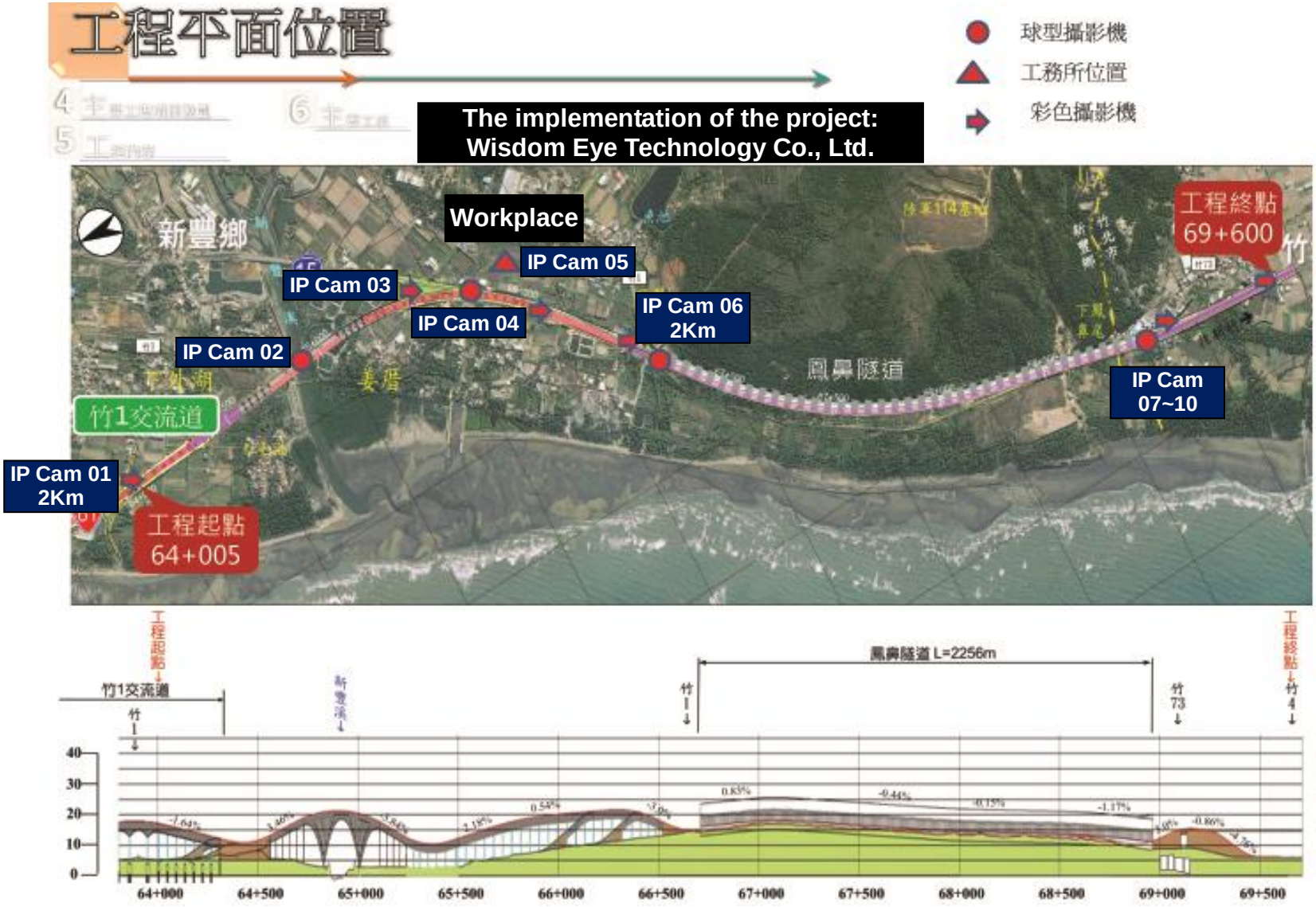
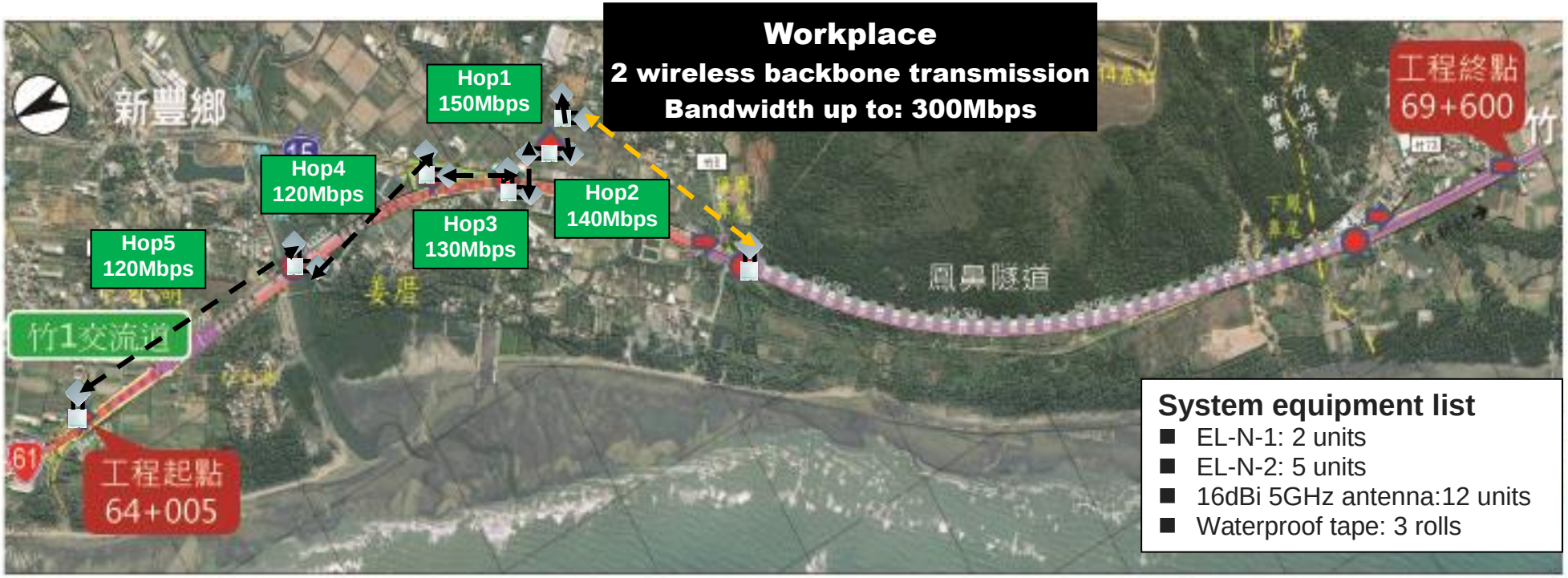
Xi-Bin Expressway Elevated Engineering PTP Mesh Wireless Monitoring Transmission System Case Study



