

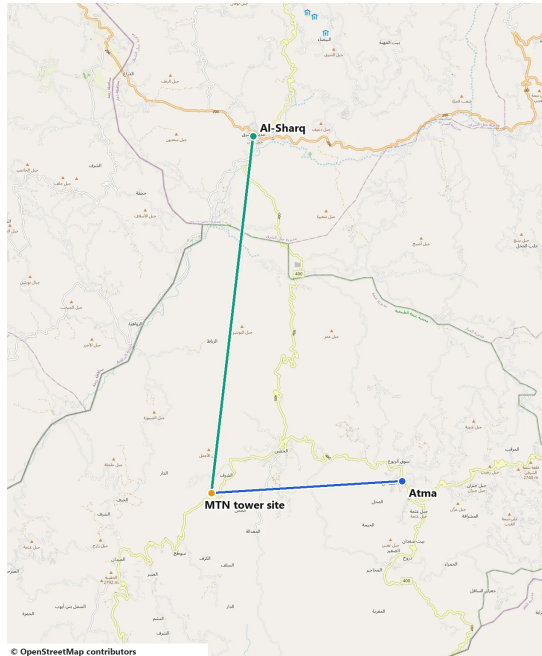
Wireless Link Planning and RF Engineering

Atma to Al-Sharq backhaul and seven-zone distribution

The implemented network links Atma to Al-Sharq through the MTN tower area. This engineering review joins source requirements, authentic simulation captures, reproducible RF calculations and a commissioning evidence plan.

The reviewed 5.8 GHz capability case predicts 19.93 dB and 29.45 dB margin at MCS15. These margins support further validation; permitted EIRP, interference and near-site obstructions can change the result. No measured RSSI, payload throughput or availability has been supplied.

يربط المشروع عتمة بمدينة الشرق عبر محطة وسيطة في منطقة أبراج MTN، ثم يوزع الخدمة على سبع مناطق. تتضمن هذه المراجعة صور المستند الأصلي ولقطات فعلية من أداة المحاكاة وحسابات قابلة لإعادة التشغيل. نتائج المحاكاة توقعات هندسية؛ أما قياسات التشغيل وصور التركيب فتحتاج إلى سجلات الموقع.



Project route map. Base map: OpenStreetMap contributors. Positions shown at map scale.

Source requirements and engineering inputs

The original requirements specify 8.5 km and 16.5 km. The retained terrain profiles yield 8.277 km and 15.556 km, while UISP displays 8.31 km and 15.64 km. Keep all three distance bases labelled; confirm actual mounting points before adopting a final path length.

The historical budget lists one link on each hop: PowerBeam M5 400 (\$180) and a 34 dBi RocketDish link (\$1,200). A link requires both endpoints; the second hop also requires compatible Rocket radios. Exact procurement quantities must be reconciled.

Input	Basis
7 distribution zones	1, 4, 6, 10, 12, 13, 14; planned range 500 m
61 terrain samples per hop	Existing Copernicus GLO-90 profile through Open-Meteo
Profile sample spacing	About 138 m on H1 and 259 m on H2
Reviewed radio calculation	5.8 GHz; 20 MHz; 800 ns guard interval
Clearance scenario	6 m antennas; k = 4/3; 5 m clutter
Observed operating data	Not supplied

متطلبات نقل الانترنت من مركز المدينة عتمة الى مدينة الشرق

منطقة الربط	المسافة التقديرية	الاجهزة المطلوبة	العدد	تكلفة الاجهزة
مركز المدينة "عتمة" الى منطقة ابراج "MTN"	8.5 كيلومتر	power beam M5 400	لينك واحد	180 دولار
منطقة ابراج "MTN" الى مدينة الشرق	16.5 كيلومتر	Rocket dish M5 34DBI	لينك واحد	1200 دولار

متطلبات توزيع الانترنت "مدينة الشرق"

رقم المنطقة حسب الخارطة	مسافة البث التقديرية	الاجهزة المطلوبة	العدد	تكلفة الاجهزة
رقم "1"	500 متر	namo station M2 11DBI	2	160 دولار
		SECTOR 15 DBI M5 120	1	270 دولار
رقم "4"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	2	160 دولار
رقم "6"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	2	160 دولار
رقم "10"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	3	240 دولار
رقم "12"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	2	160 دولار
رقم "13"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	3	240 دولار
رقم "14"	500 متر	power beam M5 400	1	90 دولار
		namo station M2 11DBI	2	160 دولار

