

# Number One Network Solutions Provider

**Wave**  
**E**lectronics  
[www.wavetc.com](http://www.wavetc.com)

# ***Company Introduction***

Since its foundation in 1999, Wave Electronics has been providing the Mobile Communications Equipment such as RRH, Femtocell, RF power Amp and RF Filters for the Major customers in Korea, Japan and U.S.A.

Wave Electronic is registered in KOSDAQ Market.

Nowadays, To lead the trend of Wired and Wireless technology fusion, We merged a very well-known and fully proven Network Solution R&D Company and has started to provide unique products for the Network related Market.

Based on the technological strength and global marketing ability, We will jump up to be a leading company as a Total Network Solution provider.

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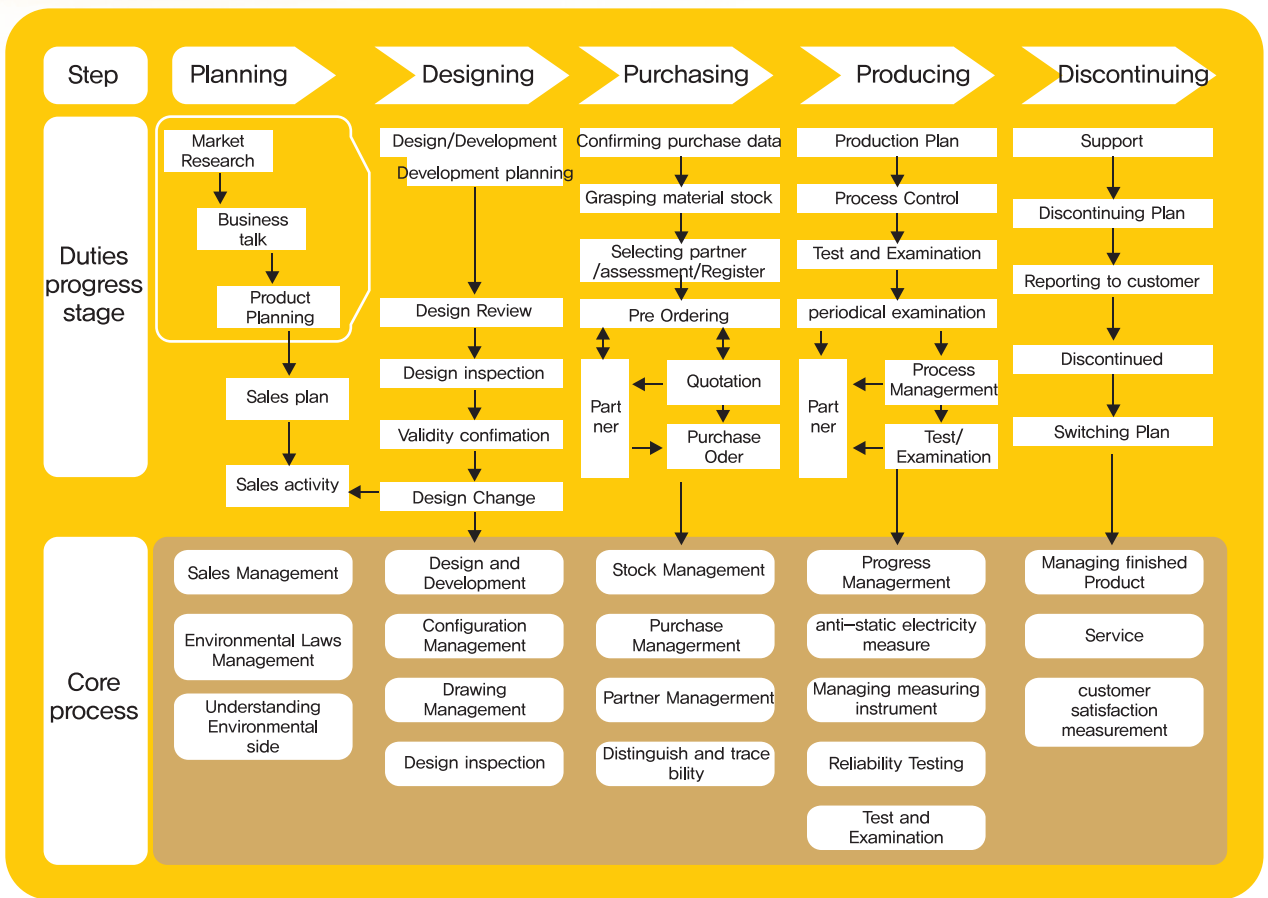


# Quality Assurance (ISO-9001&ISO14000 Certified Company)

Wave Electronics' Quality Policy is simply to provide the best products and services to our customers.

In order to achieve this goal, the management and employees at Wave Electronics strive to improve through the company-wide Total Quality Movement.

## Quality Management System



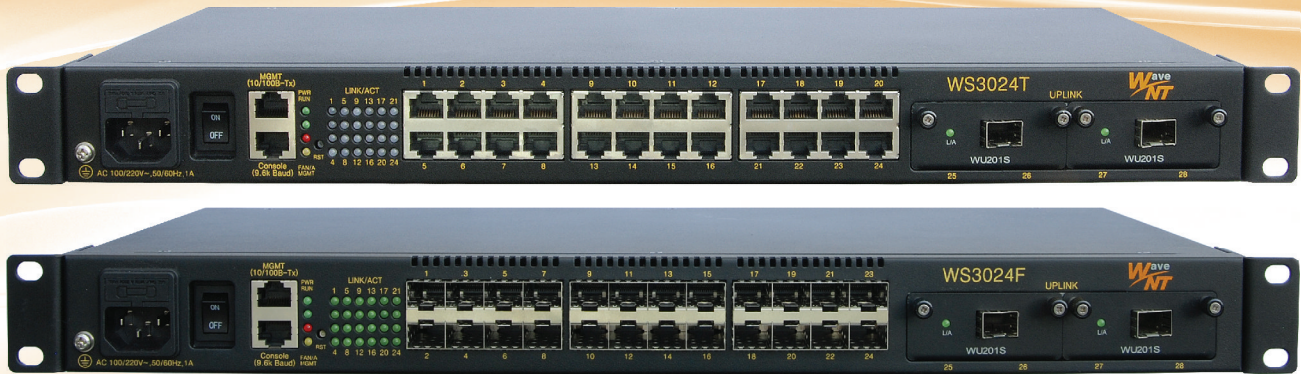
## ISO 14001



## ISO 9001 & TL 9000



# WS2024/WS3024 Series L2 Gigabit Ethernet Access Switch



The WS2024/WS3024 Series is a Telco-Grade Gigabit Ethernet Layer 2 Switch that brings cost effectiveness, continuous availability, enhanced security and advanced QoS, while maintaining simplicity of management. It is suitable for Service Provider to provide Gigabit bandwidth service to home user or business users. The WS2024/WS3024 Series provides either 24 10/100/1000-Tx ports or 24 Gigabit Ethernet SFP (Small Form Factor Pluggable) ports with two uplink slots which can be equipped with up to 4 of 1GbE, 2 of 10GbE uplink ports or 1 of GEAPON uplink port.

## ■ KEY FEATURES

### High Performance Switching

It features high performance Gigabit Ethernet access switch with non-blocking switching fabric for high speed data transmission without traffic congestion in every single port and supports 16K MAC address table so as to high capacity packet switching.

### Enhanced Reliability

Such features as RPVSTP(Rapid Per VLAN Spanning Tree), 802.1s Multiple Spanning Tree (MSTP) providing Layer 2 load sharing on redundant link and 802.1w Rapid Spanning Tree (RSTP) providing a loop-free network with rapid convergence enhance overall network stability and reliability.

### Efficient Traffic Management for Triple Play

QoS/CoS features are implemented to ensure optimal performance for such real-time applications as voice and video. Multicast VLAN Registration (MVR) and IGMP snooping provide efficient multicast traffic management for growing IPTV applications.

### Enhanced Security

Rich security features like Layer 1 ~ 4 packet filtering (Access Control List), NetBIOS/NetBEUI filtering, Private DHCP server packet filtering, MAC Address Restriction per port, Rate limit of port for both Ingress & Egress, Broadcast/Multicast/DLF packet limit, TCP Sync attack protection, TCP port scan attack blocking, Abnormal source MAC blocking, Packet Dump, Port Flood Guard, ARP Inspection, CPU Inflow packet control, Unicast/ICMP/IGMP Storm Control, ARP Spoofing protection and Incoming ICMP packet limit are available for maximum system and network protection.

