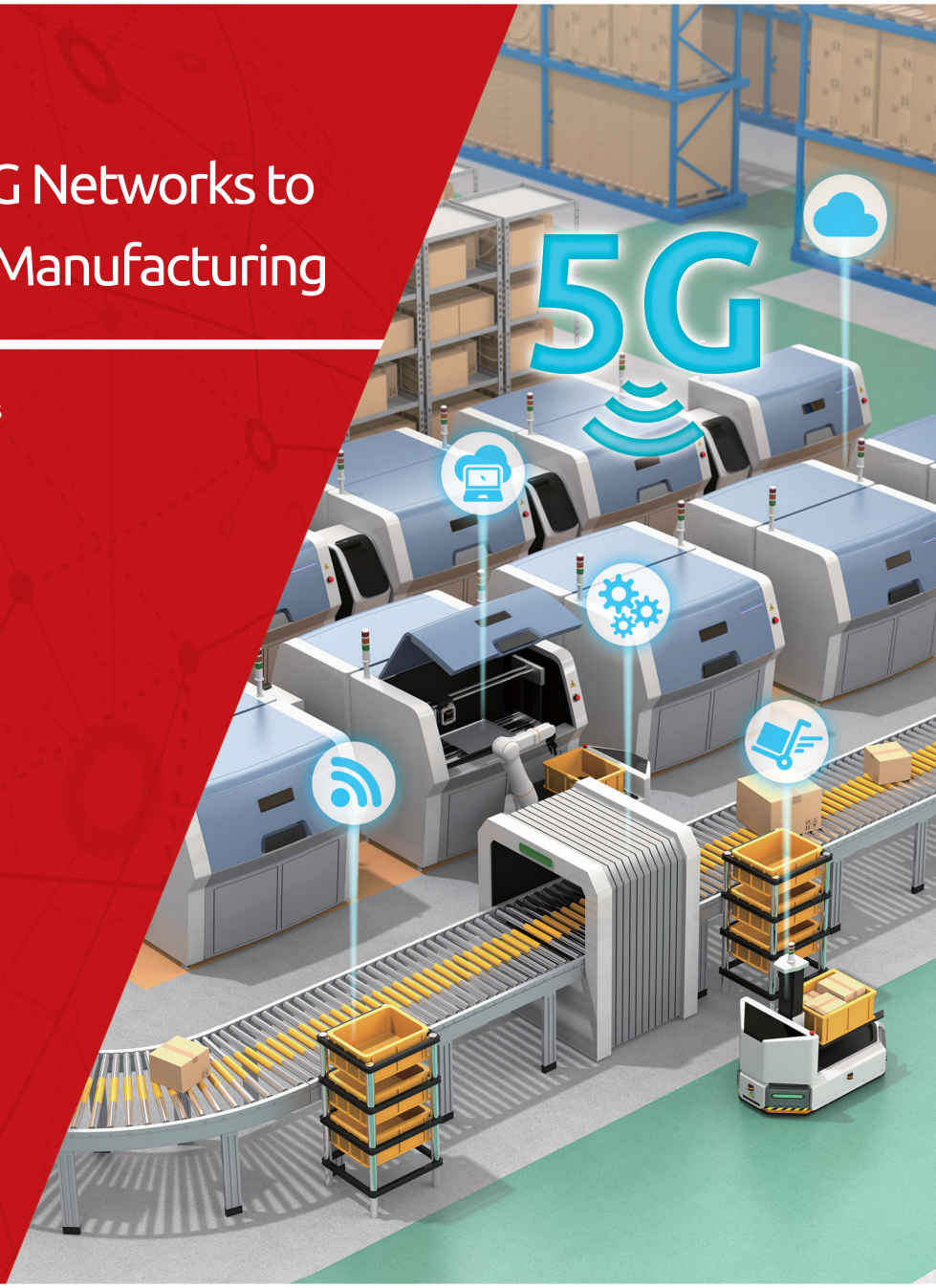
ADLINK
LEADING EDGE COMPUTING

Solution Brief

Building Private 5G Networks to Accelerate Smart Manufacturing

ADLINK MECS Series Edge Servers



www.adlinktech.com

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Why Private 5G Networks?

