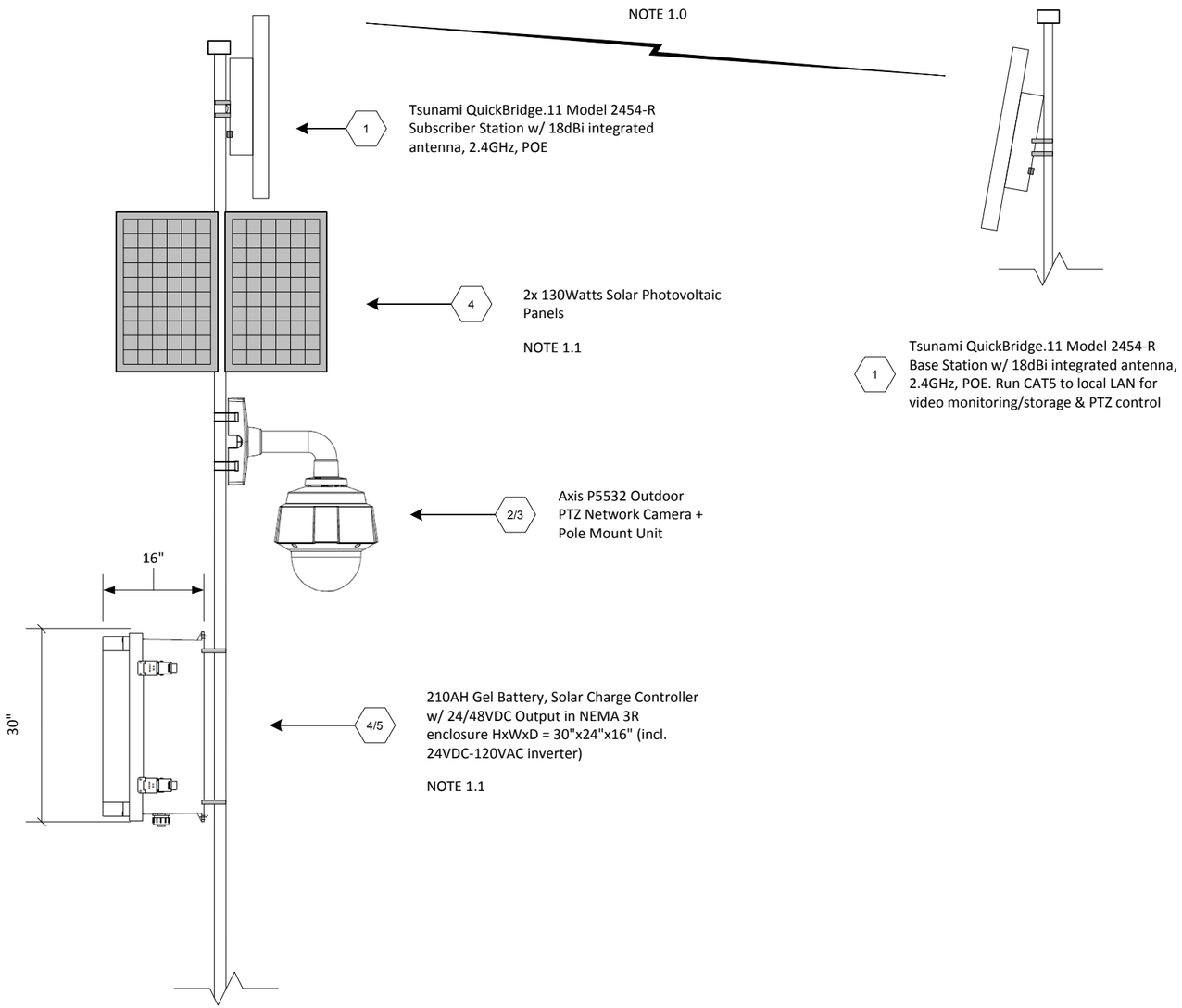
Section 1: System Overview



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Solar Powered Wireless Video Surveillance for Remote Site/ U.S.A