### Excellent Operation and Management

Standard-based management protocols like SNMP, Telnet, Console and SSH, remote software upgrade via TFTP and FTP and very low noise system make the system easy, simple and comfortable.

## ■ Technical Specification

	Product Model	WS2024T	WS2024F	WS3024T	WS3024F
Subscriber Port	10/100/1000Base-T (RJ-45)	24	–	24	–
	1000Base-X (SFP)	–	24	–	24
Uplink Port (optional)	10/100/1000Base-T (RJ-45)	Max. 4	Max. 4	Max. 4	Max. 4
	1000Base-X (SFP)	Max. 4	Max. 4	Max. 4	Max. 4
	10GbE (SFP+)	–	–	Max. 2	Max. 2
	GEAPON	Max. 1	Max. 1	Max. 2	Max. 2
Management Port	10/100Base-Tx (RJ-45)	1	1	1	1
	Console (RJ-45)	1	1	1	1
Performance	Switching Capacity	56Gbps	56Gbps	88Gbps	88Gbps
	Flash Memory	16Mbytes	16Mbytes	32Mbytes	32Mbytes
	DRAM	128Mbytes	128Mbytes	128Mbytes	128Mbytes
	MAC Address Table Size	16K	16K	16K	16K
	Jumbo Frames	9K	9K	16K	16K
	Auto-Nego, Auto-MDI/MDIX	0	0	0	0
Mechanical	Rack Mount	19"	19"	19"	19"
	Dimension (W x D x H) mm	430 x 225 x 44	430 x 225 x 44	438 x 235 x 44	438 x 235 x 44
	Weight (Kg)	Max. 3.7	Max. 3.9	?Max. 3.9	Max. 4.1
Power Supply	100–240VAC, 50/60Hz	0	0	0	0
	Max. Power Consumption (Watts)	Max. 33	Max. 33	Max. 35	Max. 35
Environmental	Operating Temperature (° C)	–20 ~ 60	–20 ~ 60	–20 ~ 60	–20 ~ 60
	Storage Temperature (° C)	–35 ~ 75	–35 ~ 75	–35 ~ 75	–35 ~ 75
	Operating Humidity (non-condensing)	5 ~ 95%	5 ~ 95%	5 ~ 95%	5 ~ 95%
	Storage Humidity (non-condensing)	5 ~ 95%	5 ~ 95%	5 ~ 95%	5 ~ 95%
	Noise (dBA)	Max. 35	Max. 35	Max. 35	Max. 35
	WEEE	0	0	0	0
	RoHS	0	0	0	0
Electromagnetic Compatibility	Power Surge Protection	4KV	4KV	4KV	4KV
	FCC Class A	0	0	0	0
	CE	0	0	0	0

## Features

### L2 Features

#### Storm Control:

- Broadcast
- Multicast
- Unknown Unicast

#### Spanning Tree Protocol:

- IEEE 802.1D Spanning Tree Protocol (STP)
- IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
- IEEE 802.1s Multiple Spanning Tree Protocol (MSTP)
- RPVSTP(Rapid Per-VLAN Spanning Tree Protocol)
- BPDU Guard
- BPDU filtering
- Root Guard
- Loopback detection

#### VLANs:

- Supports 4K VLAN
- Port-based VLAN
- IEEE 802.1Q VLAN
- IEEE 802.1v Protocol-based VLAN for WS3024
- Subnet based VLAN for WS3024
- MAC-based VLAN for WS3024
- VLAN Trunking
- VLAN Translation
- Independent VLAN learning

#### L2 Virtual Private VLAN

- QinQ

#### Link Aggregation:

- Static Trunk
- IEEE 802.3ad Link Aggregation Control Protocol
- Trunk groups: 13, up to 8 ports per group
- Load balance based on MAC SA/DA, Ethertype, SIP, DIP, Source (TCP/UDP) port, Destination (TCP/UDP) port

#### Multicast:

- IGMP v1/v2/v3 snooping
- IGMP Proxy reporting
- IGMP Filtering
- IGMP Immediate Leave
- IGMP Querier
- MVR (Multicast VLAN Registration)

#### Learning up to 16K MAC address entries

#### Port Mirroring

#### VLAN Mirroring

#### MAC Based Mirroring

#### Self-loop control

#### Supports jumbo frames

#### Auto-negotiation for port speed and duplex mode

#### Auto MDI/MDI-X

#### SFP port support changeable 1000Base-SX/LX/LHX/ZX / TX transceiver

#### Digital Diagnostic Monitoring (DDM)

#### Flow Control:

- IEEE 802.3x for full duplex mode

#### Congestion Control:

- Back-Pressure for half duplex mode
- HOL (Head Of Line) Blocking prevention

### QoS Features

#### Priority Queues: 8 hardware queues per port

#### Traffic Classification CoS

- IEEE 802.1p based CoS
- IP Precedence based CoS
- IP DSCP based CoS
- MAC access control lists (source/destination MAC, Ether type, priority ID/VLAN ID)
- IP standard access control lists (source IP)
- IP extended access control lists (source/destination IP, protocol, TCP/UDP port number)

#### Traffic Scheduling

- Strict Priority
- Weighted Round Robin
- Deficit Round Robin

#### Ingress traffic policing

#### Egress traffic shaping per port

#### Ingress Data Rate Limiting per class/flow

- GE: Resolution 64 Kbps ~ 1000 Mbps

#### Marking/remarking

#### DiffServ

More than 128 ACL QoS rule based on Layer 1 ~ 4

\* : Features To be implemented

## ■ Features

### Security Features

- IEEE 802.1X MAC-based authentication
- L1/L2/L3/L4 Access Control Lists
- Protocol type/ToS field control ACL
- DHCP Snooping
- DHCP Relay
- DHCP Option 82
- Dynamic ARP Inspection
- RADIUS Authentication
- User name password authentication
  - Local authentication
  - Remote authentication via RADIUS
- Management Interface Access Filtering
  - SNMP
  - Telnet/SSH
- MAC filter
- PPPoE intermediate agent
- MAC Address Limitation(0–255) per Port
- Port Flood Guard
- NetBEUI/NetBIOS/NBT Packet Filtering
- Private DHCP Server Packet Filtering
- Logon filter
- Dynamic VLAN by Authentication Server

### IPv6 Features

- IPv4/IPv6 dual protocol stack
- IPv6 Address Types Stack: Unicast
- IPv6 Neighbor Discovery
- SNMP over IPv6\*
- HTTP over IPv6\*
- Remote IPv6 ping
- IPv6 ACL
- IPv6 MLD (Multicast Listener Discovery) Snooping

### Management Features

- Switch Management:
  - CLI via console port or Telnet
  - SNMP v1, v2c, v3
- Firmware and Configuration:
  - Firmware upgrade via TFTP/FTP server
  - Multiple configuration files
  - Configuration file upload/download via TFTP/FTP server
- RMON by CLI
- RTC
- SNTP
- Event/Error Log/Syslog
- IP clustering (up to 8 systems)
- Dual Booting
- FAN ON/OFF Status Monitoring/Automatic Control by temperature of built-in thermometer
- System Watchdog and Automatic System Reset
- Packet Dump
- Virtual Cable Test Function(WS2024,WS3024 only)
- Event log by dying Gasp (Optional)
- OAM Interface with EPON OLT

### Electromagnetic Compatibility

- CE Mark
- FCC Class A
- 4KV Surge Protection
- 8KV/15KV ESD Protection

### Environmental Specification

- Temperature:
  - 20°C to 60°C (Standard Operating)
  - 35°C to 75°C (Non-Operating)
- Humidity: 5% to 90% (Non-condensing)