Historically, the operational technology (OT) environments common in manufacturing have not needed real-time data processing beyond the end device, but that is changing as OT and IT increasingly converge. Ethernet has been the preferred technology in OT environments, but the industrial Internet of Things (IIoT) now places more device and connectivity demands on industrial operations than wired networks can accommodate. Going forward, wireless networking will facilitate data gathering from any point or device in the work environment, from cameras to robotic arms to autonomous warehouse vehicles, and put that data immediately to work. And 5G will be the wireless technology of choice for manufacturers in their pursuit of transformative digitalization.

5G delivers a range of benefits over competing technologies, such as Wi-Fi and Bluetooth. For example, 5G provides sub-millisecond data latencies while accelerating throughput thanks in part to features such as ultra-reliable low-latency communications (URLLC). URLLC directly benefits industrial controls, process controls, robots, and high-speed machine-to-machine (M2M) communications. Similarly, massive machine type communications (mMTC) enables 5G environments to support up to one million connected devices into a square kilometer, and features such as time-sensitive networking (TSN) allow these devices to synchronize with nearly perfect precision. Moreover, 5G frees implementers from costly Ethernet sensors and expensive wiring installations.

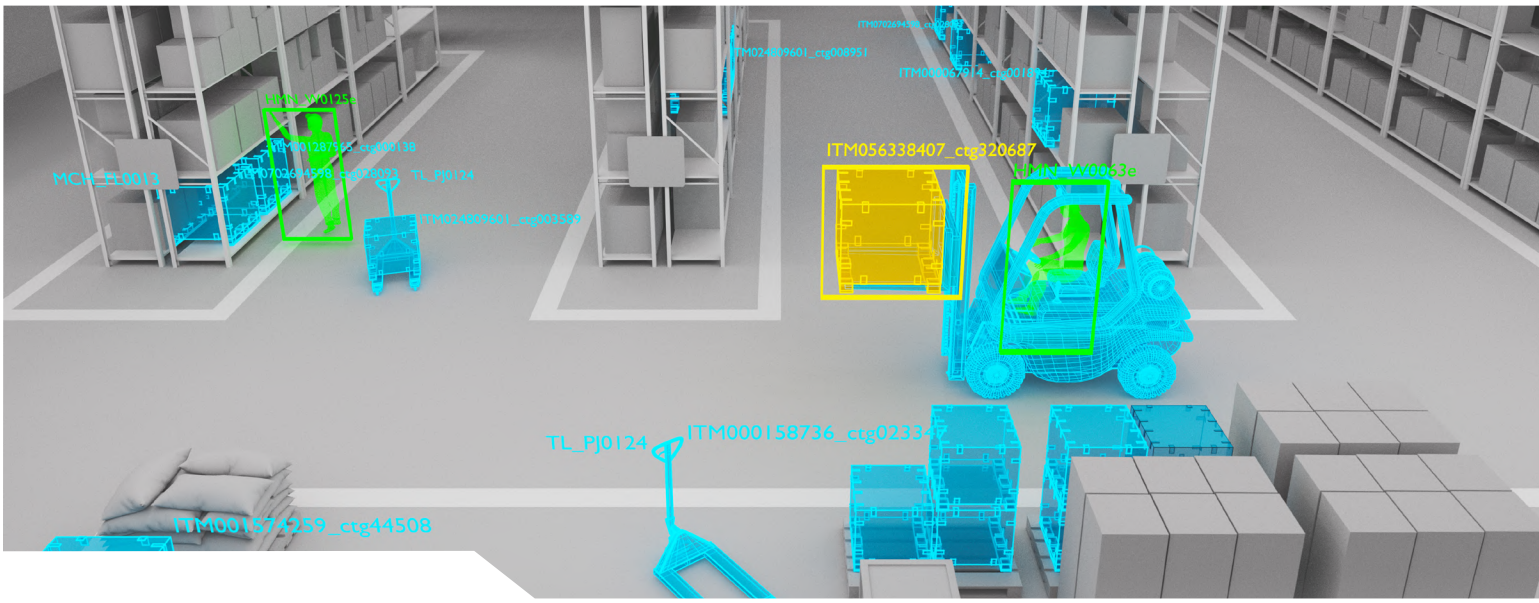
The question becomes what sort of 5G network to implement. Public networks backed by deeply funded service providers may dominate in the short term due to immediate turnkey solution availability. However, ABI Research predicts private 5G will gain market dominance by 2035. Augmented by the availability of additional spectrum such as Citizens Broadband Radio Service (CBRS), private 5G offers a competitive advantage over public networks, as private networks allow users to incorporate new advances more quickly. Additionally, companies can manage their own 5G networks, removing dependency on communication service providers. This can yield significant time savings, as when waiting on a provider's technical support or dealing with planned or unplanned outages.