IP PTZ Camera, Unlicensed 2.4GHz Wireless Backhaul, Solar PV Alternate Power
JOB # BWA-41875-1010
Section 1: System Overview

DRAWN BY: RT (Engr) APPROVED BY:	SIZE	LIC NO AZ ROC # 253407	DWG NO DWG-BW-418751010-002 / REV 1A
FREQ(s): 2.4GHz ISM	SCALE **NO SCALE**	FRN: 0018086041	SHEET 1 OF 5

Bill of Materials

ITEM	QTY.	RFWEL SKU	DESCRIPTION
1	1	2454-QB-US	Tsunami QuickBridge 11 Point-to-Point Wireless Bridge
2	1	AXISP5532	Axis P5532 Outdoor PTZ Network Camera
3	1	AXT91A67	T91A67 Pole Mounting Brackets for Axis PTZ Dome
4	1	SOL260W321836	Pre-Packaged 260W, 210AH, 24/48V POE Solar System
5	1	PST-30S-24A	300W 24VDC-120VAC Pure Sine Wave Inverter

NOTES:

1.0 See Page-2 on RF link budget analysis and wireless link assumptions.

1.1 See Page-5 on solar module sizing including load estimates & usage duty-cycle assumptions.

1.2 System designed for wireless video backhaul into a command & control center 0.5miles from camera installation location. Could be easily extended to several miles or replaced with alternative wireless backhaul methods such as cellular 3G (EVDO RevA, HSPA, HSPA+) or 4G data (WiMax, LTE). Contact an Rfwel wireless support tech to discuss any required modifications.

Section 2: 2.4GHz Point-to-Point Radio RF Link Analysis for > 6Mbps datarate at < 0.5 mile w/ nLOS

PTP Link for Video Surveillance Backhaul

Link Budget Calculator
Tsunami MP.11 2454 (User-defined Regulations)

Regulations	USA/Canada		BSU Alternative EIRP in dBm
			SU Alternative EIRP in dBm
Channel Selection	2.400 - 2.483 GHz (2.4)	(EIRP: 36 dBm with 1 for 3 rules if antenna above 6 dB)	
Data Rate	12 Mbps (20 MHz)		
Terrain Factor	0.25 (Mountainous)		Alternative Terrain Factor
Climate Factor	0.5 (Humid)		Alternative Climate Factor
Link Distance	0.5	Units: (•) Miles ( ) Kilometers	

Type of BSU	Outdoor 2454 BSU-R		
Transmission Line Length at BSU		Units: (•) Feet ( ) Meters	
Transmission Line Type at BSU	Other		Alternative Transmission Line Specification
Number of Connectors on This Side		(1/4dB loss per connector)	Units: (•) dB per 100 Feet ( ) dB per 100 Meters
Additional Losses on This Side		dB	
Antenna at BSU	Other	18	Enter Gain (dBi) of Alternative Antenna

Type of SU	Outdoor 2454 SU-R/SU-A		
Transmission Line Length at SU		Units: (•) Feet ( ) Meters	
Transmission Line Type at SU	Other		Alternative Transmission Line Specification
Number of Connectors on This Side		(1/4dB loss per connector)	Units: (•) dB per 100 Feet ( ) dB per 100 Meters
Additional Losses on This Side		dB	
Antenna at SU	Other	18	Enter Gain (dBi) of Alternative Antenna

Analysis From BSU to SU:				Analysis From SU to BSU:
TPC Value Used at BSU	0		0	TPC Value Used at SU
Transmit Power at BSU Used for Calculation	16.0	dBm	16.0	Transmit Power at SU Used for Calculation
Received Signal Level (RSL) at SU	-46.2	dBm	-46.2	Received Signal Level (RSL) at BSU
Threshold at SU	-89	dBm	-89	Threshold at BSU
Fade Margin into SU	42.8	dB	42.8	Fade Margin into BSU
Predicted Availability BSU-towards-SU	100.00000%	percent	100.00000%	Predicted Availability SU-towards-BSU
Predicted Outage BSU-towards-SU	0.00	minutes	0.00	Predicted Outage SU-towards-BSU