1. "Xi-Bin Expressway Elevated Project" wireless monitoring transmission-PTP Mesh multi-point hops platform backbones transmission system design



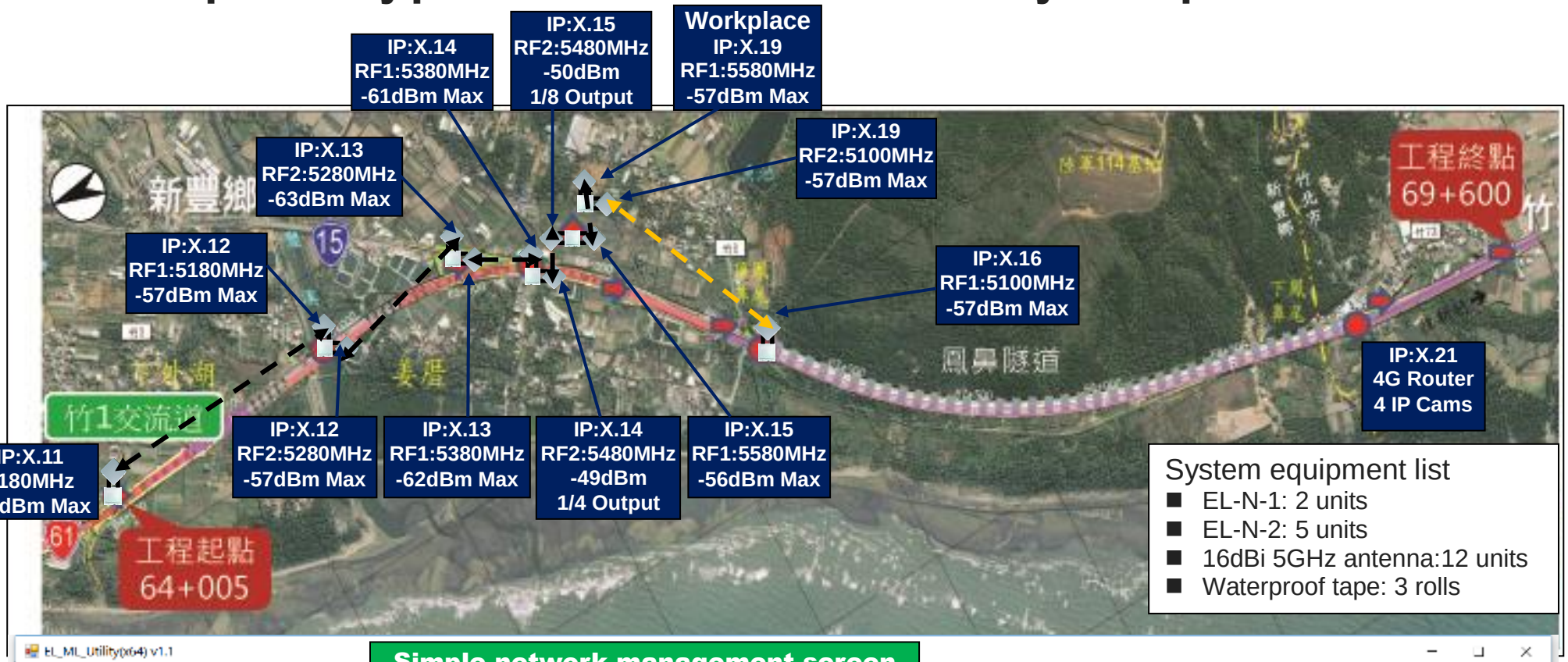
PTP Mesh loop backup system

Wired or wireless can form a loop, the system will automatically determine the disconnect point and repair connection point

Hop once, about to reduce the 5-10Mbps, continuous hop platform 12 times, still maintain bandwidth 100Mbps above

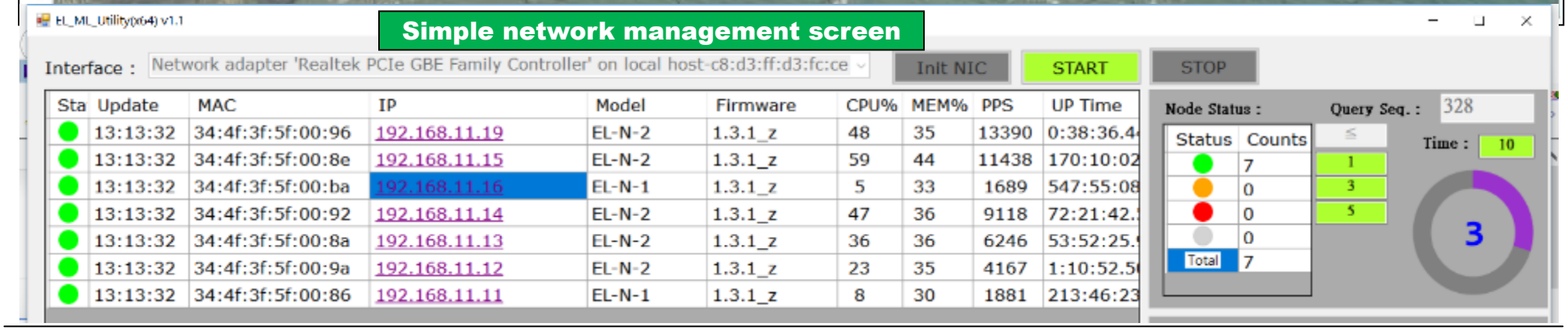
Each hop jump once, delay about 1ms, every 3 hops will increase after 3ms

2. "Xi-Bin Expressway Elevated Project" wireless monitoring and transmission - PTP Mesh multi-point relay platform Backbone transmission system operation



System equipment list
- EL-N-1: 2 units
- EL-N-2: 5 units
- 16dBi 5GHz antenna:12 units
- Waterproof tape: 3 rolls

