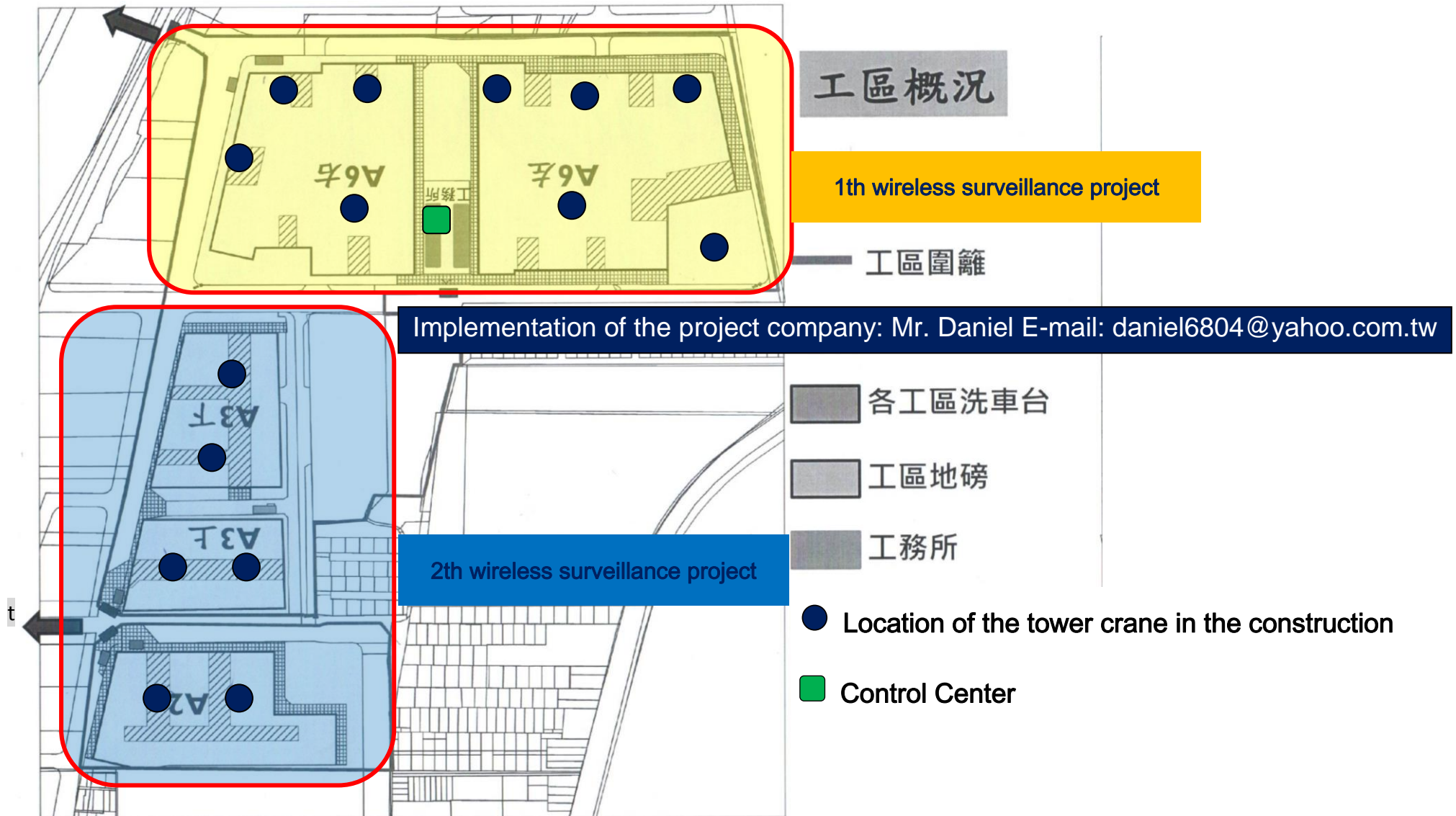




# Construction Site High-tower Crane Wireless Surveillance Multiple Hops Transmission System

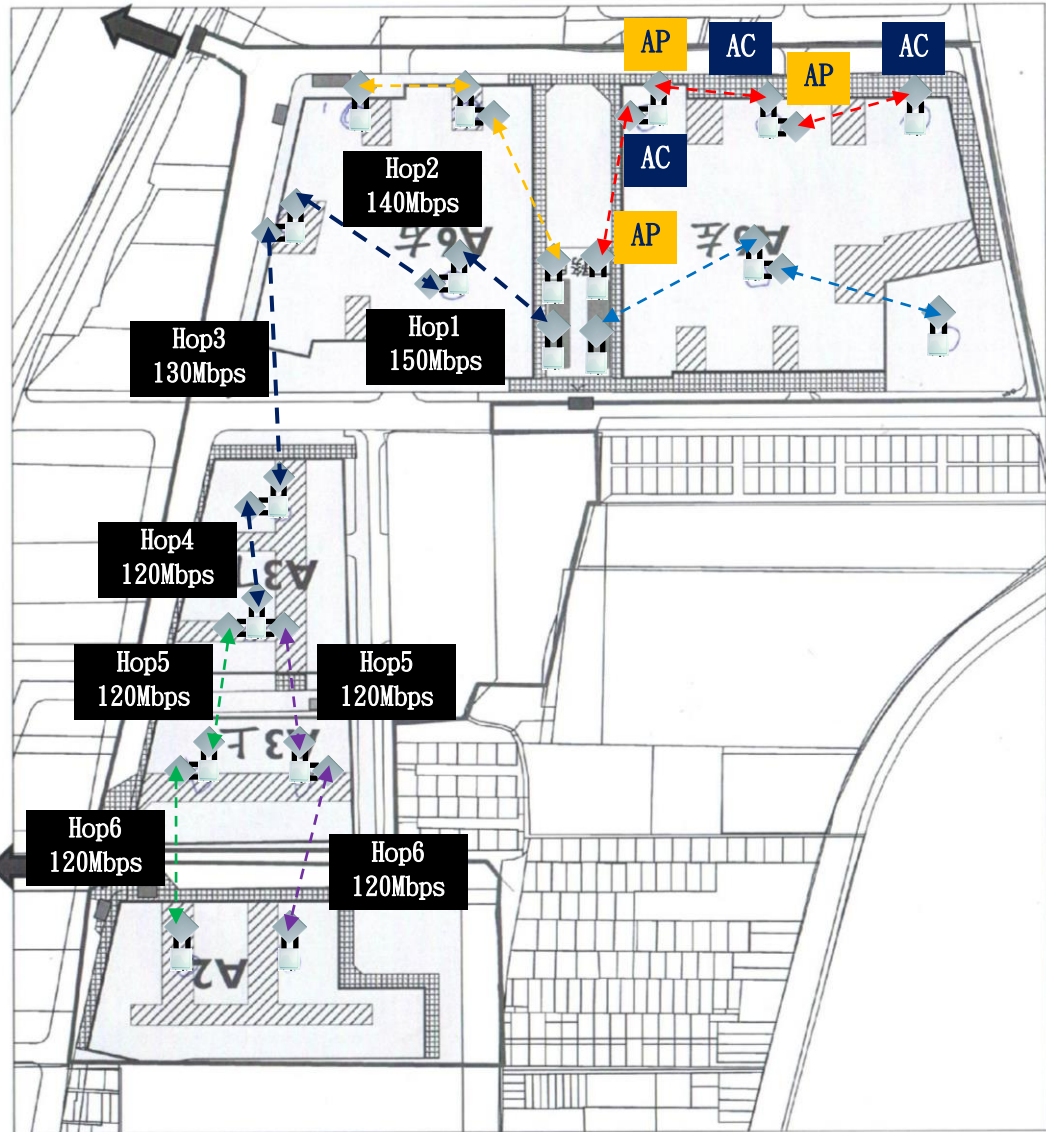
## 1、 Location of tower crane (Large-scale construction in Taiwan)