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Section 2: 2.4GHz RF Radio Link Analysis & Specifications

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FREQ(s): 2.4GHz ISM	SCALE: NO SCALE	FRN: 0018086041	SHEET: 2 OF 5	

NOTES:

2.0 Notice that we use a worst-case mountainous humid environment with 12mbps target datarate (As shown in Page-3 Axis P5532 Camera at, 6fps frame rate, 704x480 resolution & 10% MJPEG compression requires ~3mbps for live streaming). Results of link analysis shows that we meet this 0.5mile link with 42dB fade margin (typical fade margin of >10dB required to account for interference power, environmental conditions, orientation imperfections etc).

2.1 System designed for 0.5 mile line-of-sight (LOS) or near-line-of-sight (nLOS) links. Not compatible with full Non-line-of-sight (NLOS) links. For nLOS the expected obstructions would be light foliage and/or partial Fresnel zone obstruction.

2.2 QB.11 2454 radios capable of range of several miles depending on desired throughput and number/nature of obstructions present in the line-of-sight. Shown here with 18dBi integrated panel antennas. To increase link range you would need:

i) Replace the model with 18dBi integrated antennas with system with external antenna ports such that external antennas may be installed to meet specific site needs e.g co-location interference suppression, improved coverage radius, improved range with higher antenna gain etc.

ii) Use 5.8GHz for long-distance, high throughput links or if site analysis shows too much 2.4GHz interference. NOTE that 5.8GHz radios offer less immunity to obstructions to the LOS.

2.3 Selected Proxim Tsunami QB.11 radios designed for Point-to-point (PtP) links. To expand the system to include multiple camera nodes monitored/controlled from the same command center or NOC you would need to:

i) Replace Base-station radio to Proxim Tsunami MP.11 or QB-8100 point-to-multipoint radios (the latter includes MIMO technology for better range, throughput and obstruction avoidance).

ii) Use omni-directional or sector antenna at base-station to provide appropriate beamwidth pattern to camera nodes.

Section 3: Outdoor Rugged Network PTZ Camera Specification & Possible Configuration Settings for Designed Backhaul Bandwidth

	Name	Model	No. of cams	Bandwidth (View, Rec, Event)	Storage (8 days)
1	Remote Wireless Video	AXIS P5532 (60Hz)	1	3.0 Mbit/s, 1.4 Mbit/s, 862.5 Kbit/s	178.3 GB

Client Hardware Recommendation

Server
Dual Core 2.0GHz CPU,
1GB RAM,
100Mbit Network Card,
1 HDDs providing at least 214.0 GB storage,
Windows XP professional, Vista Business or Windows 7 professional or higher (32/64bit)

Client
Dual Core 2.0GHz CPU,
1GB RAM,
100Mbit Network Card,
Graphics card with full DirectX 9.0 and 256MB onboard memory,
Professional monitor with resolution 1280x800 or higher,
Windows XP professional, Vista Business or Windows 7 professional or higher (32/64bit)

License Recommendation US

License	qty.
4-base license *Part: 0202-054*	1

Camera

Name	Image scenario	Audio	Model	No. of channels
Remote Wireless Video	Station	☐	AXIS P5532 (60Hz)	1

Viewing

Frame rate	Resolution	Compression type	Compression	Bandwidth
6 fps	704x480 4CIF	MotionJPEG	10	3158 Kbit/s

Continuous recording

Record for	Frame rate	Resolution	Compression type	Compression	Bandwidth
24 h	6 fps	704x480 4CIF	MotionJPEG	70	1447 Kbit/s

Event recording

Alarm	Frame rate	Resolution	Compression type	Compression	Bandwidth
10 %	30 fps	704x480 4CIF	MotionJPEG	50	8625 Kbit/s

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Section 3: Video Specifications

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FREQ(s): 2.4GHz ISM	SCALE **NO SCALE**	FRN: 0018086041	SHEET 3 OF 5	