Furthermore, when manufacturers use their own private 5G network, data remains safely within the company's own security infrastructure, minimizing the risk of outside infiltration, data breaches, and other security violations. The network-owning manufacturer controls its own 5G network and data, so there is no accountability to a third-party provider. The manufacturer is free to be as strict or lenient in its data policies as circumstances dictate.

Global companies are building out private 5G networks to transform their operations with much enhanced network reliability, security, and density. In Japan, Toyota Production Engineering worked with Nokia to implement private 5G to support IoT devices, equipment digitization, and visualization technologies. In Sweden, Volvo CE partnered with Ericsson to deploy 5G at its research and development facility, largely with the aim to create "more efficient production, logistics, greater flexibility, and safer work."



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Customer Application

With demand for 5G rising in the Asia-Pacific region, Gemtek Technology, one of Taiwan's leading wireless communication solution providers, wanted to develop an advanced 5G small cell system for the manufacturing industry. This would enable dedicated, reliable, and secure private 5G networks and edge analytics platforms. Gemtek's edge solution would help manufacturers build cost-effective, flexible, and large-scale networks, allowing customers to confidently run business-critical operations on a private 5G network without the extensive proprietary equipment required for large-scale public networks. This solution lets customers deploy private 5G with significantly lower cost, high flexibility, and off-the-shelf component expandability, while providing high throughput, dense device counts, and low latencies.

Gemtek's small cell system provides a compact and integrated design by implementing the dual functions of baseband unit (BBU) and 5G Core (5GC) into the ADLINK's MECS-7210 edge server. For small scale network deployments, the extra processing capabilities of the MECS-7210 can also be allocated to enable manufacturing-specific applications with the appropriate hardware acceleration. The small cell system harnesses enhanced flexibility and versatility to handle the types of growing workloads commonly found in manufacturing. These include an expanding number of mobile, IoT, and AI devices and applications, all of which may need to interface wirelessly to a server at the network edge. A capable edge server in this capacity will help enable real-time performance and feedback loops with edge devices while relieving core data center systems and network infrastructure of edge data loads.

Challenges

To complete its private 5G edge solution, Gemtek needed to address a range of challenges and requirements common to manufacturing deployments.

Harsh Operating Environments with Limited Installation Space

To provide maximum coverage and utility, a small cell/edge computing system must fit within a variety of locations. Whether in a building's data closet or an outdoor enclosure, the 5G edge solution should be able to fit into tight spaces and be rugged enough for harsh environmental conditions, including high-vibration environments found in manufacturing facilities.

High Availability and Reliability

Any solution must be able to sustain operation, even in sub-optimal conditions. As a mission-critical device, the edge system must be able operate with maximum uptime and an acceptable mean time between failures (MTBF). This is especially important for edge systems deployed to locations with limited access.