## 2、The design of tower crane wireless transmission in construction

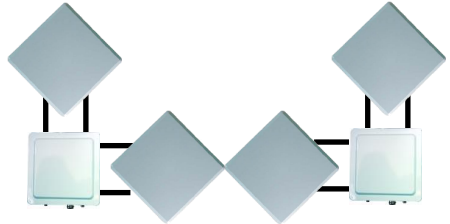
AC=AP Client=Client side  
 AP=Access Point=Receive side



### 工區概況

- 工區圍籬
- 各工區出入大門
- 各工區洗車台
- 工區地磅
- 工務所

Outdoor wireless AP  
 Type: APM-101R (1RF)  
 Antenna: MIMO 5GHz 20dBi  
 Bandwidth/Distance: 150Mbps/5Km



Outdoor wireless AP  
 Type: APM-102R (2RF)  
 Antenna: MIMO 5GHz 20dBi  
 Bandwidth/Distance: 300Mbps/5Km

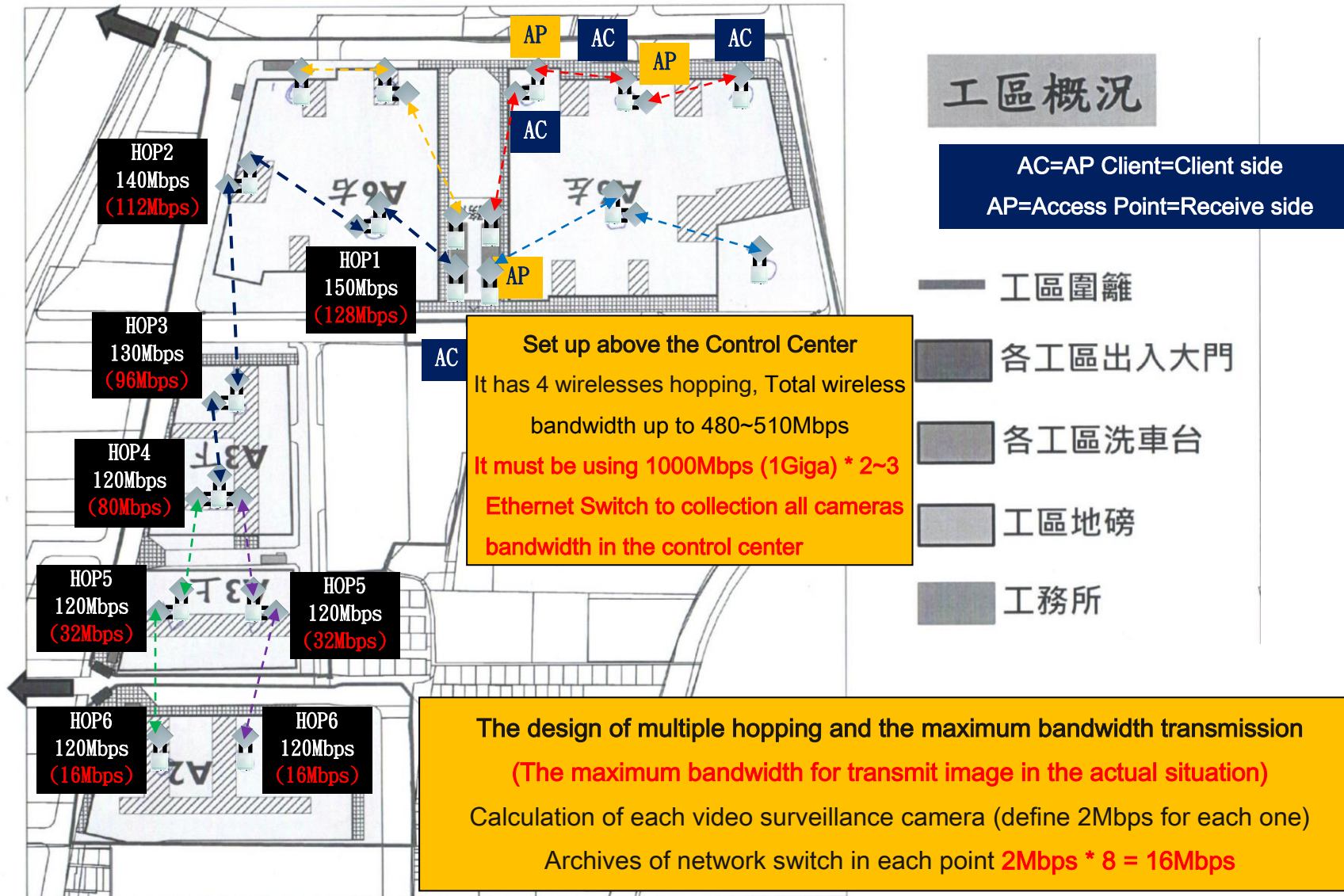


Outdoor wireless AP  
 Type: APM-103R (3RF)  
 Antenna: MIMO 5GHz 20dBi  
 Bandwidth/Distance: 350Mbps/5Km