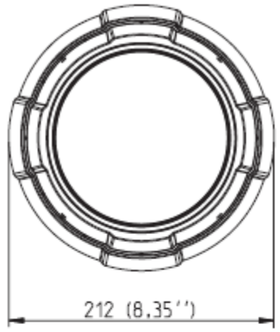
NOTES:

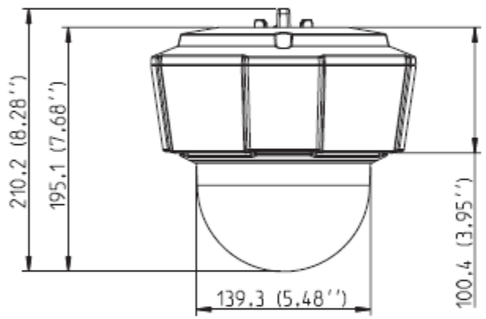
3.0 If you switch backhaul to Cellular 3G you will need to adjust the configuration settings to account for the lower backhaul bandwidth vs a point-to-point or point-to-multipoint system.

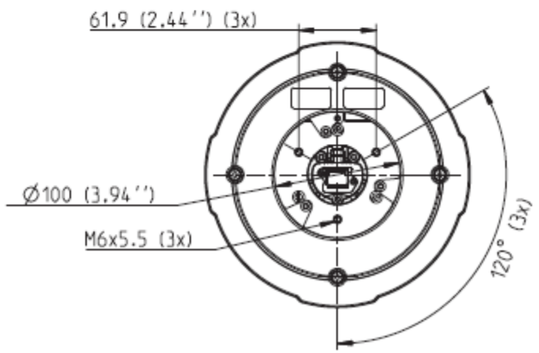
For example:
i) change viewing resolution to 352x240 CIF for 1.253Mbps
ii) Leave resolution as 704x768 4CIF and change compression to H.264 for 980kbps

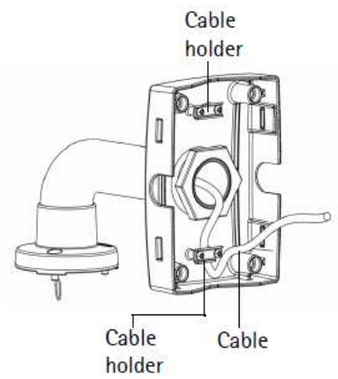
3.1 Camera includes software license for viewing/recording/control from one remote station. For multiple station support additional licenses required.

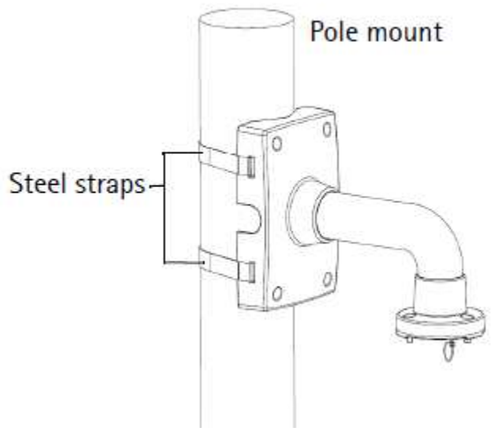
Section 4: Outdoor Pole Mounted Network Camera Dimensions











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Section 4: Network Camera Dimensions

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FREQ(s): 2.4GHz ISM	SCALE **NO SCALE**	FRN: 0018086041	SHEET 4 OF 5	

Section 5: Solar Sizing & Load Estimates

5.0 Solar system sized for the following requirements: "… will need power for daytime use and enough to power the camera and other equipment when the weather doesn't cooperate. This is not a high security or mission critical installation, so the camera doesn't have to be up all the time, but uptime needs to be reasonable …"

5.1 Usage window estimated at approximately 0700h-1800h daily with a 100% usage duty cycle in that window. Battery capacity sized to power loads during this window without any recharge from solar panels and for 80% battery discharge limits when no solar during that window.