### Power Supply

- AC Power code
- 100 to 240 V, 50–60 Hz

## Ordering Information

Optional Uplink Modules	Product Description
WU202S-S	2 x 1000Base-X (SFP) Uplink module for WS2024T/WS2024F
WU202S	2 x 1000Base-X (SFP) Uplink module for WS3024T/WS3024F
WU201S	1 x 1000Base-X (SFP) Uplink module for WS3024T/WS3024F
WU202T_S	2 x 10/100/1000Base-T (RJ-45) Uplink module for WS2024T/WS2024F
WU202T	2 x 10/100/1000Base-T (RJ-45) Uplink module for WS3024T/WS3024F
WU201P_S	1 x GEAPON (SFP) Uplink module for WS2024T/WS2024F
WU201P	1 x GEAPON (SFP) uplink module for WS3024T/WS3024F
WU301S	1 x 10GbE (SFP+) Uplink module for WS3024T/WS3024F



# WS 2124T GIGABIT ETHERNET ACCESS SOLUTION

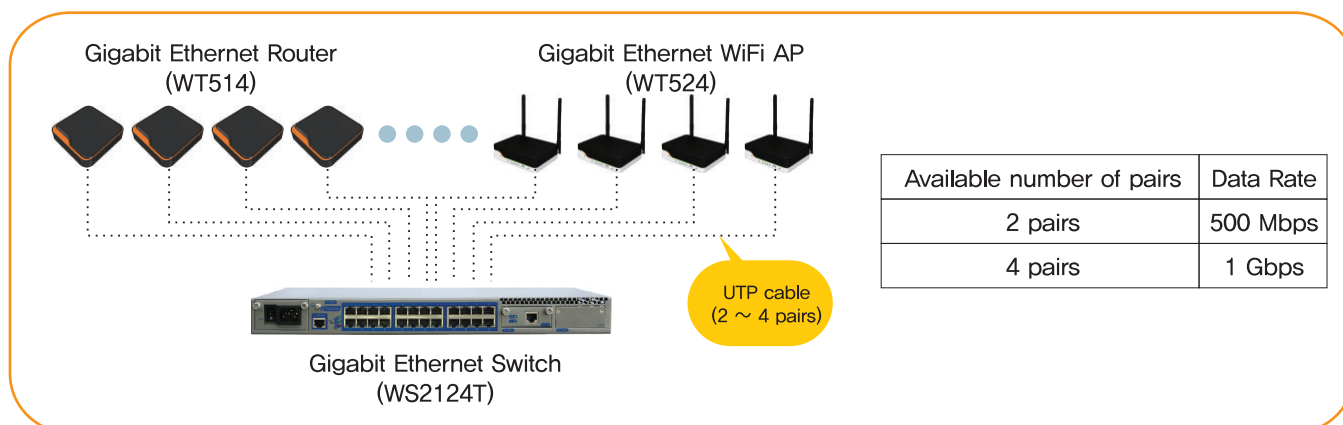


## HIGH SPEED ETHERNET SERVICE FOR RESIDENTIAL AND BUSINESS APPLICATIONS

The WS2124T is a cost-effective, single-board gigabit switch designed for customer premises with reliable layer 2 functionalities. The unit provides 24 ports of 100/500/1000Base-TX interfaces with RJ-45 connectors and includes two mounting slots for an optional uplink unit.

The WS2124T performs several functions including QoS, multicast, security, and improved operational efficiencies traffic aggregation. It can also serve as a suitable solution for multimedia broadband service, IPTV, VoD, and others. The WS2124T features non-blocking architecture and interfaces that provide wire-speed and full-duplex packet traffic on all ports. It supports uplink interface units of the following types: 1000 Base-X (SFP), 1000 Base-T, and 1-port modular G-PON. Each uplink module can be inserted into the two front slots. The MGMT and console interface is located on the front panel with embedded LEDs for LNK/ACT and TX/RX indication for equipment management via remote access or CLI.

The WS2124T supports up to 500 Mbps speed in an environment using two pairs of minimum category 5 cable.



5 Times faster than 100 Base-T for 2 pairs

## KEY FEATURES

### High Performance

The WS2124T delivers 56 Gbps switching capacity with 41 Mpps throughput. It supports enhanced QoS (Quality of Service) features to ensure that network traffic is optimally classified, prioritized, and efficiently handled for multimedia and time-sensitive applications.

### Flexible Service Scenario

The WS2124T can be used for various applications as a gigabit ethernet layer 2 switch as well as a G-PON ONU. The PON service consists of optical line termination (OLT), ONU (optical network unit), and a passive optical splitter. OLT is located in the central office, and it connects ONU via an optical splitter.

### 500 Mbps for 2 pairs UTP

The WS2124T supports up to 500 Mbps speed in an environment using two pairs of minimum category 5 cable. Data-rate (10/100/500/1000 Mbps) is detected automatically between connections.

### Traffic Monitoring

A traffic analyzer application allows the operator to monitor network traffic on a specific port and perform traffic management, monitoring, and analysis.

## Features

### Platform

L2 switching	
Uplink	G-PON module 10/100/1000 Base-TX module (option) 1000 Base-X (SFP) module (option)
Downlink	24 Ports 100/500/1000 Base-TX

### G-PON

ITU-T G.984.x G-PON compliant	
Downstream	2.5 Gbps
Upstream	1.25 Gbps
Capacity & performance	
Throughput	56 Gbps
Packet forwarding	41 Mpps

### L2 Switching

IEEE802.3 CSMA/CD, IEEE802.1q VLAN tagging, double VLAN tagging, jumbo frame, link aggregation, IEEE802.1d STP, IEEE802.1w RSTP, IEEE802.1p CoS, IEEE802.3x flow control, storm control, port mirroring, max MAC control per port

### DHCP

DHCP snooping, simplified option82

### Multicast

IGMP snooping v1/v2  
IGMP static join  
IGMP fast leave  
IGMP report suppression  
IGMP join filter/ limit



WT514



WT524

### QoS

Queuing & Scheduling (SPQ, WFQ, WRR)  
Queues per port (8)  
Ingress/ egress rate control (1 Mbps Step)  
classification (L2/L3/L4), CoS, DSCP mark/emark, DiffServ

### Management & Security

FTP software up-grade, CLI (Command Line Interface), SNMP v1/v2, MIB II, private MIB, syslog, SSH, telnet, DHCP filtering, NetBEUI filtering, NBT filtering (VISTA LTD filtering), ARP spoofing protection, MAC flood guard, Port flood guard, self loop detection (SLD), directed broadcast protection

### Physical

Dimension 432(W)x44(H)x185(D) mm

### Environmental Spec.

Operating temp. - 20 °C ~ 60 °C  
Non-operating temp. - 40 °C ~ 80 °C  
Operating humidity 5% ~ 95% (non-condensing)

### Power

Input voltage 100 ~ 240 VAC  
Frequency 50 ~ 60 Hz  
Power consumption 27 W (Max)

Network interface	1 Port RJ-45 , 100/500/1000 Base-Tx Auto-negotiation
User interface	4 Port RJ-45 , 10/100/1000 Base-Tx Auto-negotiation 2.4 GHz & 5 GHz dual-concurrent (H524G)
CPU	Embedded 700 MHz CPU
Memory	DDR2 SDRAM 64 Mbytes Flash 16Mbytes
Mac address	2K MAC entries
Power (adapter)	DC 5V@2A
Dimension	WT514 : 35 (H) x 135(W) x 135(D) mm WT524 : 38 (H) x 170(W) x 130(D) mm

# Instant Upgrading to 500 Mbps Internet with 2-pair Ethernet

In the past two years, a new technology called "2-pair Ethernet" has been introduced in Korea, apparently increasing broadband Internet speeds 5 times faster, from 100 Mbps to 500 Mbps, instantly. It certainly is fascinating in that such speed improvement was achieved without the hassle of re-cabling construction in apartment buildings. Because 100 Mbps had seemed unbeatable for almost a decade, this sure was a long-awaited good news. So, we will take a moment to see what this technology is and in what cabling systems it can be employed.