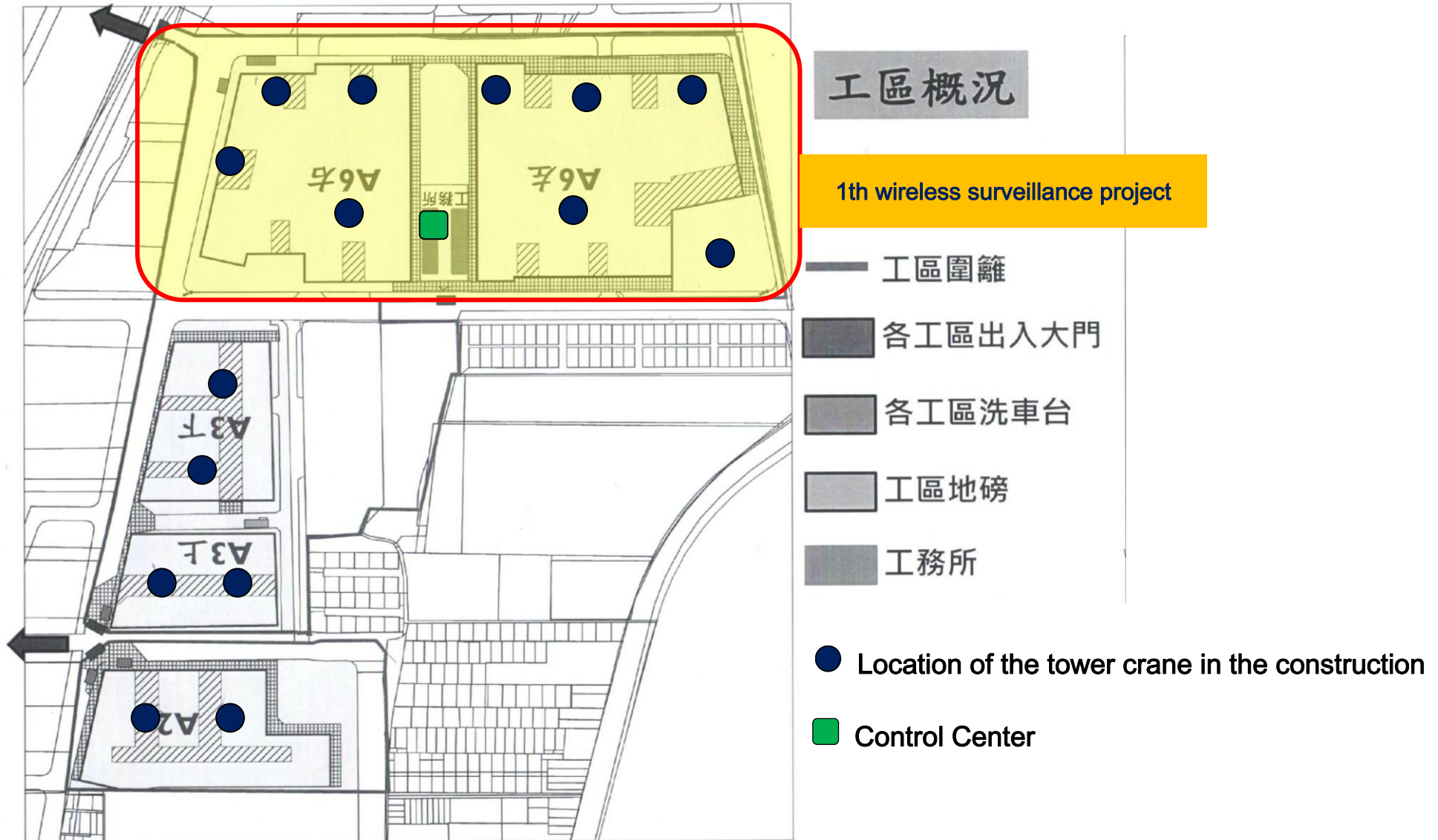


### 3、 The design of wireless surveillance transmission system applied to the camera image transmission.





#### 4、Picture of construction (1th wireless surveillance project: Construction in Taiwan A6East, A6West)





#### 4-1. Tower crane: Tower B equipment set up



#### 4-2 Tower crane: Tower H equipment set up

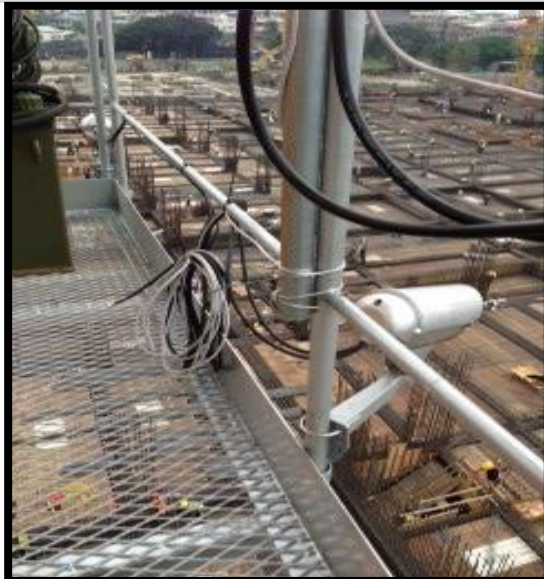




### 4-3. Tower crane: Tower J equipment set up



### 4-4. Tower crane: Tower C equipment set up





#### 4-5. Tower crane: Tower Q equipment set up



#### 4-6. Tower crane :Tower O equipment set up





#### 4-7. Tower crane: Tower R equipment set up



Remote live screen images  
from the control center

#### 4-8. Tower crane: Tower V equipment set up



Remote live screen images  
from the control center




#### 4-9. Tower crane: Tower N equipment set up











## 5、 Installation Devices and Quantity

1th project A6 left & A6 right Wireless Surveillance Transmission System					
No.	Device Name	Device Model	Main SPEC	Quantity	Remark
1	Wireless WiFi MIMO AP  -(Camera Side)	APM-101R (1 Module)  	<ol style="list-style-type: none"> <li>1. One MIMO 2*2 RF Module (802.11a/g/n)</li> <li>2. System Operation Mode: Bridge</li> <li>3. Output Power : 21dBm (Max)</li> <li>4. Multiple Hops</li> <li>5. Bandwidth Throughput : 160Mbps (@40MHz)</li> <li>6. &gt;= 4Hops Throughput 120Mbps</li> </ol>	7	
2	Wireless WiFi MIMO AP  -(Bridge Hops Side)  -(Control Center Side)	APM-102R (2 Modules)  	<ol style="list-style-type: none"> <li>1. Two MIMO 2*2 RF Module (802.11a/g/n)</li> <li>2. System Operation Mode: Bridge</li> <li>3. Output Power : 21dBm (Max)</li> <li>4. Multiple Hops</li> <li>5. Bandwidth Throughput : 320Mbps (@40MHz)</li> <li>6. &gt;= 4Hops Throughput 120Mbps</li> </ol>	6	
3	Outdoor WiFi MIMO 5GHz  20dBi Dual Linear Panel Antenna	IOP-PANFO-5M2001010  	<ol style="list-style-type: none"> <li>1. Frequency: 5150 - 5875 MHz</li> <li>2. Gain: 20dBi</li> <li>3. VSWR: 2:1</li> <li>4. Polarization : Dual Linear +/- 45°</li> <li>5. N-Type Jack * 2</li> </ol>	19	
4	Antenna RF Cable	IOP-RFCFD-400150NMR	<ol style="list-style-type: none"> <li>1. Connector: N-type Plug to N-type Plug</li> <li>2. Cable Loss: &lt;48dB/100m @5800MHz</li> <li>3. Temp: - 40 ~ + 85°C</li> </ol>	38	





			4. Length: 1.5M		
5	RF Connector Rainproof Tape	IOP-RMTOC-173830510B 	1. Thickness: 1.7mm ± 0.5mm 2. Elongation: 1000% 3. Adhesion: Detachment < 2cm 4. Breaking Strength: >2kg 5. Water Absorption: <0.2%	15	

### 1th project A3 Down & A3 Up & A2 Wireless Surveillance Transmission System













No.	Device Name	Device Model	Main SPEC	Quantity	Remark
1	Wireless WiFi MIMO AP -(Camera Side)	APM-101R (1 Module) 	1. One MIMO 2*2 RF Module (802.11a/g/n) 2. System Operation Mode: Bridge 3. Output Power : 21dBm (Max) 4. Multiple Hops 5. Bandwidth Throughput : 160Mbps (@40MHz) 6. >= 4Hops Throughput 120Mbps	2	
2	Wireless WiFi MIMO AP -(Bridge Hops Side) -(Control Center Side)	APM-102R (2 Modules) 	1. Two MIMO 2*2 RF Module (802.11a/g/n) 2. System Operation Mode: Bridge 3. Output Power : 21dBm (Max) 4. Multiple Hops 5. Bandwidth Throughput : 320Mbps (@40MHz) 6. >= 4Hops Throughput 120Mbps	3	