5.2 LOADS:

- Proxim QB2454 PTP Radio: POE - 48VDC, 7.5W typical, 20W max *(we use double the typical power for our calculations)*
- Axis P5532 PTZ Camera: POE- 55VDC, 30W max *(we use worst case max power value for our calculations)*
- Samlex 24VDC-120VAC Inverter: 85% peak efficiency, <400 mA idle current. *(we use a 75% efficiency estimate)*

Load1 (radio) =~ 165 WH/day, **7 AH/day**
Load2 (camera) =~ 412 WH/day, **18 AH/day** (upsized 25% for inverter loss)

5.3 Min Solar insolation (Sun-Hours per day) for Chandler, AZ (Rfwel's HQ) per DOE is 5.78 Hrs/day.

5.4 SOLAR ARRY SIZING:

- Effective AH/day required to power loads = **30 AH/day** (20% loss from battery charge/discharge)
- Total solar array amps reqd = 30/5.78 A = **5.2 A**
  * note we use worst case minimum solar insolation value to allow for system margin
- Since peak amps of Kyocera 135W Solar PV module KD135SX-UPU at 800W/m^2 NOCT is 6.1A and we need 5.2 A from solar module we only need one module in parallel.
- Since each module has a nominal DC voltage of 12VDC and we wire batteries for a 24VDC output we will need 2 modules in series.

-> Total modules configured **2 x 135W** series connected.

5.5 BATTERY CAPACITY SIZING:

- As before effective AH/day required to power loads = **30 AH/day**
- We provide for **2-days** with no solar and percent of time during duty-cycle window when there will be no solar to power battery estimated at **100%** (i.e can have 2 full day without solar)
- Min Backup capacity req'd to power loads for no-sun-duration = 16.4 AH/day * 100% * 2day = **60AH**
- Retain a 20% reserve after deep discharge – min capacity = 60AH/0.8 = **75AH**
- Since we use nominal 12VDC batteries we need to arrange 2 batteries in series to yield 24VDC system voltage.

→ Batteries selected **2 x 12V 210AH** gel battery connected in series to generate a 24VDC battery bank output voltage (extra capacity used for idle mode leakage current & to protect against variations in solar insolation)

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Section 5: Solar Sizing Details

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FREQ(s): 2.4GHz ISM	SCALE **NO SCALE**	FRN: 0018086041	SHEET 5 OF 5	

NOTES:

5.6 To increase amount of load support e.g for increased usage duty cycle or night use, for increased radio throughput/range/transmit-power, to accommodate devices added to the system, to support increased number of no-sun-days or no-sun-hours per day, for increased pan, tilt & optical zoom mechanical activity or to account for environmental conditions that lead to increased use of heater/blower:

i) Increase the number of solar array modules in parallel with existing string. E.g Two more series mounted modules in parallel with existing two will give a total module output current of about 12A. Existing system includes a 30A solar-charge controller so can handle up to 4 parallel strings (or 8 modules) which should comfortably give 24hr use with excess capacity margin) *[Order SKU=KD135SX-UPU & SKU=707544 which includes 2 135 Watt modules & side-of-pole mount respectively]*

ii) Add 2 additional 12V batteries and wire the series-combination of these batteries in parallel to existing battery bank *[Order QTY=2 SKU=12V-210AH-G:12VDC 210AH Deep Cycle Gelled-Electrolyte Battery]*

5.7 NOTE one should not add batteries without adding solar module(s) unless the load is reduced since there would otherwise be little to no residual current to charge increased battery capacity during sun-day duration. In fact notice current system at max loads provides a slow rate of battery recharge so if non-sun-days/hrs are anticipated to exceed estimates, additional solar pv modules strongly recommended.

5.8 The 24VDC-120VAC inverter used to power the AXISP5532 High Power 802.3at POE includes a low-voltage disconnect setting when battery bank output voltage goes below 20V (and a reconnect when it goes back to 23V). This prevents camera from draining battery completely which would affect useful battery life.

5.9 If system usage activity or load as detailed in 5.6 is increased or not carefully controlled outside spec'd usage window and to accommodate the idle PTP radio power (with no transmit/receive activity) and inverter idle leakage power after camera disconnect consider additional LVD circuit at output of battery bank *[Order SKU=LVD24-50-NM 24V Variable Low Voltage Disconnect]*