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Flexible Configuration for Computing Power and Acceleration

In order to operate in different locations and perform different roles, the solution needs to accommodate optional expansion, particularly in compute functions. Some applications, especially artificial intelligence (AI), might require additional hardware acceleration. Hence, system scalability should accommodate compute offload to a GPU or an FPGA.

Open Standards Compliance for Global Deployment

The proposed system are optimally compliant with the Open Telecom IT Infrastructure (OTII) specification set by the Open Data Center Committee (ODCC). Designed for white box telecom systems, OTII requires the following features:

- Cabinet depth <450mm
- Rack mounted, 1U or 2U
- Operating temperature range (5°C to 40°C long term, -5°C to 45°C short term)
- Front access of I/O interfaces
- Unified indicator light and BIOS configuration
- Standard management interface support (Redfish and IPMI)
- Balanced I/O design (up to 6x PCIe)

Remote Access

Since the proposed system may be installed in locations with restrictive access, remote monitoring, control, and configuration are essential for efficient system management.

These requirements apply across a range of applications. For instance, manufacturing increasingly relies on AI to assist in areas such as troubleshooting production bottlenecks and monitoring scrap metrics. Through sensors and camera image analysis, AI can help identify signs of robot component failure before problems become critical. Similar techniques can identify product anomalies on production lines. Other implementations of AI might include autonomous guided vehicles (AGV) and ensuring that workers adhere to safety codes.



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ADLINK's Solution

ADLINK, a global edge computing company, and Gemtek Industries collaborated in developing a 5G-based solution targeting manufacturing companies deploying private 5G networks and edge analytic platforms to support their mission-critical applications. The solution uses ADLINK's MECS-7211 2U edge server to serve as both a multi-access edge computing (MEC) platform and a private 5G base station to provide real-time data access and connectivity. Powered by dual Intel® Xeon® Scalable processors with 512GB of DDR4 memory, the MECS-7210 was an ideal fit for Gemtek's private 5G product.

The ADLINK MECS-7210 met or surpassed Gemtek's small cell solution requirements in the following ways:



Rugged Build Combined with Compact Design

The 2U, 420mm deep, rack-mountable MECS-7210 is built to fit into compact spaces such as data closets and withstand dust, shock, and vibration. The MECS-7210 can also operate at temperatures between -5°C to +55°C and a relative humidity of 10% to 85% at 40° C.

Redfish or IPMI v2.0 for Remote Management

ADLINK's MECS-7210 supports the Redfish® open industry standard. Redfish provides simple, modern, and secure management of scalable platform hardware. Administrators can also use the Intelligent Platform Management Interface (IPMI) with iKVM and Serial Over LAN (SoL) to manage and monitor the edge server remotely via a web browser.

Expandable Compute Power

In addition to processing power provided by dual Intel® Xeon® Scalable Silver/Gold processors, manufacturers can use the MECS-7210's two full-height full-length (FHFL) PCIe x16 Gen3 slots to offload compute loads to a GPU and/or FPGA accelerator cards.

Built-in Hardware Redundancy

As a server-class system, the ADLINK MECS-7210 features redundant storage with hot-swappable drives and redundant power supplies, ensuring uptime even in the event of component failure.

OTII-compliant Design

From physical dimensions to form factor design to I/O accessibility, the ADLINK MECS-7210 conforms to the telecom-based design specifications dictated by the OTII standard.

Validated for NVIDIA NGC-Ready and Amazon AWS Device

Validated for NGC-Ready, the MECS-7210 allows customers to leverage NVIDIA's extensive range of GPU-accelerated AI frameworks for real-time intelligent decision making in on-premises, cloud, and edge deployments. The additional validation from the AWS Device Qualification Program makes the MECS-7210 pre-qualified to run various Amazon edge platforms.

Early manufacturing deployments of the Gemtek solution in Taiwan allowed users to increase production capacity through more successful deployment of AI and robotics, which led to savings in labor deployment and more intelligent analytics for failure prediction.