3	Wireless WiFi MIMO AP  -(Bridge Hops Side)	APM-103R (3 Modules)  	<ol style="list-style-type: none"> <li>1. Three MIMO 2*2 RF Module (802.11a/g/n)</li> <li>2. System Operation Mode: Bridge</li> <li>3. Output Power : 21dBm (Max)</li> <li>4. Multiple Hops</li> <li>5. Bandwidth Throughput : 320Mbps (@40MHz)</li> <li>6. &gt;= 4Hops Throughput 120Mbps</li> </ol>	1	
4	Outdoor WiFi MIMO 5GHz  20dBi Dual Linear Panel Antenna	IOP-PANFO-5M2001010  	<ol style="list-style-type: none"> <li>1. Frequency: 5150 - 5875 MHz</li> <li>2. Gain: 20dBi</li> <li>3. VSWR: 2:1</li> <li>4. Polarization : Dual Linear +/- 45°</li> <li>5. N-Type Jack * 2</li> </ol>	11	
5	Antenna RF Cable	IOP-RFCFD-400150NMR  	<ol style="list-style-type: none"> <li>1. Connector: N-type Plug to N-type Plug</li> <li>2. Cable Loss: &lt;48dB/100m @5800MHz</li> <li>3. Temp: - 40 ~ + 85°C</li> <li>4. Length: 1.5M</li> </ol>	22	
6	RF Connector Rainproof  Tape	IOP-RMTOC-173830510B  	<ol style="list-style-type: none"> <li>1. Thickness: 1.7mm ± 0.5mm</li> <li>2. Elongation: 1000%</li> <li>3. Adhesion: Detachment &lt; 2cm</li> <li>4. Breaking Strength: &gt;2kg</li> <li>5. Water Absorption: &lt;0.2%</li> </ol>	8	



## 6、 Device Model and SPEC

	Model	APM-101R (H)	APM-102R (H)	APM-103R (H)
<b>Product Images</b>	<b>Rear Side</b>			
	<b>Top of Antenna Connector</b>			
	<b>Below of Antenna Connector</b>			
	<b>Front Side</b>			





## Product Specifications

### Hardware Specification

Key Components	
Main Processor	Atheros AR7161(680Mhz)
Wireless Chipset	Atheros AR9220 based miniPCI module, Up to three modules
Switch Controller	Atheros AR8035 / Atheros AR8021
Flash Memory	16MBytes
SDRAM	64MBytes(Up to 128MBytes)
Console	UART x 1(PCBA onboard)

Interfaces	
Wireless	Up to three 2x2 MIMO radios, mini-PCI version 1.0 type 3A Frequency ranges : a. USA : 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.5 ~ 5.7 GHz, 5.725 ~ 5.825 GHz b. Europe: 2.400 ~ 2.483 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz



c. Japan: 2.400 ~ 2.497 GHz, 5.15 ~ 5.35 GHz, 5.47 ~ 5.725 GHz

d. China: 2.400 ~ 2.483 GHz, 5.725 ~ 5.85 GHz

RF output power of DNMA-92 :

a. IEEE802.11a

1. 21dBm@6M(all) 17dBm@54M(5180MHz) 16dBm@54M(5825MHz)

b. IEEE802.11b

1. 20dBm@1M(2412MHz) 19dBm@1M(2484MHz) 21dBm@11M(all)

c. IEEE802.11g

1. 23dBm@6M(all) 19dBm@54M(all)

d. IEEE802.11a/n HT20

1. 21dBm@MCS0/8(5180MHz) 19dBm@MCS0/8(5825MHz)

2. 16dBm@MCS7/15(5180MHz) 14dBm@MCS7/15(5825MHz)

e. IEEE802.11a/n HT40

1. 19dBm@MCS0/8(5190MHz) 18dBm@MCS0/8(5795MHz) 13dBm@MCS7/15(all)

f. IEEE802.11g/n HT20

1. 21dBm@MCS0/8(all) 17dBm@MCS7/15(all)

g. IEEE802.11g/n HT40

1. 21dBm@MCS0/8(2422MHz) 20dBm@MCS0/8(2462MHz)



	<p>2. 16dBm@MCS7/15(all)</p> <p>Receive Sensitivity of DNMA-92 :</p> <p>a. IEEE802.11a</p> <p>1. -82dBm@6M, 1Rx    -95/-91dBm@6M, 2Rx    2. -65dBm@54M, 1Rx    -79/-75dBm@54M, 2Rx</p> <p>b. IEEE802.11b</p> <p>1. -82dBm@1M, 1Rx    -95/-91dBm@1M, 2Rx    2. -76dBm@11M, 1Rx    -91/-87dBm@11M, 2Rx</p> <p>c. IEEE802.11g</p> <p>1. -82dBm@6M, 1Rx    -95/-91dBm@6M, 2Rx    2. -65dBm@54M, 1Rx    -80/-76dBm@54M, 2Rx</p> <p>d. IEEE802.11a/n HT20</p> <p>1. -82dBm@MCS0, 1Rx    -95/-91dBm@MCS0, 2Rx    2. -64dBm@MCS7, 1Rx    -77/-73dBm@MCS7, 2Rx</p> <p>e. IEEE802.11a/n HT40</p> <p>1. -79dBm@MCS0, 1Rx    -91/-87dBm@MCS0, 2Rx    2. -61dBm@MCS7, 1Rx    -74/-70dBm@MCS7, 2Rx</p> <p>f. IEEE802.11g/n HT20</p> <p>1. -82dBm@MCS0, 1Rx    -95/-91dBm@MCS0, 2Rx    2. -64dBm@MCS7, 1Rx    -77/-73dBm@MCS7, 2Rx</p> <p>g. IEEE802.11g/n HT40</p> <p>1. -79dBm@MCS0, 1Rx    -90/-86dBm@MCS0, 2Rx    2. -61dBm@MCS7, 1Rx    -74/-71dBm@MCS7, 2Rx</p>
Ethernet	<p>10/100/1000 Base-TX MDI/MDIX RJ-45 x 1</p> <p>Compliant with :</p>



	a. IEEE802.3 / 802.3u / 802.3at Hardware based 10/100/1000, full/half, flow control auto negotiation
Connector	101R 2 x N-type(1 radio) 102R 4 x N-type(2 radios) 103R 6 x N-type(3 radios)
Power Requirement	48V 1A PoE Support Gigabit Ethernet Link
Watch Dog	Hardware Watch Dog

Physical	
Dimensions	220 x 220 x 77 mm
Weight	101R/101RH—1.8Kg 102R/102RH—1.9Kg 103R/103RH—2.0Kg 2.0kg (3.7kg mount kit included)

Environmental	
Temperature Range	-20°C~70°C





Humidity	0% ~ 95% Non-condensing
Storage	-40~ 85°C
Dusty & Waterproof	Outdoor IP67 rated