Simple network management screen



Sta	Update	MAC	IP	Model	Firmware	CPU%	MEM%	PPS	UP Time
	13:13:32	34:4f:3f:5f:00:96	192.168.11.19	EL-N-2	1.3.1_z	48	35	13390	0:38:36.4
	13:13:32	34:4f:3f:5f:00:8e	192.168.11.15	EL-N-2	1.3.1_z	59	44	11438	170:10:02
	13:13:32	34:4f:3f:5f:00:ba	192.168.11.16	EL-N-1	1.3.1_z	5	33	1689	547:55:08
	13:13:32	34:4f:3f:5f:00:92	192.168.11.14	EL-N-2	1.3.1_z	47	36	9118	72:21:42.3
	13:13:32	34:4f:3f:5f:00:8a	192.168.11.13	EL-N-2	1.3.1_z	36	36	6246	53:52:25.9
	13:13:32	34:4f:3f:5f:00:9a	192.168.11.12	EL-N-2	1.3.1_z	23	35	4167	1:10:52.5
	13:13:32	34:4f:3f:5f:00:86	192.168.11.11	EL-N-1	1.3.1_z	8	30	1881	213:46:23

3. "Xi-Bin Expressway Elevated Project" wireless monitoring transmission -PTP Mesh multi-point relay trunk Backbone transmission system operating photos

■ Wireless transmission system erection photos and the corresponding location IP

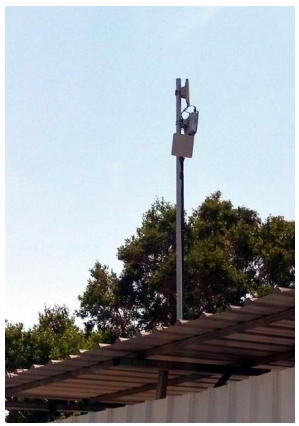

IP:X.11


IP:X.12


IP:X.13

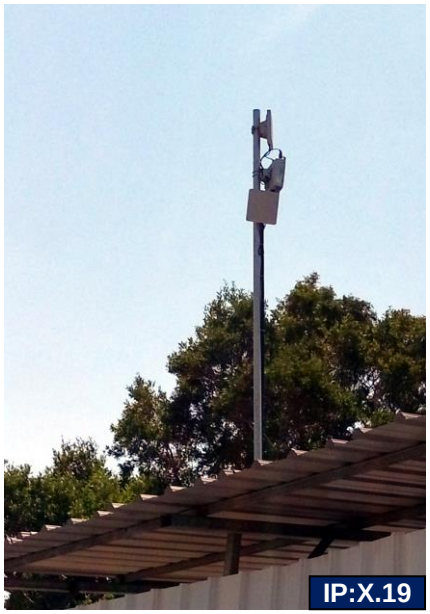

IP:X.14


IP:X.15


IP:X.19


IP:X.16

■ Wireless transmission system erection site environment and video collection



4. Wireless monitoring transmission system transmission rain signal attenuation formula

■ **Set the 2Km rain attenuation value of 5GHz wireless transmission to 100mm/hr rainfall calculation.**

2.4 ~ 2.485GHz & 5.25 ~ 5.85GHz (Rain Attenuation) Estimated unit：dB

PtP		2.4GHz ~ 2.485GHz Frequency						5GHz ~ 5.85GHz Frequency					
Rainfall Rate		100mm/hr			200mm/hr			100mm/hr			200mm/hr		
Km	EPD/Km	2.4	2.45	2.485	2.4	2.45	2.485	5.25	5.5	5.85	5.25	5.5	5.85
1	0.64	0.06	0.07	0.07	0.15	0.16	0.16	0.41	0.46	0.53	0.96	1.07	1.23
2	1.25	0.12	0.13	0.13	0.29	0.3	0.31	0.8	0.89	1.03	1.86	2.07	2.39

Note 1: Based on the practical experience of Taiwan's environment, the 5GHz wireless rain attenuation of 5km in typhoon days is within 2dB, and the wireless transmission rain attenuation of 30km in 88 strong typhoons is about 2dB. The measured results only affect the signal quality of 2dBm but the transmission bandwidth of 30km does not affected.