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ADLINK MEC Servers: Built for 5G and Beyond

ADLINK's MECS series consists of 1U and 2U COTS systems. Each system targets different sets of requirements at the 5G edge and fully comply with the Open Telecom IT Infrastructure (OTII) as defined by the Open Data Center Committee (ODCC), a collaborative industry effort helmed by Intel and others to achieve an industry standard for COTS-based, 5G network and edge server solutions.



Model Name		MECS-7211	MECS-6120	MECS-6110 / 6111
Form Factor (WxHxD)		2U 19" rackmount 438mm x 88mm x 450mm	1U 19" rackmount 438mm x 44mm x 430mm	1U 19" rackmount 438mm x 44mm x 430mm
Processor		Dual 1st or 2nd Gen Intel® Xeon® Scalable Processors	Intel® Xeon® Ice Lake-D SOC Processor	Single Intel® Xeon® D-2100 family processor
Chipset		Intel® C621/C627 Chipset	Integrated on Intel® Xeon® D SoC	Integrated on Intel® Xeon® D SoC
Memory		16x DDR4-2400/2666/2933MHz RDIMM ECC, up to 512GB	3x DDR4-2666 RDIMM sockets, ECC, REG, up to 192GB	4x DDR4-2666 1DPC RDIMM sockets, ECC, REG, up to 256GB
Storage	On-board	1x M.2 2242/2280 M Key SATA 6 Gb/s	2x M.2 SATA/NVMe, 2242/2280 M Key	2x M.2 NVME socket, 2242/2280 M Key
	Drive bay	4x 2.5" hot-swappable SATA 6 Gb/s	2x 2.5" hot-swappable SATA 6Gb/s	2x 2.5" hot-swappable SATA 6Gb/s (Only for MECS-6110)
PCIe Expansion		FHFL PCIe x16 Gen3 slot: 4x single-slot (up to 110W each) or 2x dual-slot (up to 250W each) HHHL PCIe x8 Gen3 slot: 1x low-profile (up to 75W)	1x PCIe x16 single slot FHFL interface 1x PCIe x8 single slot FHFL interface	2x PCIe x16 Gen3 single-slot FHFL interfaces
IO	Ethernet	2x 1G RJ45 Ethernet ports 4x 10G SFP+ Ethernet ports (Intel® X722)	8x 10G SFP+ Ethernet ports (10C) 5x 10G SFP+ Ethernet ports (4C, 6C, 8C) 2x RJ-45 100/1000BASE-T Ethernet ports	4x RJ-45 10/100/1000BASE-T Ethernet ports 2x 10G SFP+ Ethernet ports 2x 10GBASE-T Ethernet ports
	Console Port	1x RJ45 front access	1x RJ45 front access	1x RJ45 front access
	USB	2x USB 3.0x front access	1x USB 3.0/2.0 + 1x USB 2.0	2x USB 3.0x front access
	Power/Reset	1x Power button, 1x Reset button front access	1x Power button, 1x Reset button front access	1x Power button, 1x Reset button front access
Operating temperature		-5°C~+55°C	-5°C~+55°C	-5°C~+55°C

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ADLINK MECS series systems fulfill general edge server requirements in the following ways:

Ruggedly Built to Endure

Designed for harsh environments, the MECS-6110 and MECS-7210 are built to withstand rugged environmental conditions and can operate from -5°C to +55°C, with a storage tolerance down to -40°C. Additionally, the platforms can withstand repeated shocks of 2G (half-sine, 11ms pulse, 100 pulses in each direction) thanks to ADLINK's years experience in rugged embedded design and use of only the highest-quality mechanical parts. ADLINK edge servers feature a high mean time between failures (MTBF), extended support options, and secure remote configuration and monitoring.

Ready to Perform

To handle demanding and ever-increasing 5G workloads, ADLINK MECS series servers utilize Intel® Xeon® Scalable and Xeon®-D processors, DDR4 ECC memory, and a combination of M.2 and 2.5" SATA drives. Each model also includes PCIe expansion slots to support add-on components to meet specific application requirements, including FGPA, GPU, and I/O expansion cards. For networking, each edge server includes both 1 GbE and 10 GbE ports, which is critical for passing large amounts of data through Open RAN virtual environments without fabric bottlenecks.