Regulatory	
Certification	FCC, CE Processing (will announce in 2012/1)
Safety	Processing

### Software Specification

System Operation	
Bridge Mode	Layer 2 Switching Learning Technology
	Store-and-Forward
	Spanning Tree Protocol - IEEE 802.1d STP / IEEE 802.1w RSTP / IEEE 802.1s MSTP
	Static IP / Dynamic IP
	DHCP server / client



	Multicast / Broadcast Storm Limitation
	IEEE 802.1q Tag VLAN
	IEEE 802.1p VLAN Priority Based QoS

## Network Interface

Wireless	IEEE 802.11 a/b/g/n 2.4GHz / 5GHz Dual Band Radio
	2 x 2 MIMO Technology
	Single Radio / Dual Radios / Triple Radios
	AP mode / Client mode / WDS mode
	IEEE 802.11h DFS
	WMM QoS
	Channel / Tx Power / Data Rate / Max Distance Adjustable
	Advanced Wireless Parameters Adjustable



	Multi-SSIDs / VLAN tags mapping(Up to 16 x ESSIDs for each radio)
	Wireless Site Survey
	Node Information
	Concurrent Connected Node Limitation
	Client User Isolation
Wire	48V 1A PoE Support Gigabit Ethernet Speed
	Ethernet Link Speed Configurable
	10/100/1000 Base-TX MDI/MDIX RJ-45

Performance		
Wireless	TCP	Up to 180Mbps for one radio to Ethernet
To		Up to 320Mbps for two radios to Ethernet
Wire		Up to 320Mbps for three radios to Ethernet



	UDP	Up to 240Mbps for one radio to Ethernet
		Up to 350Mbps for two radios to Ethernet
		Up to 350Mbps for three radios to Ethernet
	PPS	>= 20,000@short packet for one radio to Ethernet
		>= 28,000@short packet for two radios to Ethernet
		>= 28,000@short packet for three radios to Ethernet
Latency	< 5ms	
Multiple Hops	2 hops	Up to 160Mbps
	3 hops	Up to 150Mbps
	>= 4hops	Up to 140Mbps
	PPS	>= 20,000@short packet at multiple hops
	Latency	< 10ms



## Security

Hide SSID(turn off ESSID broadcasting)

MAC Address ACL

WEP 64/128/152 bits

IEEE 802.1x EAP-MD5 / EAP-TLS / EAP-TTLS

WPA / WPA2 PSK / EAP with TKIP / CCMP AES based Encryption

## Management

HTTP(s) WEB GUI

Telnet

SSH

Console(optional interface)

CLI commands

SNMP v2c/v3, standard / private MIBs



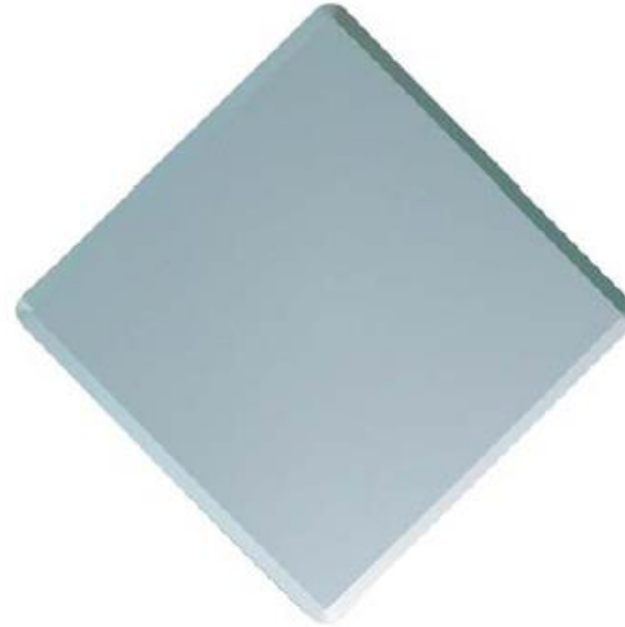
Syslog
Management VLAN Tag
NTP Client
Firmware upgrade / downgrade
Dual Images
Dual Configuration files / Factory Default
Multiple Level Management

Advanced Technology	
Multiple Hopping	Up to 10 hops with more than 120Mbps throughput
	Configurable Max. Hop Counts(default 20 hops)



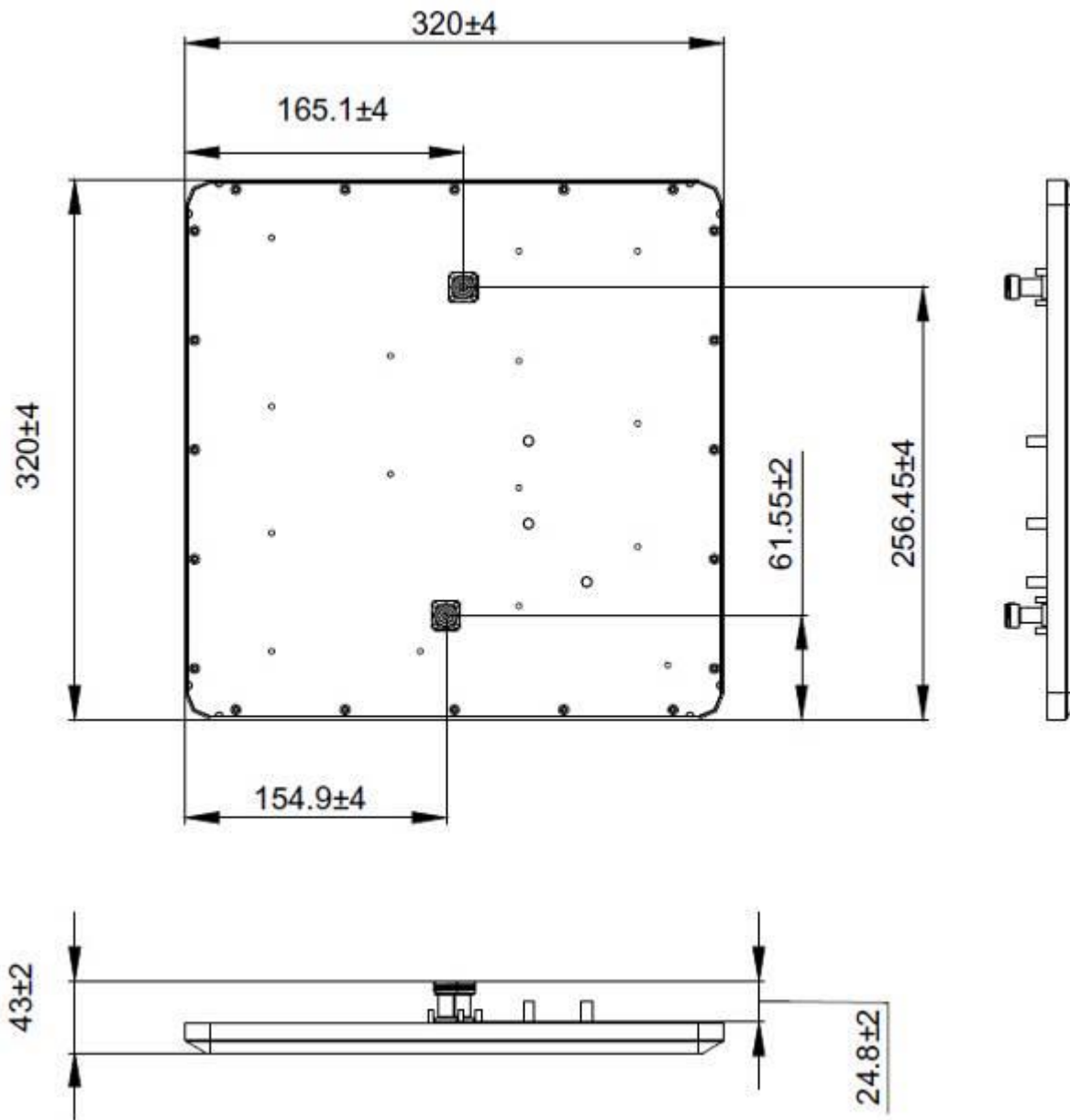
## 5GHz 20dBi Dual Polarization MIMO Panel Antenna