متطلبات لابد منها

الاجهزة المطلوبة	العدد	تكلفة الاجهزة	ملاحظات
RB AH 1100	1	350 دولار	للتوزيع
RB 750	1	70 دولار	للمنح
MODEM NETGAER	حسب الخطوط	سعر الواحد 45 دولار	نت
اسلاك شبكة	2	250 دولار	ربط
الكس	4	28	
سويتش	4	8	
قواعد	9	80000	
وتربروف	4	8000	
RG45		1000	
اسلاك شبكة 2متر	25	12500	
طابعه حبر خارجي	1	\$150	
الواح طاقة شمسية			
رافع كلفتيه			
منظم شمسية			

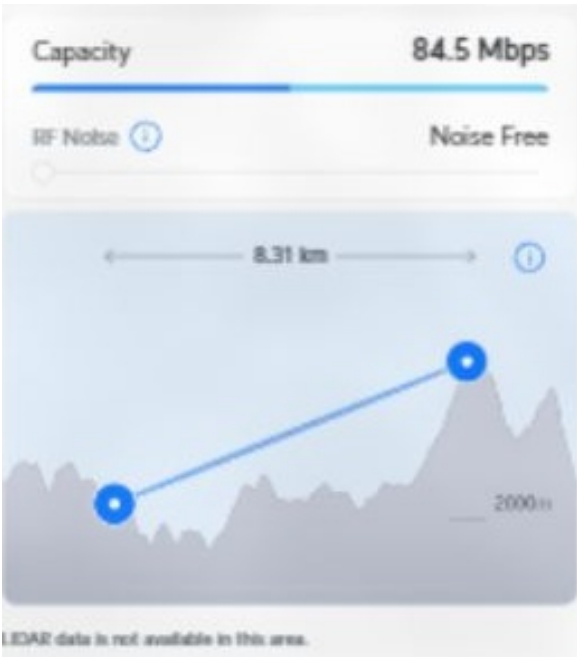
Original project requirements, page 1. Historical source quantities and prices.

Actual UISP simulation results

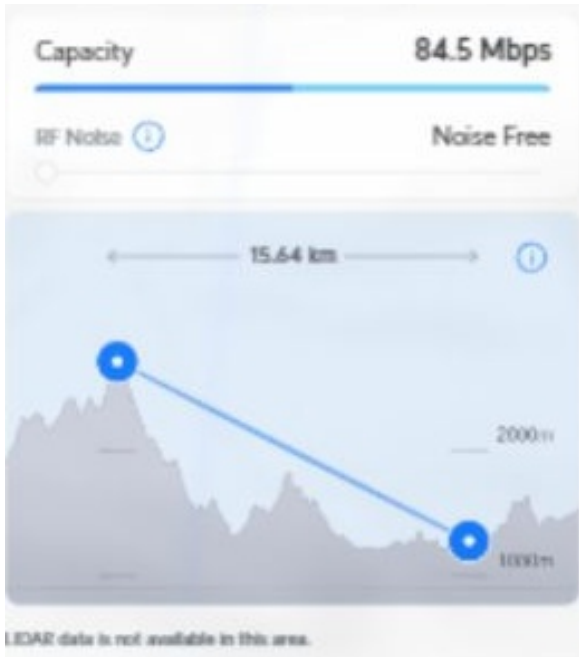
The two result images below were captured from Ubiquiti UISP Design Center on 12 October 2026. Guest mode, manual product selection, Noise Free, 20 MHz and 6 m antenna heights were used. These are actual tool outputs, not recreated interface illustrations.

UISP reports that LIDAR data is unavailable in this area. Its frequency and loss assumptions differ from the independent 5.8 GHz calculation. The displayed 84.5 Mbps is vendor-predicted capacity, not an iperf measurement or a guaranteed end-to-end service rate.