Satisfying SWaP

Both MEC servers have standard rack-mountable dimensions but are only 1U or 2U in height, occupying much less physical space and allowing them to be easily installed in remote and/or constrained locations. Smaller systems with efficient processors mean less power consumed and reduced cooling demands, which becomes doubly important when installed in environments lacking data center-like cooling and ventilation.

Easy Manageability

ADLINK's MECS series servers support the open Redfish® industry standard. Redfish provides simple, modern, and secure management of scalable platform hardware. Administrators can also use the Intelligent Platform Management Interface (IPMI) with iKVM and Serial over LAN (SoL) to manage and monitor the edge server remotely via a web browser.

Penalty-Free Scalability

Too often, proprietary edge solutions limit users' ability to grow and meet new workloads or platform enhancements. ADLINK MECS series provide two full-height, full-length (FHFL) PCI Express slots for quick, affordable performance expansion, such as with GPU or FPGA add-on cards. Ample network bandwidth can accommodate large IoT device sets and workloads including high-resolution video, as well as lateral scaling of compute resources within edge and broader RAN deployments.

Built for Business

ADLINK maintains branch offices around the world to ensure that it can provide faster, more pertinent, regionally tailored support for all its product families, including MEC servers. ADLINK further backs its edge servers with comprehensive platform certifications, including OTII compliance, NVIDIA NGC-Ready, and AWS validation (see below). Systems include a wealth of security features, from board- and chip-level trusted platform enhancements to application-level management tools designed to enforce IT policies and block unwanted activity. ADLINK offers a line of off-the-shelf MEC servers, but the company's vertical integration and exceptional ODM engineering abilities allow clients to fine-tune these systems to specific needs or even build novel MEC designs from the ground up with whatever components, functionality, or form factors are required to meet specific needs of the customer's deployment.



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Conclusion

Manufacturers will soon have two options when implementing 5G. They may select a public 5G network controlled by a provider who sets the rules on managing customer connectivity. Alternatively, a company can run its own private 5G network, placing the new wireless network under control of the company's internal IT admins. The latter choice lets companies make their own rules. However, to properly run a private 5G network, manufacturers must invest in building out the required infrastructure, including critical edge servers and small cell system solutions from vendors such as ADLINK and Gemtek.

ADLINK brings much more to the 5G table than a capable edge server product. With decades of experience in the embedded and industrial computing markets, ADLINK offers a wealth of expertise in rugged design, edge computing, industrial automation, and developing platforms for GPU-based AI applications. ADLINK delivers global geo-coverage and the industry partnerships needed to offer complete lifecycle management with assured supply longevity. As a Premier Member of Intel® Internet of Things Solution Alliance and an NVIDIA® Quadro® Embedded Partner, OEM Preferred Partner and Jetson Elite Partner, ADLINK leverages early access to partner resources, including engineers and deep service support. This gives ADLINK the ability to design and manufacture Intel® and NVIDIA-based products for maximum performance and early-to-market opportunity. Moreover, ADLINK has the in-house ODM capabilities necessary to customize solutions from board integration to cloud adaptation.

Today, Gemtek continues to build on the rewards of placing ADLINK at the foundation of its private 5G manufacturing solutions. Contact ADLINK to learn more about how its edge portfolio can help make 5G solutions simple, reliable, flexible, and profitable in a host of manufacturing environments.

https://www.adlinktech.com/en/edge_server



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Head Office

ADLINK Technology, Inc.

No. 66, Huaya 1st Road, Guishan District
Taoyuan City 333411, Taiwan
Tel: +886-3-216-5088

www.adlinktech.com

Worldwide Offices

Ampro ADLINK Technology, Inc.

6450 Via Del Oro, San Jose, CA 95119-1208, USA
Tel: +1-408-360-0200
Toll Free: +1-800-966-5200 (USA only)
Fax: +1-408-600-1189
Email: info@adlinktech.com

ADLINK Technology (China) Co., Ltd.