Electrical Specification	
Frequency range	5150 - 5875 MHz
Gain	20 dBi
VSWR	2 : 1 Max.
Polarization	Dual Linear, +/- 45°
HPBW / Horizontal	10°
HPBW / Vertical	10°
Standard compliance	N / A
Front to back ratio	-30dB (Max)
Isolation	24dB (Min)
Power handing	6W (cw)
Impedance	50 Ohms





Connector	N Jack × 2
<b>Environmental &amp; Mechanical Characteristics</b>	
Survival wind speed	216Km/hr
Temperature	-40°C to +80°C
Humidity	95% @ 55°C
Lightning protection	DC ground
Radome color	Gray
Radome material	PC, UV resistant
Weight	1245g
Dimensions	320 × 320 × 20 mm
Waterproof	IP-67
Mounting kit	Pole mount & Wall mount

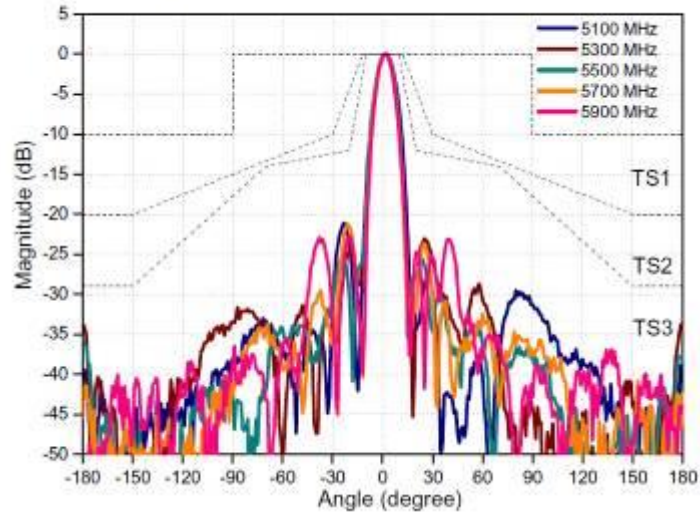




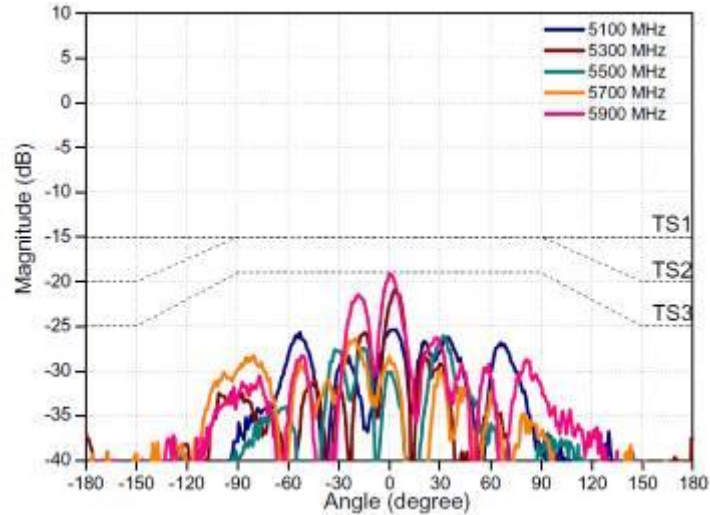


## Port 1

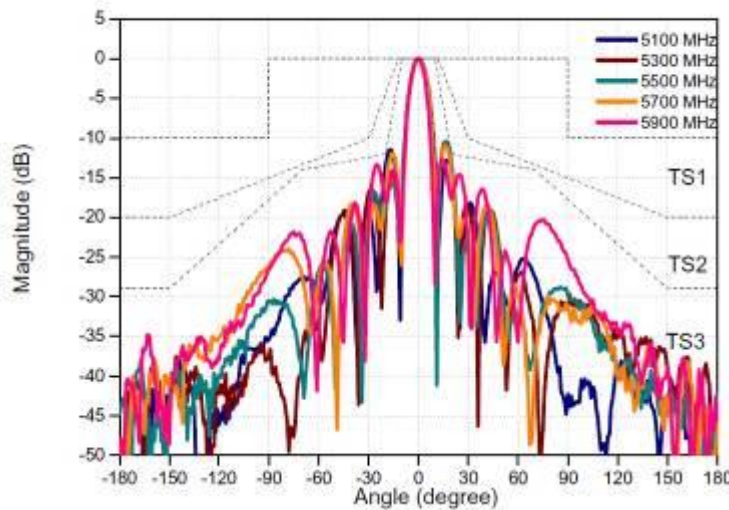
### V-plane Co-polarization Pattern



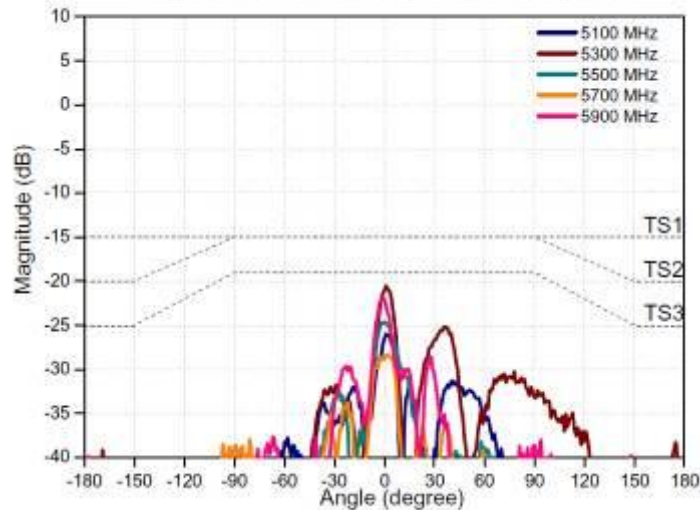
### V-plane Cross-polarization Pattern



### H-plane Co-polarization Pattern



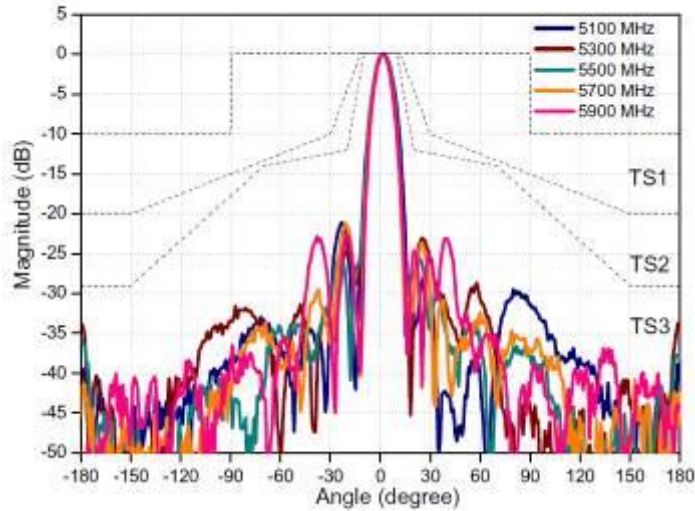