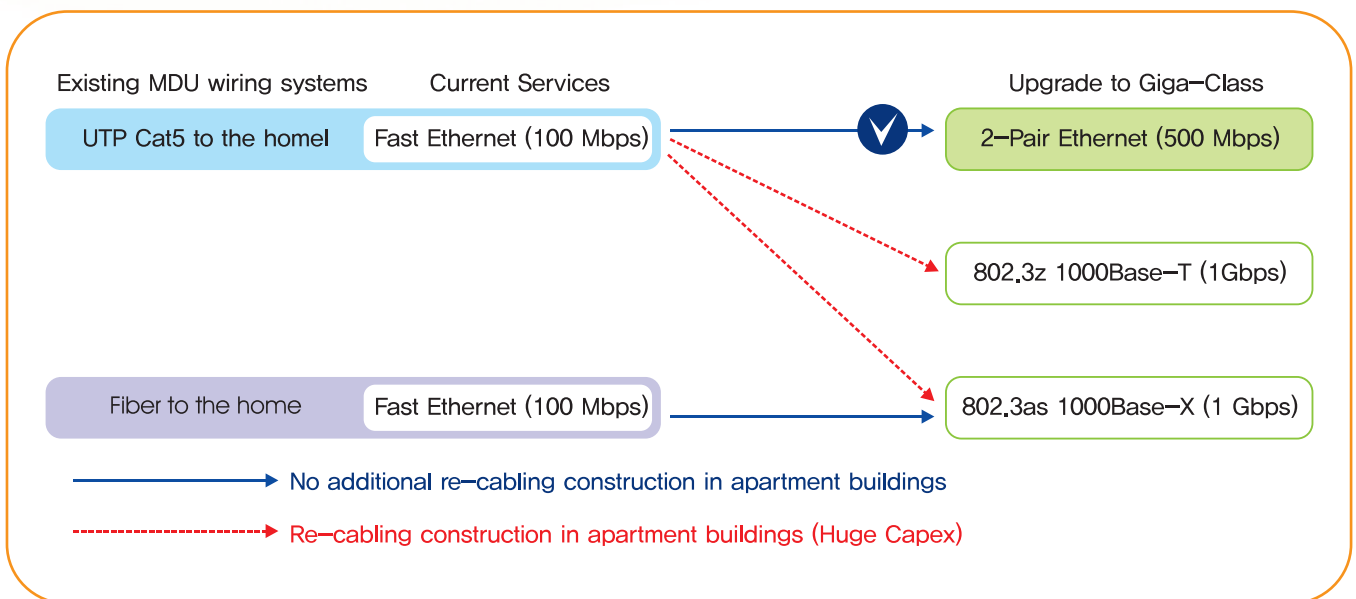


Figure 1. Migration Strategies to Giga-Class MDU Broadband

First, we may want to think about what has brought this technology into the market.

Korean big 3 operators are currently offering Giga Wi-Fi Service (802.11ac) at hotspots like Starbucks, actually supporting 250~400 Mbps. To achieve this high speed, the operators expanded their wired access networks for hotspots, where Wi-Fi APs are connected, up to 1 Gbps. But for home users, because the maximum broadband speeds are 100 Mbps no matter what service they use (i.e. VDSL2, LAN or FTTH), Giga Wi-Fi service is not yet available for them. In order for these home users to use the service, their home broadband access should be as fast as hundreds of Mbps.

There has been concern about the quality of 4K UHD IPTV service, which was just launched by KT and SK Broadband (SKB) in September. According to Benchbee ([www.benchbee.co.kr](http://www.benchbee.co.kr)), the most popular Internet speed test site in Korea, the operators' claimed maximum speeds were different from the actual speeds measured. For example, in case of LAN (UTP to the home) and FTTH also with a claimed 100 Mbps, the actual averages were 40~80 Mbps (KT, SKB and LG U+). Because 4K UHD IPTV service requires a broadband of 15~30 Mbps, home users with more than one TV are likely to suffer from unstable quality of service.

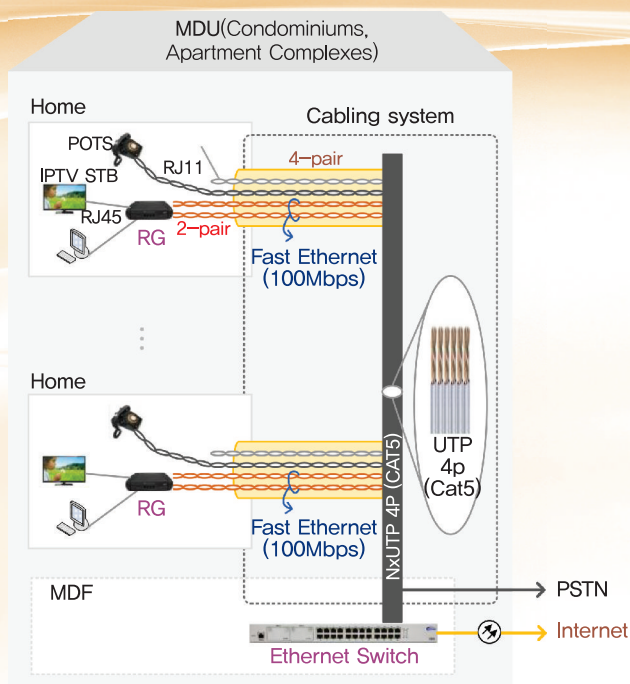


Figure 2. Current UTP cabling architecture

Over 5 million households living in apartment units have UTP Cat5 cables in Korea

To address this concern, Korean operators have been working to improve speeds of the existing UTP-based (Cat5) Internet services, from 100 Mbps to 500 Mbps for home users living in apartment complexes. What is common in all the strategies by them is pretty obvious. They want to do this without re-cabling, that is without replacing the existing cables installed in apartment buildings. A person at operator familiar with this matter noted, "Technically, cables installed in buildings are owned by the building owners. So, installing new cables certainly means a lot of steps to go through. Discussions should be arranged, consents should be obtained from all the residents, and costs should be shared by them, etc."

To offer Internet (LAN service: UTP to the home, 100 Mbps) and telephone services to households living in apartment units where UTP Cat5 cables (4-pair) are installed, operators use 2 pairs of the

lines inside a cable for Internet service (Fast Ethernet with 100 Mbps), and 1 pair for POTS phone service. And the last 1 pair is left unused. According to the standards (for Gigabit Ethernet and Fast Ethernet), 1 Gbps requires all 4 pairs of lines (Cat5e/Cat6) while 100 Mbps requires only 2 out of 4 pairs (Cat5). To achieve 1 Gbps speeds, all 4 pairs should be used, and cables have to be Cat5e/6. So, additional cabling is inevitable.

### Wave Electronics's Solution: 2-pair Ethernet

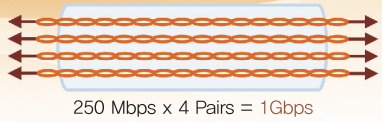
To avoid this issue, that is, to support Internet speeds higher than 100 Mbps without additional installation of cables, Wave Electronics developed a new technology that can support up to 500 Mbps by using only 2 pairs of existent Cat5 cables (bidirectional 500 Mbps at a distance of 100 m).

The 2-Pair Ethernet technology is implemented by modifying the current 1000Base-T standard (IEEE 802.3ab).

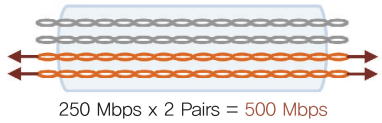
This technology enables an Ethernet switch (i.e., FTTB ONU for apartment buildings) to utilize 2 out of 4 pairs inside a single Category 5 UTP cable, providing 500 Mbps data transmission (= 250 Mbps per pair x 2 pairs) through the 2 pairs. The 2-pair Ethernet system is actually implemented by adding a specific functional block of 2-pair Ethernet operation to the MAC/PHY Layer of the existing 1000Base-T Ethernet system. The following functionalities are to be added to the 2-pair Ethernet system as shown in Figure 3:

- ① Rate adaption function between 1000Base-T (1 Gbps) and 2-pair Ethernet (500 Mbps) interface
- ② Flow control function that prevents overflow (speed mismatch) and a loss of Ethernet frame traffic
- ③ Signal conversion function that converts signals of 4-pair based 1000Base-T into those suitable for 2-pair transmission (2D-PAM5)