Vendor run input / prediction	H1	H2
Product	PowerBeam M5 400 pair	Rocket M5 + RD-5G34 pair
Distance	8.31 km	15.64 km
Frequency	5,000 MHz	5,500 MHz
TX / gain	26 dBm / 25 dBi	27 dBm / 34 dBi
Height / width	6 m / 20 MHz	6 m / 20 MHz
Expected signal	-49 dBm	-36 dBm
Displayed capacity	84.5 Mbps	84.5 Mbps



H1: PowerBeam M5 400

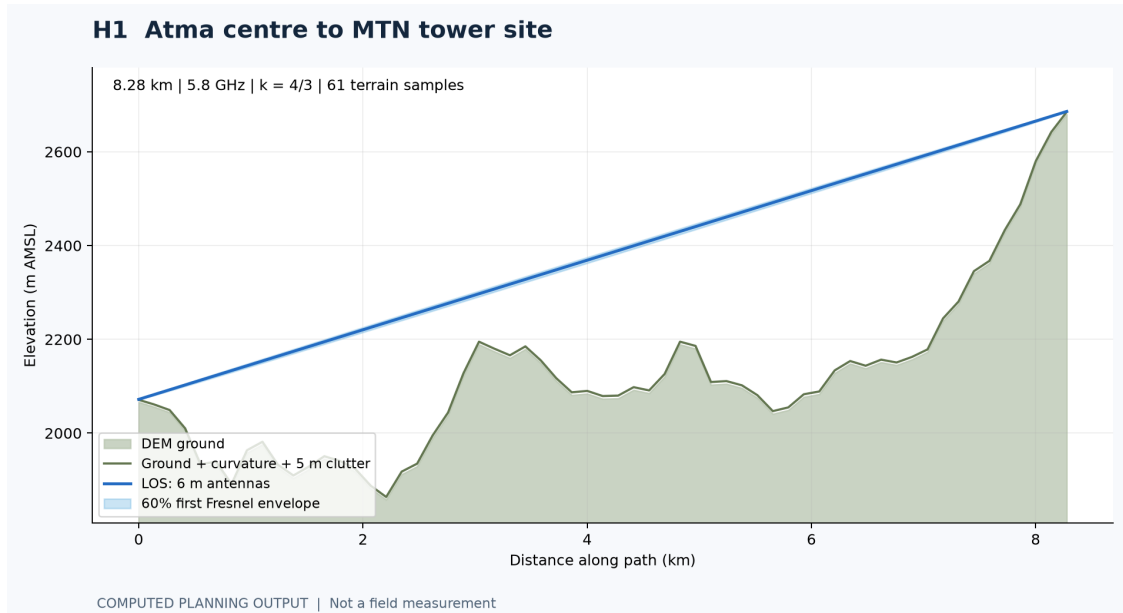


H2: Rocket M5 + 34 dBi dish

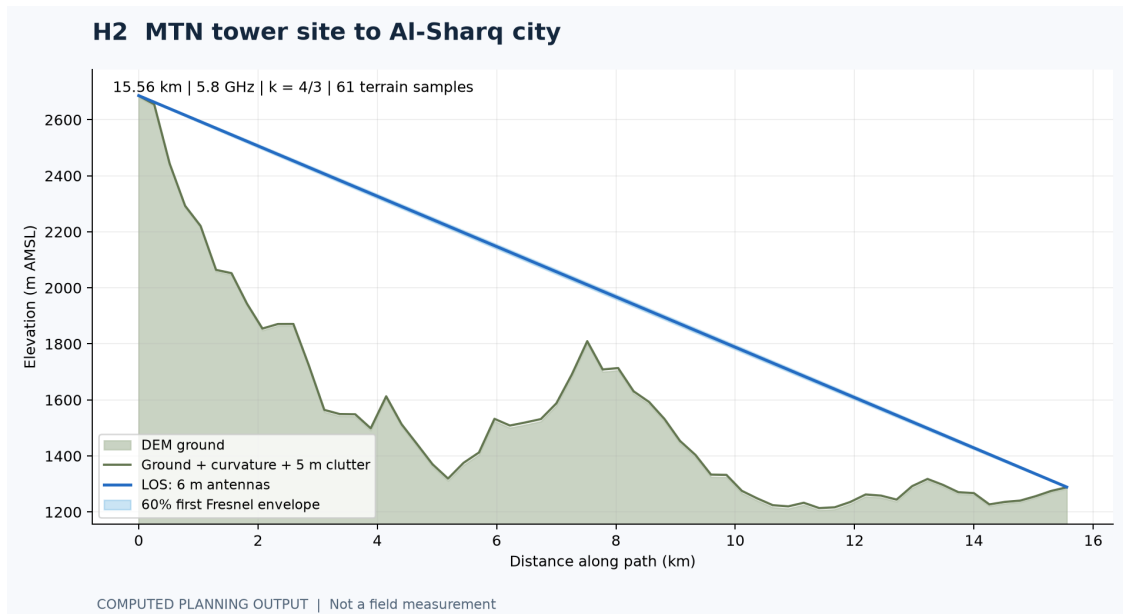
Terrain and Fresnel clearance

The nominal sampled paths clear 60% of the first Fresnel zone. The midpoint first-zone radii are about 10.34 m and 14.18 m at 5.8 GHz. Curvature is applied once, with $k = 4/3$. Ground elevations are in metres above mean sea level; antenna heights are above local ground.