### H-plane Cross-polarization Pattern



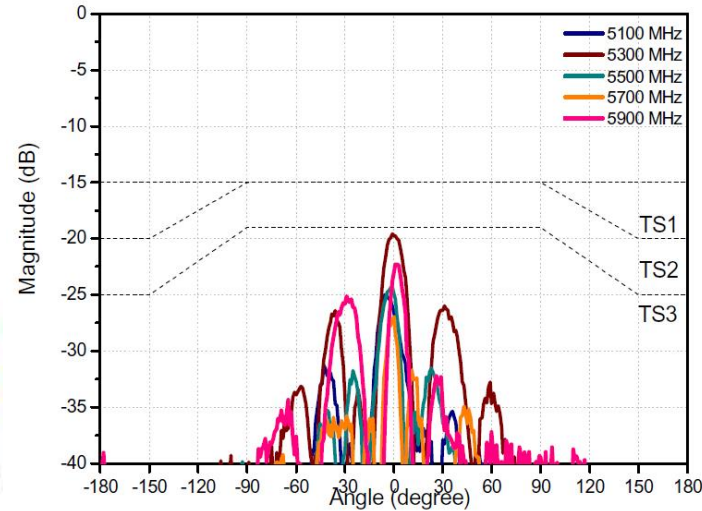


## Port 2

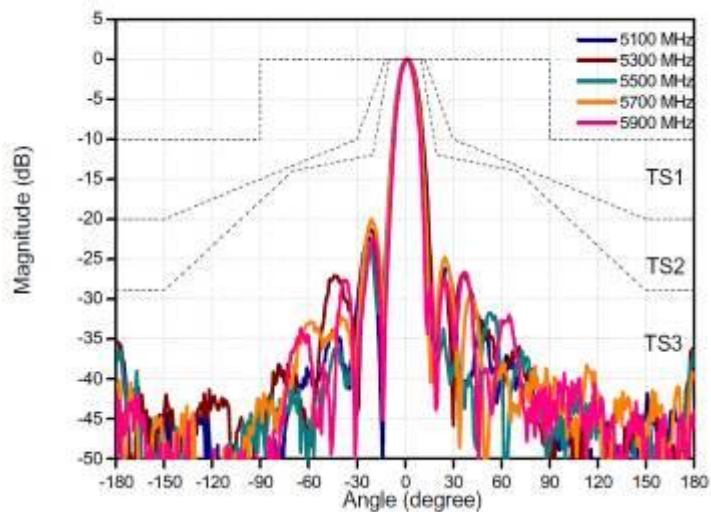
### V-plane Co-polarization Pattern



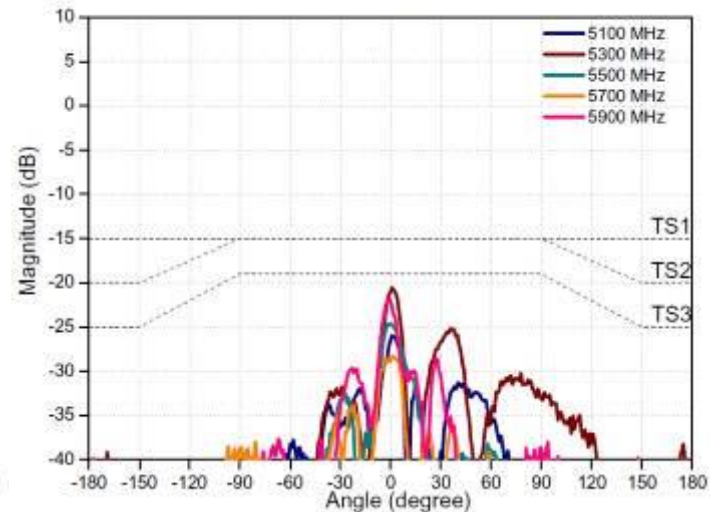
### V-plane Cross-polarization Pattern



### H-plane Co-polarization Pattern



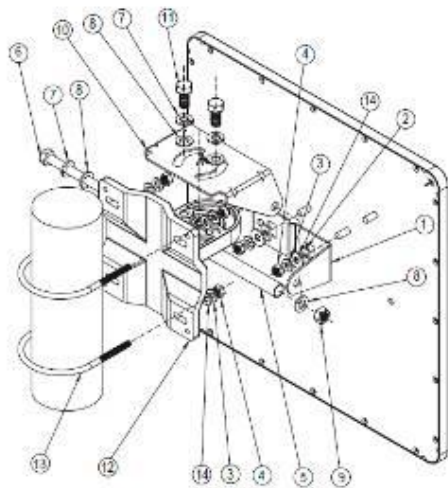
### H-plane Cross-polarization Pattern



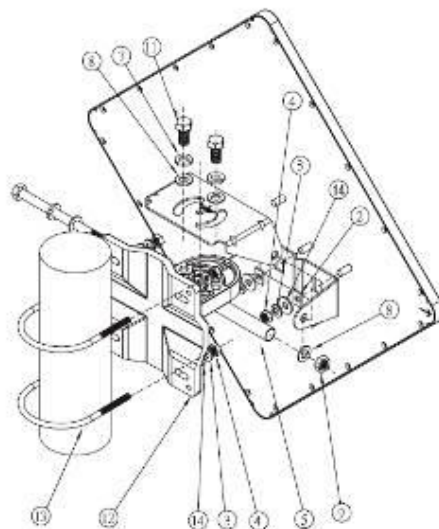


## Pole Mount

Slant+45 Degree Polarization



Hor. & Ver. Polarization

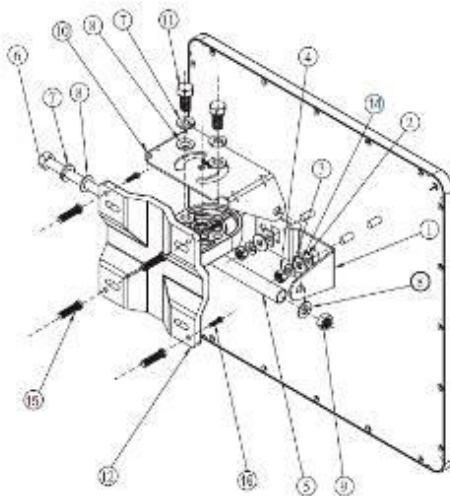


- |                       |      |
|-----------------------|------|
| 1. M-Type breaket (L) | 1Pcs |
| 2. Space Keeper       | 2Pcs |
| 3. Spaing washer      | 6Pcs |
| 4. M6-1.0 Nut         | 6Pcs |
| 5. Steel tube 93.2 mm | 1Pcs |
| 6. XHM8-1.25*120      | 1Pcs |
| 7. M8 spring washer   | 3Pcs |
| 8. M8 washer          | 4Pcs |
| 9. M8 Nut             | 1Pcs |