Gigabit Ethernet / CAT5e 100m / Full Duplex



2-pair Ethernet / CAT5 100m / Full Duplex



Fast Ethernet / CAT5 100m / Full Duplex

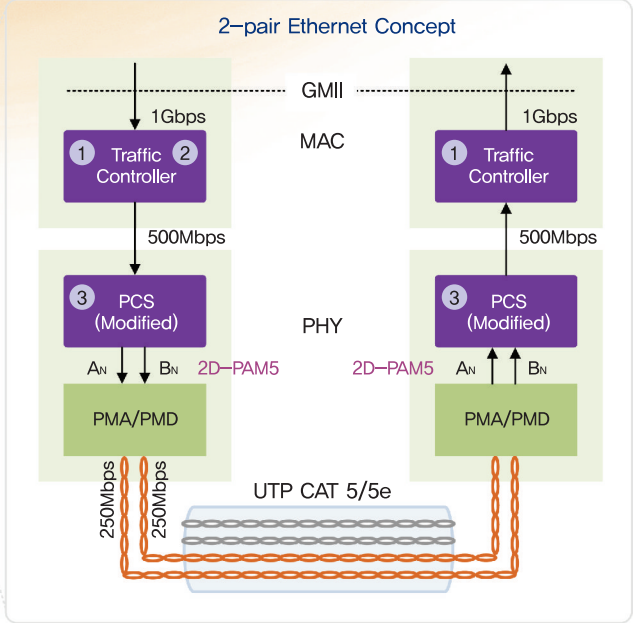
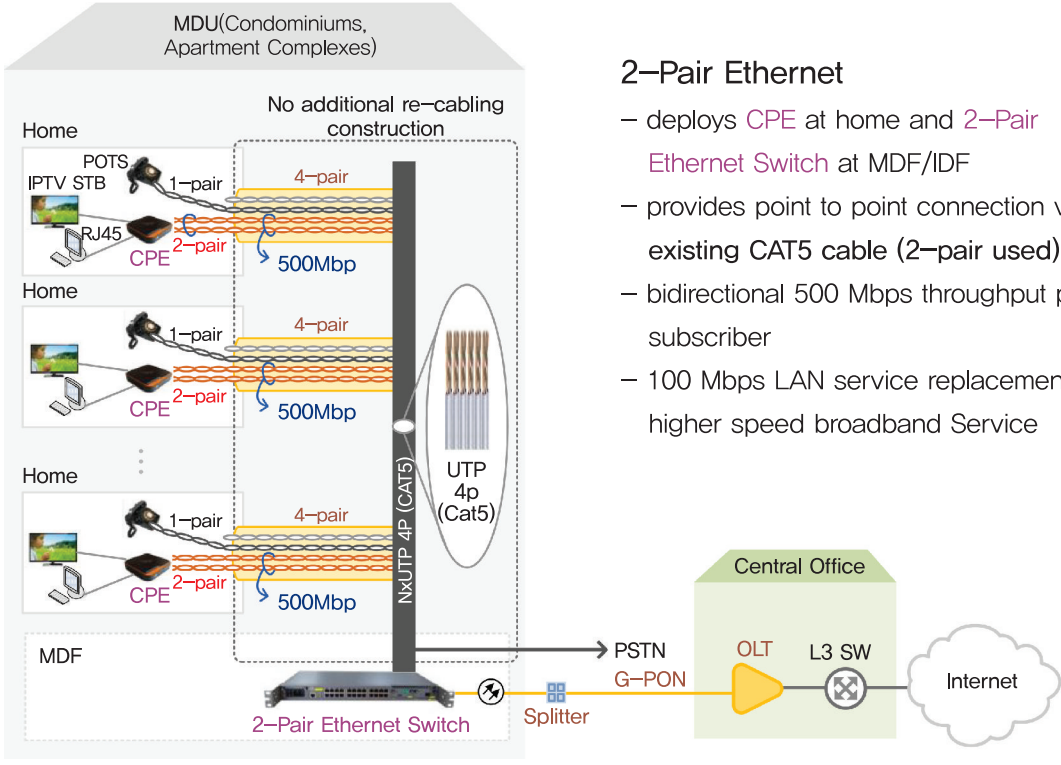


Figure 3. 2-pair Ethernet technology developed by Wave Electronics



2-Pair Ethernet

- deploys CPE at home and 2-Pair Ethernet Switch at MDF/IDF
- provides point to point connection via existing CAT5 cable (2-pair used)
- bidirectional 500 Mbps throughput per subscriber
- 100 Mbps LAN service replacement for higher speed broadband Service

Figure 4. SK Broadband's MDU broadband innovation – 500 Mbps with just 2 pairs

SKB adopted new device specially designed for this purpose and launched a new service in June 2013. In each household, a 2-pair Ethernet CPE is installed. On MDF, a 2-pair Ethernet switch is added. But, UTP cables that connect each household and MDF are kept unchanged. These new installation allow for bidirectional Internet speed improvement from 100 Mbps to 500 Mbps for all the households.

After almost a decade of stagnation in speed improvement, Korea is finally taking a long-overdue step forward toward Giga-class Internet service. For apartment buildings that were built recently and thus have optical fiber or Cat 5e/6 UTP cables already installed, upgrading to 1 Gbps is easy. On the other hand, for older buildings, it requires installation of new cables, which would apparently result in huge CAPEX. Given that, it is quite impressive that the Wave Electronics managed to find ways to offer Giga-class service of 500 Mbps to users without re-cabling.

# WS6024

## VDSL2 Box DSLAM

The WS6024 complied with ITU-T G.993,2 is a high performance VDSL2 Box DSLAM which transports the traffic at the speed of up to 100Mbps for both downstream and upstream over copper twisted pair and provides service up to 3km. It supports OLR (Online Reconfiguration) function which enhances service stability by dynamically adapting the data rate without interrupting service for retraining. The WS6024 provides 24 VDSL subscriber ports with one uplink slot which can be equipped with up to 2 of 1GbE uplink ports or 1 of GEAPON uplink port.



WS6024  
VDSL2 Box DSLAM

### ■ KEY FEATURES

#### • High Speed Transmission with 30a profile

Transmission speed up to 100Mbps in both upstream and downstream is supported with 30a profile. It is designed with non-blocking switching fabric for high speed data transmission without traffic congestion in every single port and supports 16K MAC address table so as to high capacity packet switching to upper networks.

#### • Enhanced Reliability

Such features as RPVSTP (Rapid Per VLAN Spanning Tree) and 802.1s Multiple Spanning Tree (MSTP) providing Layer 2 load sharing on redundant link and 802.1w Rapid Spanning Tree (RSTP) providing a loop-free network with rapid convergence enhance overall network stability and reliability.

#### • Efficient Traffic Management for Triple Play

QoS/CoS features are implemented to ensure optimal performance for such real-time applications as voice and video.

Multicast VLAN Registration (MVR) and IGMP snooping provide efficient multicast traffic management for growing IPTV applications.

#### • Enhanced Security

Such rich security features as Layer 1 ~ 4 packet filtering (Access Control List), NetBIOS/NetBEUI filtering, Private DHCP server packet filtering, MAC Address Restriction per port, Rate limit of port for both Ingress & Egress, Broadcast/Multicast/DLF packet limit, TCP Sync attack protection, TCP port scan attack blocking, Abnormal source MAC blocking, Packet Dump, Port Flood Guard, ARP Inspection, CPU Inflow packet control, Unicast/ICMP/IGMP Storm Control, ARP Spoofing protection and Incoming ICMP packet limit are available for maximum system and network protection.

#### • Excellent Operation and Management

Standard-based management protocols like SNMP, Telnet, Console and SSH, remote software upgrade via TFTP and FTP and very low noise system make the system easy, simple and comfortable.