These profiles do not resolve every tree, rooftop or narrow ridge. A direct survey of the endpoint approaches remains necessary. A zero-height result from a sparse model is not an installation height recommendation.



H1 actual calculation output from the retained terrain dataset.



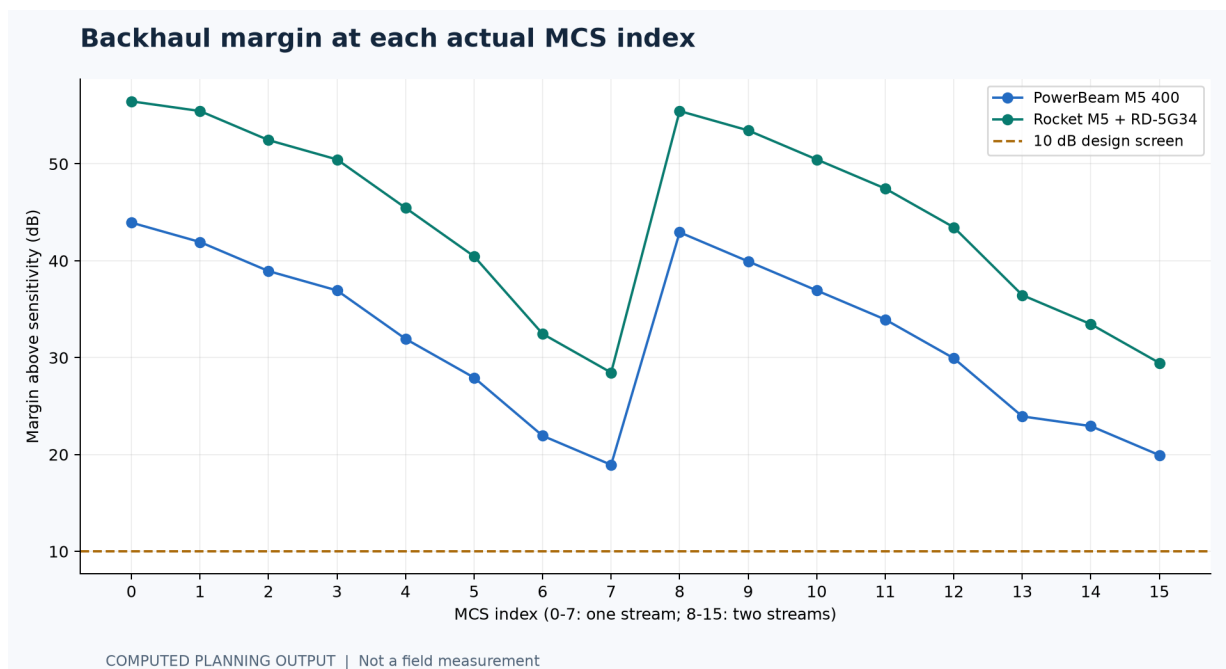
H2 actual calculation output from the retained terrain dataset.

RF budget and MIMO capacity

Each device uses its own manufacturer TX table. MCS0-7 denotes one stream; MCS8-15 denotes two streams. The highest two-stream example is MCS15, 130 Mbps PHY at 20 MHz/800 ns GI. At an assumed 50% payload efficiency, 65 Mbps is an illustrative per-hop estimate, shared across subscribers and directions.

The RF equations use dBm for absolute power, dBi for antenna gain and dB for losses. H1 has an integrated antenna and no separately added external RF-feed loss. H2 assumes 0.5 dB feed loss per end. Both include 2 dB other losses.