上海市浦东新区张江高科技园区芳春路300号 (201203)
300 Fang Chun Rd., Zhangjiang Hi-Tech Park
Pudong New Area, Shanghai, 201203 China
Tel: +86-21-5132-8988
Fax: +86-21-5192-3588
Email: market@adlinktech.com

ADLINK Technology Beijing

北京市海淀区上地东路1号盈创动力大厦E座801室 (100085)
Rm. 801, Power Creative E, No. 1 Shang Di East Rd. Beijing, 100085 China
Tel: +86-10-5885-8666
Fax: +86-10-5885-8626
Email: market@adlinktech.com

ADLINK Technology Shenzhen

深圳市南山区科技园南区高新南七道数字技术园A1栋2楼C区 (518057)
2F, C Block, Bldg. A1, Cyber-Tech Zone, Gao Xin Ave. Sec. 7 High-Tech Industrial Park S.,
Shenzhen, 518054 China
Tel: +86-755-2643-4858
Fax: +86-755-2664-6353
Email: market@adlinktech.com

ADLINK Technology Singapore Pte Ltd.

1008 Toa Payoh North, 07-17/18 Singapore 318996
Tel: +65-6844-2261
Fax: +65-6844-2263
Email: singapore@adlinktech.com

ADLINK Technology Singapore Pte Ltd. (Indian Liaison Office)

#50-56, First Floor, Spearhead Towers
Margosa Main Road (between 16th/17th Cross)
Malleswaram, Bangalore - 560 055, India
Tel: +91-80-42246107, +91-80-23464606
Fax: +91-80-23464606
Email: india@adlinktech.com

ADLINK Technology Japan Corporation

〒101-0045 東京都千代田区神田鍛冶町3-7-4
ユニゾ神田鍛冶町三丁目ビル4F
Unizo Kanda Kaji-cho 3 Chome Bldg. 4F,
3-7-4 Kanda Kajicho, Chiyoda-ku,
Tokyo 101-0045, Japan
Tel: +81-3-5209-6001
Fax: +81-3-5209-6013
Email: japan@adlinktech.com

ADLINK Technology Korea Ltd.

경기도 용인시 수지구 신수로 767 A동 1503호
(동천동, 분당수지유타워) (우) 16827
A-1503, U-TOWER, 767 Sinsu-ro, Suji-gu,
Yongin-si, Gyeonggi-do, Republic of Korea, 16827
Toll Free:+82-80-800-0585
Tel: +82-31-786-0585
Fax: +82-31-786-0583
Email: korea@adlinktech.com

ADLINK Technology, Inc. (Israel Liaison Office)

MIXER Herzliya (Building B, 9 Floor)
3 Arik Einstein st., Zip code 4610301
Herzliya, Israel, P.O.Box - 351
Tel: +972-54-632-5251
Fax: +972-77-208-0230
Email: israel@adlinktech.com

ADLINK Technology GmbH

Hans-Thoma-Straße 11
D-68163 Mannheim, Germany
Tel: +49 621 43214-0
Fax: +49 621 43214-30
Email: germany@adlinktech.com

Ulrichsbergerstraße 17
D-94469 Deggendorf, Germany
Tel: +49 991 290 94–10
Fax: +49 991 290 94–29
Email: germany@adlinktech.com

ADLINK Technology, Inc. (French Liaison Office)

Bâtiment Thalès - Parc des Algorithmes,
Route de l'Orme des Merisiers,
91190 SAINT AUBIN, France
Tel: +33 (0) 1 60 12 35 66
Fax: +33 (0) 1 60 12 35 66
Email: france@adlinktech.com

ADLINK Technology, Inc. (UK Liaison Office)

First Floor West Exeter House,
Chichester fields Business Park Tangmere,
West Sussex, PO20 2FU, United Kingdom
Tel:+44-1243-859677
Email: uk@adlinktech.com

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