## ■ Technical Specification

	Product Model	W62024
VDSL	VDSL2	24
	Telco Connection	One Telco 50 for 24 VDSL ports One Telco 50 for 24 POTS ports
Uplink Port (optional)	10/100/1000Base-T (RJ-45)	Max. 2
	1000Base-X (SFP)	Max. 2
	GEAPON	Max. 1
Management Port	10/100Base-Tx (RJ-45)	1
	Console (RJ-45)	1
Performance	Switching Capacity	12.8Gbps
	Flash Memory	14MB
	DRAM	128MB
	MAC Address Table Size	16K
	Jumbo Frames	13K
	Auto-Nego, Auto-MDI/MDIX	0
Mechanical	Rack Space	19"
	Dimension (W x D x H) mm	445 x 280 x 66
	Weight (Kg)	Max. 5.8
Power Supply	100-240VAC, 50/60Hz	0
	Max. Power Consumption (Watts)	Max. 75
Environmental	Operating Temperature (°C)	-20 ~ 60
	Storage Temperature (°C)	-35 ~ 75
	Operating Humidity (non-condensing)	5 ~ 95%
	Storage Humidity (non-condensing)	5 ~ 95%
	Noise (dBA)	Max. 40
	WEEE	0
	RoHS	0
Electromagnetic Compatibility	Power Surge Protection	2kV
	FCC Class A	0
	CE	0



## Features

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- Trunk groups: 13, up to 8 ports per group
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#### IGMP Snooping:

- IGMP v1/v2/v3 snooping
- IGMP Proxy reporting
- IGMP Filtering
- IGMP Immediate Leave
- IGMP Querier
- MVR (Multicast VLAN Registration)

Learning up to 16K MAC address entries

#### Port Mirroring

#### VLAN Mirroring

#### MAC Based Mirroring

#### Self-loop control

#### Supports jumbo frames

#### Auto-negotiation for port speed and duplex mode

#### Auto MDI/MDI-X

SFP port support changeable 1000Base-SX/LX/LHX/ZX/TX transceiver

#### Digital Diagnostic Monitoring (DDM)

#### Flow Control:

- IEEE 802.3x for full duplex mode

#### Congestion Control:

- Back-Pressure for half duplex mode
- HOL (Head Of Line) Blocking prevention

### VDSL Features

ITU-T G.993.2 VDSL2 Standard compliant

Max. Data Rate :

- Down/Up: 100 Mbps/100 Mbps

Max. Service Distance: 3Km (AWG 26)

UPBO (Upstream Power Back-Off) enable/disable

DPBO (Downstream Power BackOff) enable/disable

OLR(On-Line Reconfiguration) function

ADSL band and UO band enable/disable

Amateur Radio (HAM) band enable/disable

Data channel: Interleave/Fast Channel

INP, TEQ, Trellis coding

### QoS Features

Priority Queues: 8 hardware queues per port

#### Traffic Classification COS

- IEEE 802.1p based COS
- IP Precedence based COS
- P DSCP based COS

– MAC access control lists (source/destination MAC, Ether type, priority ID/VLAN ID)

– IP standard access control lists (source IP)

– IP extended access control lists (source/destination IP, protocol, TCP/UDP port number)

#### Traffic Scheduling

- Strict Priority
- Weighted Round Robin
- Deficit Round Robin

#### Ingress traffic policing

#### Egress traffic shaping per port

#### Ingress Data Rate Limiting per class/flow

– GE: Resolution 64 Kbps ~ 1000 Mbps

#### Marking/remarking

#### DiffServ

More than 128 ACL QoS rule based on Layer 1 ~ 4

### Security Features

IEEE 802.1X port-based and MAC-based authentication\*

L1/L2/L3/L4 Access Control Lists

DHCP Snooping

DHCP Relay

DHCP Option 82

Dynamic ARP Inspection

RADIUS Authentication\*

User name password authentication

– Local authentication

– Remote authentication via RADIUS

Management Interface Access Filtering

– SNMP

– Telnet/SSH

MAC filter

PPPoE intermediate agent

MAC Address Limitation(0-255) per Port

Port Flood Guard

NetBEUI/NetBIOS/NBT Packet Filtering

Private DHCP Server Packet Filtering

\* : Features To be implemented

## Features

### IPv6 Features

IPv4/IPv6 dual protocol stack\*  
 IPv6 Address Types Stack: Unicast\*  
 IPv6 Neighbor Discovery\*  
 SNMP over IPv6\*  
 HTTP over IPv6\*  
 Remote IPv6 ping\*  
 IPv6 ACL\*

### Management Features

Switch Management:  
 – CLI via console port or Telnet  
 – SNMP v1, v2c, v3  
 Firmware and Configuration:  
 – Firmware upgrade via TFTP/FTP server  
 – Multiple configuration files  
 – Configuration file upload/download via TFTP/FTP server  
 RMON by CLI  
 RTC  
 SNTP  
 Event/Error Log/Syslog  
 IP clustering (up to 8 systems)  
 Dual Booting  
 FAN ON/OFF Status Monitoring/Automatic Control by  
 temperature of built-in thermometer  
 System Watchdog and Automatic System Reset  
 Packet Dump  
 Virtual Cable Test Function(WS2024,WS3024 only)  
 Event log by dying Gasp (Optional)  
 OAM Interface with EPON OLT

\* : Features To be implemented

### Electromagnetic Compatibility

CE Mark  
 FCC Class A  
 4KV Surge Protection  
 8KV/15KV ESD Protection

### Environmental Specification

Temperature:  
 –20°C to 60°C (Standard Operating)  
 –35°C to 75°C (Non-Operating)  
 Humidity: 5% to 90% (Non-condensing)

### Power Supply

AC Power code  
 100 to 240 V, 50–60 Hz

## Ordering Information

Optional Uplink Modules	Product Description
WU202S-S	2 x 1000Base-X (SFP) Uplink Module
WU202T_S	2 x 10/100/1000Base-T (RJ-45) Uplink Module
WU201P_S	1 x GEAPON (SFP) Uplink Module

# WT702 series 3G/4G LTE M2M Gateway

The WT702 series M2M Gateway with powerful processor featuring dual core and dual DSP engine for wide range of industrial M2M application is designed for easy system management, simple cellular connectivity to OEMs equipment, easy integration of various embedded solution with multi-mode technology.

The WT702 series M2M Gateway features high level of network security and availability owing to its options of SSL VPN and auto failover function of switching between fixed line connection and cellular connection.

The WT702 series M2M Gateway provides such various interface as LAN, WAN, RS-232, RS-485, USB, WiFi (optional), 3G/LTE (optional), microphone connector and Micro-SD connector. Battery back-up option is also available to keep it alive up to 2 hours in case of power grid failure.



WT702 series  
3G/LTE M2M Gateway

## ■ KEY FEATURES

- LAN: 2x 10/100Base-Tx (RJ45)
- WAN: 1x 10/100Base-Tx (RJ45)
- WLAN: 802.11b/g/n 2.4GHz (option)
- 3G/LTE (option)
- Serial: 2x RS-232 (RJ11) and 1x RS-485 (RJ11)
- 1x USB2.0
- Li-ion backup battery (option)
- Hardened Design
- SMS
- Auto network failover
- Comprehensive device remote management and configuration
- Application framework for custom M2M application
- Management: User friendly Web interface, Telnet, SSH, SNMP v1, v2 (option)
- Secure connection: SSL VPN, L2TP/IPSec\*

\*To be implemented

## ■ Technical Specification

### WAN

- 10/100Base-Tx (RJ45)

### LAN

- 2 x 10/100Base-T (RJ45)
- Auto-negotiable, Auto MDI/MDIX

### Wireless LAN (option)

- IEEE 802.11b/g/n (2.4GHz)
- 2T2R External Antenna, MIMO
- WEP, WPA-PSK/WPA2-PSK, 802.1x
- 8 SSIDs
- WPS, WDS, WMM
- Wireless Bridge

### 3G (option)

- Single band WCDMA/HSDPA
- TCP/IP, UDP/IP, PPP
- One Antenna

### LTE (option)

- TCP/IP, UDP/IP, PPP
- Two Antenna (MIMO 2x2)

### USB

- 1 x USB 2.0 – Type A
- USB memory/HDD, USB Printer
- 5V, 1.5A USB port power supply

### Serial

- 2x RS232
- RS232 modem interface (Dial-up, PPP, Direct PPP)
- RS232 Serial to Ethernet (server/client)
- 1x RS485
- RS485 Serial to Ethernet (Server/Client)\*
- RS485 Modbus\*

### Backup battery (option)

- 2600mA Li-ion rechargeable battery
- Battery monitoring
- Built-in protection circuit for charging and discharging
- Up to 2 hour operation

### Other I/O

- Micro-SD connector
- Microphone connector (2.5mm)

### Routing

- High performance H/W based NAT routing (Up to 2Gbps)
- Static IP configuration and Static routing
- DHCP client and server
- DNS proxy
- Dynamic DNS (DDNS) client