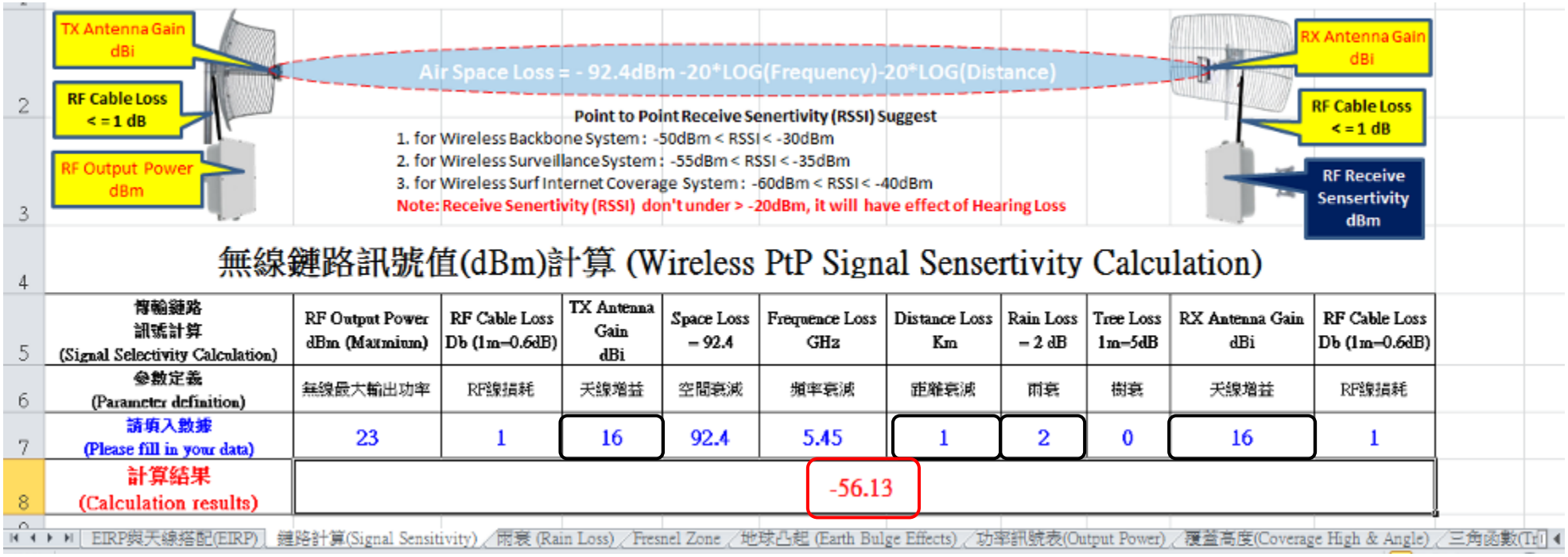
Note 2: The fog has less influence on the wireless transmission of WiFi 5GHz than rain attenuation, and has been wirelessly transmitted from 5 islands and South Pole around the island of Matsu since 2010 and has not been affected by the fog of Matsu for 5 years in bandwidth and stability of wireless transmission (The same signal attenuation with the same rain 2dBm).

Note 3: The increasingly serious smog problem in China should theoretically affect the signal attenuation of wireless transmission. In practice, the long-term observation of the result of wireless transmission has confirmed its effect. However, the signal value of only about 2dBm is still not observed seriously affect the phenomenon.

Note 4: The above table is a purely theoretical calculation. In practice, the value of rain attenuation rarely exceeds 2dB and the value of wireless signal is less than 2dBm. Therefore, the calculation of the wireless transmission link is defined by 2dBm rain attenuation value.

5. Wireless monitoring transmission system transmission signal estimation

■ **Wireless repeater wireless backbone transmission signal value calculation: According to the designed multi-point hop platform, the point-to-point distance is within 1km. It is suggested that the 5GHz 16dBi directional antenna should be set up within 2Km to obtain the wireless backbone connection signal value, Estimated -56dBm intensity, can reach 150Mbps full-speed transmission bandwidth.**



無線鏈路訊號值(dBm)計算 (Wireless PtP Signal Sensertivity Calculation)