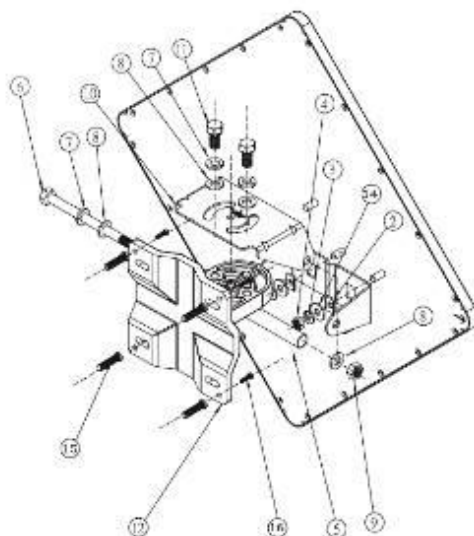
- |                        |      |
|------------------------|------|
| 10. Rotating bracket   | 1Pcs |
| 11. XHM8-1.25*20       | 2Pcs |
| 12. Mounting main fram | 1Pcs |
| 13. U-Type Screw       | 2Pcs |
| 14. M6 washer          | 6Pcs |
| 15. Wall Tiger         | 4Pcs |
| 16. TH 5/32-16*1"      | 4Pcs |

## Wall Mount

Slant+45 Degree Polarization



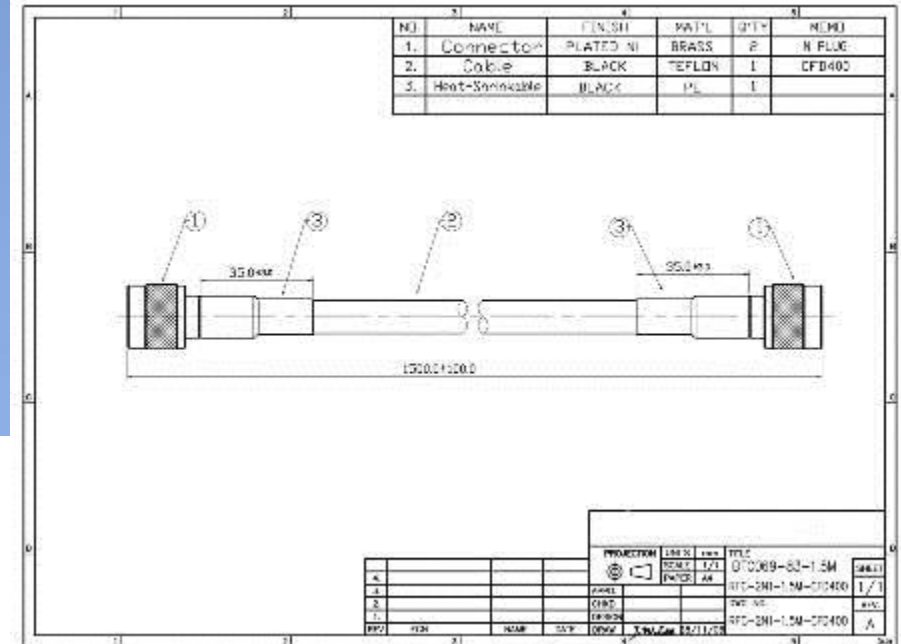
Hor. & Ver. Polarization





# IOP-RFCFD-400150NMR

## CFD-400 N-Type 1.5M Antenna RF Cable





CFD-400 RF Cable SPEC

Standard: CFD400 (CFD400-E) CABLE 1/2.74MM X 1C

CONSTRUCTION:

ITEM	UNIT	2.74MM
No. of Wire	P·C	1C
1) Conductor	Material	Copper Clad Aluminium
	Size	No./mm 1/2.74
2) Insulation	Material	PEF
	Thickness	mm (NOM.) 2.2
	O.D	mm (NOM.) 7.24
3) Binder		Scaled Aluminum Mylar Tape
4) Braid Shield	Material	Tinned Copper Wire
	Coverage	% 85% ↑
5) Jacket	Material	PVC or PE
	O.D	mm 10.3±0.25

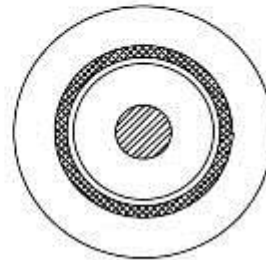
MECHANICAL PROPERTIES:

ITEM	UNIT	
Minimum Bend Radius	mm	25.4
Weight	kG/m	0.1
Tensile strength	kG	72.6
Operating temperature	°C	-40/85

ELECTRICAL PROPERTIES (20°C):

ITEM	UNIT	
Conductor Resistance	Ω/Km	1.67
Impedance	Ω	(NOM.) 50
Capacitance	PF/FT	(NOM.) 23.9
Velocity of propagation	%	(NOM.) 85
DC resistance, inner cond.	Ω/Km	4.56
DC resistance, outer cond.	Ω/Km	5.41
Shielding effectiveness	dB	≥ 90

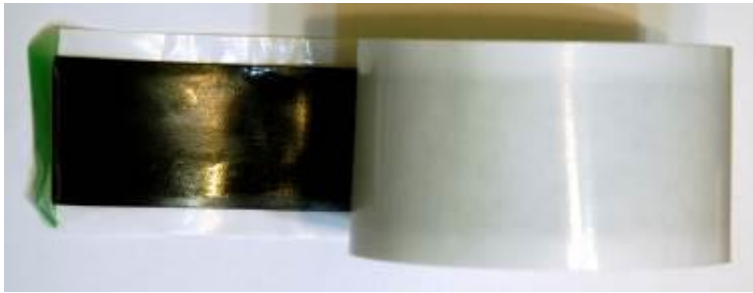
Attenuation (nom.)	
MHz	dB/100ft
30	0.7
50	0.9
150	1.5
450	2.7
900	3.9
1500	5.1
2000	6.0
2500	6.8
5800	10.8





# IOP-RMTOC-173830510B

## Self-Bonding Rainproof Insulating Tape SPEC





## Applicable

- ⊙ The electric insulation of bus under 1000V.
- ⊙ The insulation and waterproof treatment of the cable connector under 1000V.
- ⊙ The waterproof, erosion-resist coating treatment of the T shape or irregular type connector on high/low voltage bus.
- ⊙ The waterproof treatment of the high voltage cable direct circuit connector.
- ⊙ The waterproof treatment of the L shape connector.
- ⊙ The general operation temperature is kept at 90°C, but under emergency the temperature may go up to 130°C for 100 hours.
- ⊙ The coating treatment of the suspending cable.

## Operation Explain