### Firewall

- NAT
- Inbound/outbound rules
- Port Forwarding, DMZ
- VPN pass-through

### VPN (option)

- SSL VPN
- L2TP/IPSec\*

### LEDs

- PWR, WAN, LAN, WLAN, 3G/LTE

### Management

- WEB
- Telnet, SSH,
- Remote configuration upload/download
- Remote software upload/download
- Syslog
- Remote power reset
- System watchdog
- Dying-gasp
- Management server interface
- Li-ion battery control and monitoring
- SNMP v1, v2 (option)
- 3G/LTE module power reset
- Management via SMS

### Environmental

- Operation Temperature : -20°C ~ 65°C
- Operation Humidity: 0~ 90% non condensing

### Physical

- Dimension: 142(w) x 141(d) x 33(h) mm,
- Weight: max. 640g

### Power Supply Adapter

- Input : 90~240VAC 50/60Hz
- Output : 12VDC 2A

### Power consumption

- Max. 9W

\*To be implemented

## Product Matrix

Model Name		WT702 Series							
		WT7023	WT7023W	WT7024	WT7024W	WT7025	WT7025W	WT702	WT702W
WAN	1x 10/100Base-Tx	O							
LAN	2x 10/100Base-Tx	O							
Serial	2x RS232 & 1x RS485	O							
USB2.0		O							
WLAN	2.4GHz	X	O	X	O	X	O	X	O
Item	3G	O		X					
Mobile	LTE	X		O		X		X	
Item	3G/LTE Dual	X				O		X	
Backup battery		Option							



WT702 series  
3G/LTE M2M Gateway

# JL-514

## LTE Residential Small Cell

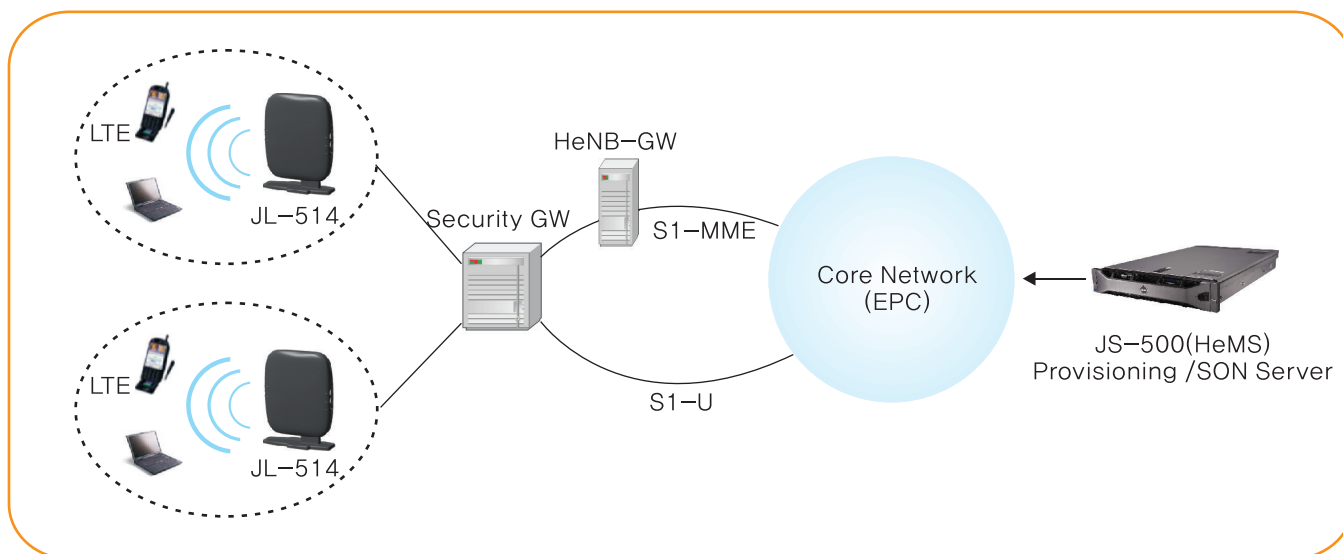
The JL-514 and the In-Building gateway combine to make the LTE Intelligent residential System. This system enables operators to supply LTE coverage and capacity to small venues and residential space. The JL-514 is a compact in size which enables it to easily blend into houses and small venues. Using the JL-514 with In-Building Gateway allows the additional flexibility to a venue or client by allowing LTE devices to connect to local LAN system without complex VPNs or security measures and all non-Internet traffic can stay local to the venue.



JL-514  
LTE Residential Small Cell

### KEY FEATURES

- 8 – 16 Simultaneous Active Users
- 5 / 10 / 15 / 20 MHz Channel Bandwidth
- LTE Single Mode
- 3GPP Release 9 S1-MME/S1-U Interface
- JL-514: 14dBm (25mW) Per Path (17dBm (50mW) with 2x2 MIMO)
- Can be used with existing LANs CAT-5
- Automated Provisioning and Network Integration with JS-500: Provisioning and SON Server



### ■ JL-514 LTE Residential Small Cell (Home Small Cell)

Parameters	JL-514
Frequency Bands	700, 800, 900, 1800, 1900, 2100 or 2600 MHz
Max Output Power	14dBm (25mW) Per Path (17dBm (50mW) with 2x2 MIMO)
Number of Active User	8 – 16 Simultaneous Active Users
Max Throughput	LTE : (DL / UL) 150 / 50 Mbps
RF Antenna	Internal
Ethernet Type	RJ-45 1000 BASE-T
Synchronization	IEEE1588v2 (GPS Optional)
Size / Weight	Size: 5.9 in x 7.9 in x 1.5 in ( 151 mm x 201 mm x 37 mm , W x H x D) Weight: < 0.38 KG ( < 0.84 lb )

### ■ Provisioning and SON

- Optionally support automated provisioning and self-optimization with JS-500 server

### ■ Data Access

- IP protocol LAN over Ethernet, 1000BASE-T

### ■ Standards Compliance

- 3GPP Release 9 S1-MME/S1-U Interface Support

※Specifications subject to change and can be modified for your needs.

# JL-620

## LTE Enterprise Indoor Small Cell

The JL-620 is a LTE Enterprise HeNB System. This product will provide an operator the ability to provide fixed and mobile services to clients in LTE / WiFi dual mode (WiFi Optional). Ideal applications for this product are hotspot applications such as coffee shops and hotels, enterprise internet access and indoor coverage, and campus coverage solutions. JL-620 can be optionally supported automated provisioning and network integration with provisioning and self-optimizing SON server JS-500.

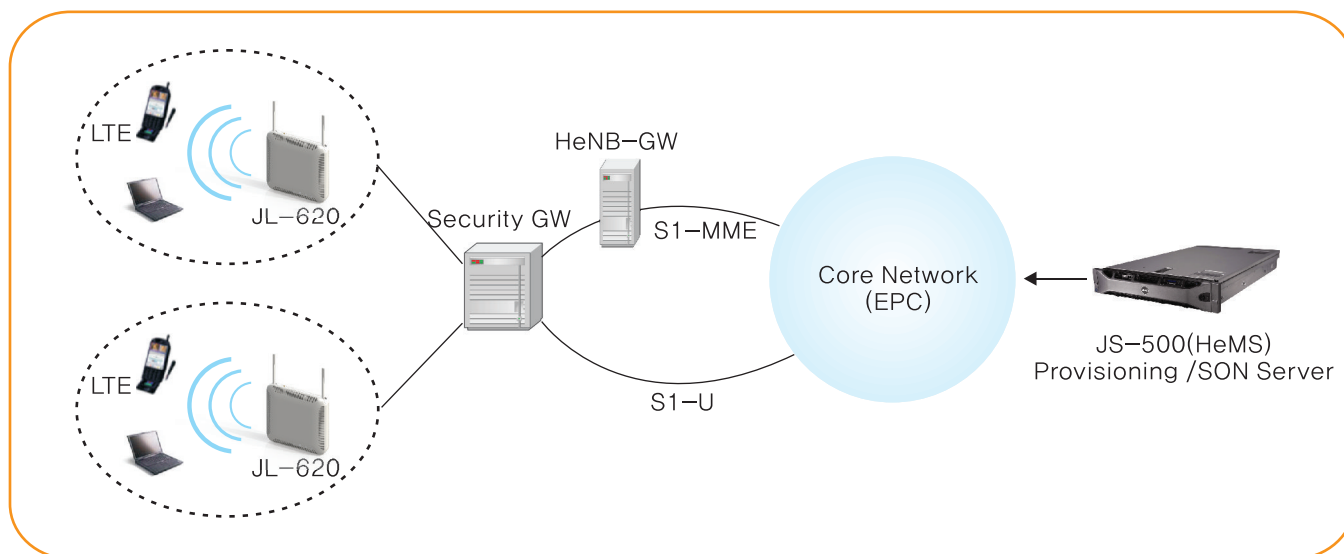


JL-620

32 – 128 Simultaneous Active Users

### KEY FEATURES

- 16 – 32 Simultaneous Active Users
- 3GPP Release 9 S1-MME/S1-U Interface
- PoE+ (Power over Ethernet) Support
- 20dBm (100mW) Per Path  
23dBm (200mW) with 2x2 MIMO
- Max Throughput (DL/UL): 150/50 Mbps
- 5 / 10 / 15 / 20 MHz channel bandwidth
- LTE / WiFi Dual Mode – WiFi Optional
- Automated Provisioning and Network Integration with JS-500:  
Provisioning and SON Server
- Heterogeneous Network