傳輸鏈路 訊號計算 (Signal Selectivity Calculation)	RF Output Power dBm (Matmium)	RF Cable Loss Db (1m=0.6dB)	TX Antenna Gain dBi	Space Loss = 92.4	Frequence Loss GHz	Distance Loss Km	Rain Loss = 2 dB	Tree Loss 1m=5dB	RX Antenna Gain dBi	RF Cable Loss Db (1m=0.6dB)
參數定義 (Parameter definition)	無線最大輸出功率	RF線損耗	天線增益	空間衰減	頻率衰減	距離衰減	雨衰	樹衰	天線增益	RF線損耗
請填入數據 (Please fill in your data)	23	1	16	92.4	5.45	1	2	0	16	1
計算結果 (Calculation results)	-56.13									

EIRP與天線搭配(EIRP) 鏈路計算(Signal Sensitivity) 雨衰 (Rain Loss) Fresnel Zone 地球凸起 (Earth Bulge Effects) 功率訊號表(Output Power) 覆蓋高度(Coverage High & Angle) 三角函數(Trl)

Ps: the connection signal value of some wireless set-up points, because the equipment is set up on the viaduct bridge high point and the bridge under the low point of the connection height difference between the blocking problem, resulting in wireless signals due to the interference of the Fresnel Zone, reducing the wireless connection signal strength.

6. The number of erection equipment

Outdoor wireless transmission system equipment list

No.	Device name	Equipment model	Brief specifications	Amount	Remarks
1	**PTP wireless Mesh network base station**	EL-N-1 (1 Module) 	1. One WiFi MIMO 2 * 2 4.9 ~ 6.1GHz wireless single-band RF module (802.11an) 2. System Operation PTP Mesh Point-to-point multipath network connection transmission 3. Wireless output power single-frequency network card 25dBm (maximum) 4. Point-to-point back to back through the wired network connection function 5. After 10 times the relay platform, still can maintain the following response delay of 15ms 6. Support IGMP broadcast packet protocol features 7. The largest backbone bandwidth 200Mbps (40MHz) 8. Wireless with cable cascading> = 8hops maximum bandwidth 150Mbps(40MHz) 9. Support PTP Mesh / AP Mode / STA Mode	**2**	
2	**PTP wireless Mesh network base station**	EL-N-2 (2 Modules) 	1. Two WiFi MIMO 2 * 2 4.9 ~ 6.1GHz wireless single-band RF module (802.11an) 2. System Operation PTP Mesh Point-to-point multipath network connection transmission 3. Wireless output power single-frequency network card 25dBm (maximum) 4. Point-to-point back to back through the wired network connection function 5. After 10 times the relay platform, still can maintain the following response delay of 15ms 6. Support IGMP broadcast packet protocol features 7. The largest backbone bandwidth 300Mbps (40MHz) 8. Wireless with cable cascading> = 8hops maximum bandwidth 150Mbps(40MHz) 9. Support PTP Mesh / AP Mode / STA Mode	**5**	

3	**PTP wireless Mesh network base station**	EL-N-3 (3 Modules) 	1. Three WiFi MIMO 2 * 2 4.9 ~ 6.1GHz wireless single-band RF module (802.11an) 2. System Operation PTP Mesh Point-to-point multipath network connection transmission 3. Wireless output power single-frequency network card 25dBm (maximum) 4. Point-to-point back to back through the wired network connection function 5. After 10 times the relay platform, still can maintain the following response delay of 15ms 6. Support IGMP broadcast packet protocol features 7. The largest backbone bandwidth 300Mbps (40MHz) 8. Wireless with cable cascading> = 8hops maximum bandwidth 150Mbps(40MHz) 9. Support PTP Mesh / AP Mode / STA Mode	**0**	
4	**Base station with MIMO antenna Plane-Oriented Medium Gain Antenna**	IOP-PANJO-5M1602422 	1. Pointing plate antenna 2.5GHz 15-16dBi Outdoor Antenna 3. Frequency range: 5.150-5.875GHz 4. Horizontal / Vertical Angle: Horizontal: 17-24° / Vertical : 17-24° 5. Connector: RG233, 70cm & N Jack × 2 6.Weight: 0.8Kg 7. Dimensions: 210 x 210 x 73 mm 8. IPX5, resistant to wind pressure 216Km/hr	**12**	
5	**Waterproof Tape**	IOP-RMTOC-173830510B 	Breaking force: 2Kg above Adhesion / peel force: 2cm or less Black, thickness: 1.7mm ± 0.5mm Water absorption rate of 0.2% or less Stability 130℃ / 100hrs no plastic flow Elongation of more than 1000%	**3**	