## ■ JL-620 LTE Enterprise Indoor Small Cell

Parameters	JL-620
Frequency Bands	700, 800, 900, 1800, 1900, 2100 or 2600 MHz
Max Output Power	20dBm (100mW) Per Path 23dBm (200mW) with 2x2 MIMO
Number of Active User	16 – 32 Simultaneous Active Users
Max Throughput	LTE : (DL/UL) 150 / 50Mbps
Ethernet Type	RJ-45 1000BASE-T
DC 12 V Support	Yes
Synchronization	IEEE1588v2 (GPS Optional)
PoE Support	PoE+ Support
Power Consumption	< 25W
AC Adaptor	Input: AC 100–240 V, 50–60Hz, Output: 10Vdc ? 22Vdc
Size / Weight	Size: 7.8 in x 8.1 in x 2.0 in ( 200mm x 205mm x 51mm, W x H x D ) Weight: < 1.0 KG ( < 2.2 lb )

### ■ Provisioning and SON

- Optionally support automated provisioning and self-optimization with JS-500 server

### ■ Data Access

- IP protocol LAN over Ethernet, 1000 BASE-T

### ■ Standards Compliance

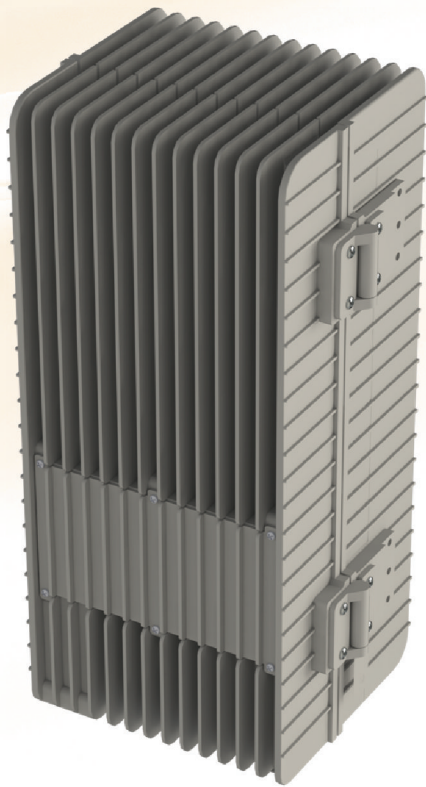
- 3GPP Release 9 S1-MME/S1-U Interface Support

※ Specifications subject to change and can be modified for your needs.

※ Case design can be changed to fit your needs.

# JL-740 LTE Outdoor Small Cell

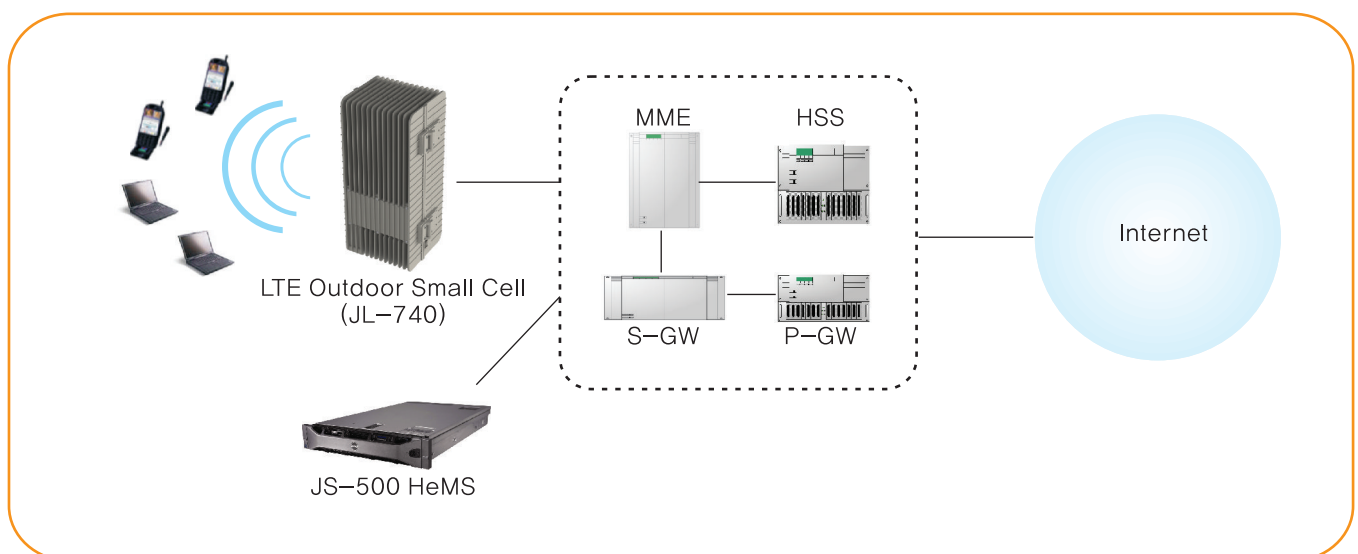
The JL-740 is an ideal alternative to macro deployments for coverage and capacity needs. JL-740 is very compact and light-weight and enables it to be easily assembled. Moreover, it was designed to have outstanding output power of 10 Watts per path (JL-740). The unit works perfectly in conjunction with JS-500 HeMS management / SON server.



JL-740  
(LTE Outdoor Small Cell)

## KEY FEATURES

- 32 – 128 Simultaneous Active Users
- 3GPP Release 9 S1-MME/S1-U Interface
- 5 / 10 / 15 / 20 MHz channel bandwidth
- 40dBm (10W) Per Path  
43dBm (Total 20W with 2x2 MIMO)
- Synchronization: GPS  
(IEEE1588v2 Optional)
- LTE Single Mode
- JS-500 HeMS Management Support
- Heterogeneous Network



## ■ JL-740 LTE Outdoor Small Cell

Parameters	JL-740
Frequency Bands	700, 800, 900, 1800, 1900, 2100 or 2600MHz
Max Output Power	40dBm (10W) Per Path 43dBm (20W) with 2x2 MIMO
Number of Active User	32 – 128 Simultaneous Active Users
Max Throughput	LTE : (DL / UL) 150 / 50 Mbps
RF Antenna	External N-Type
Backhaul Type	Fiber Optic and RJ-45 1000BASE-T
Power	110~240 VAC, 50~60Hz, -48 VDC (optional)
Synchronization	GPS IEEE1588v2 Optional
Size / Weight	Size: 8.3 in x 17.3 in x 6.9 in ( 210mm x 440mm x 175mm, W x H x D ) Weight: < 15 KG ( < 33.1 lb )

## ■ Provisioning and SON

- Optionally support automated provisioning and self-optimization with JS-500 server


## ■ Data Access

- IP protocol LAN over Ethernet( 1000BASE-T)

## ■ Standards Compliance

- 3GPP Release 9 S1-MME/S1-U Interface Support

※ Specifications subject to change and can be modified for your needs.

A close-up photograph of a hand holding a silver and black pen, positioned vertically. The hand is in sharp focus, while the background is a soft, out-of-focus bokeh of warm, golden-yellow and orange tones.

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