Item	H1 PowerBeam	H2 Rocket + dish
Path length	8.28 km	15.56 km
Frequency / channel	5.8 GHz / 20 MHz	5.8 GHz / 20 MHz
MCS15 TX / gain	23 dBm / 25 dBi	21 dBm / 34 dBi
RF feed / other loss	0 dB per end / 2 dB	0.5 dB per end / 2 dB
FSPL	126.07 dB	131.55 dB
Predicted MCS15 RSSI	-55.07 dBm	-45.55 dBm
Sensitivity / margin	-75 dBm / 19.93 dB	-75 dBm / 29.45 dB
After TX/RX 4 dB tolerance	15.93 dB	25.45 dB
PHY / illustrative payload	130 / 65 Mbps	130 / 65 Mbps



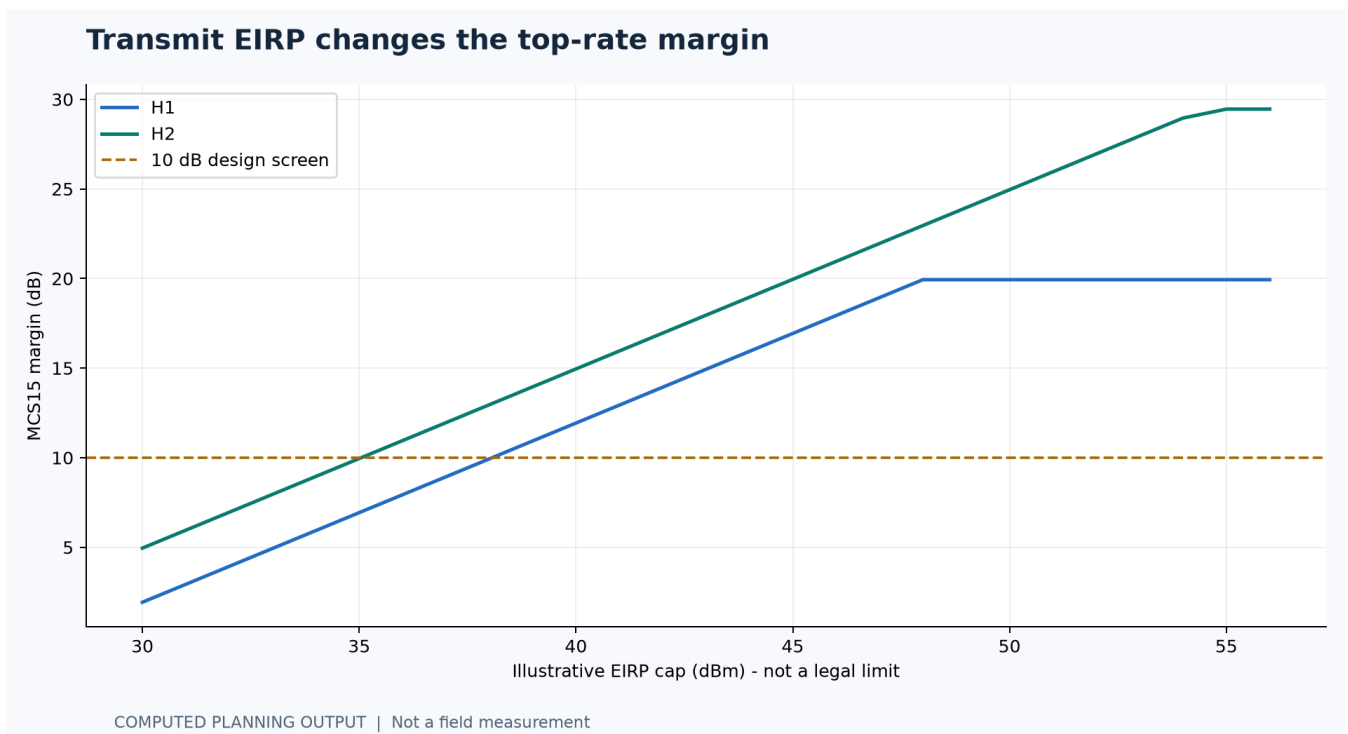
Actual model output: device-specific margin across all MCS indices.

EIRP and uncertainty change the decision

Hardware maximum TX power is a capability input, not a permitted operating setting. The illustrative EIRP sweep shows how lower radiated power changes top-rate margin. It does not assert any legal EIRP limit for Yemen. Confirm the applicable band, channel, country profile and radiated-power limit.

For a 36 dBm illustrative EIRP cap, the MCS15 margins fall to 7.93 dB on H1 and 10.95 dB on H2. H1 then falls below the 10 dB screen at MCS15 and requires a lower modulation rate. Device TX and receiver sensitivity tolerances alone may consume another 4 dB.

Unmodelled factor	Required evidence
Interference / co-site coupling	Spectrum scan and simultaneous-link test
Alignment and chain imbalance	Per-chain readings and mounting inspection
Actual legal setting	Applicable limits and configuration export
Annual availability	Valid model domain, local climate and operational outage records



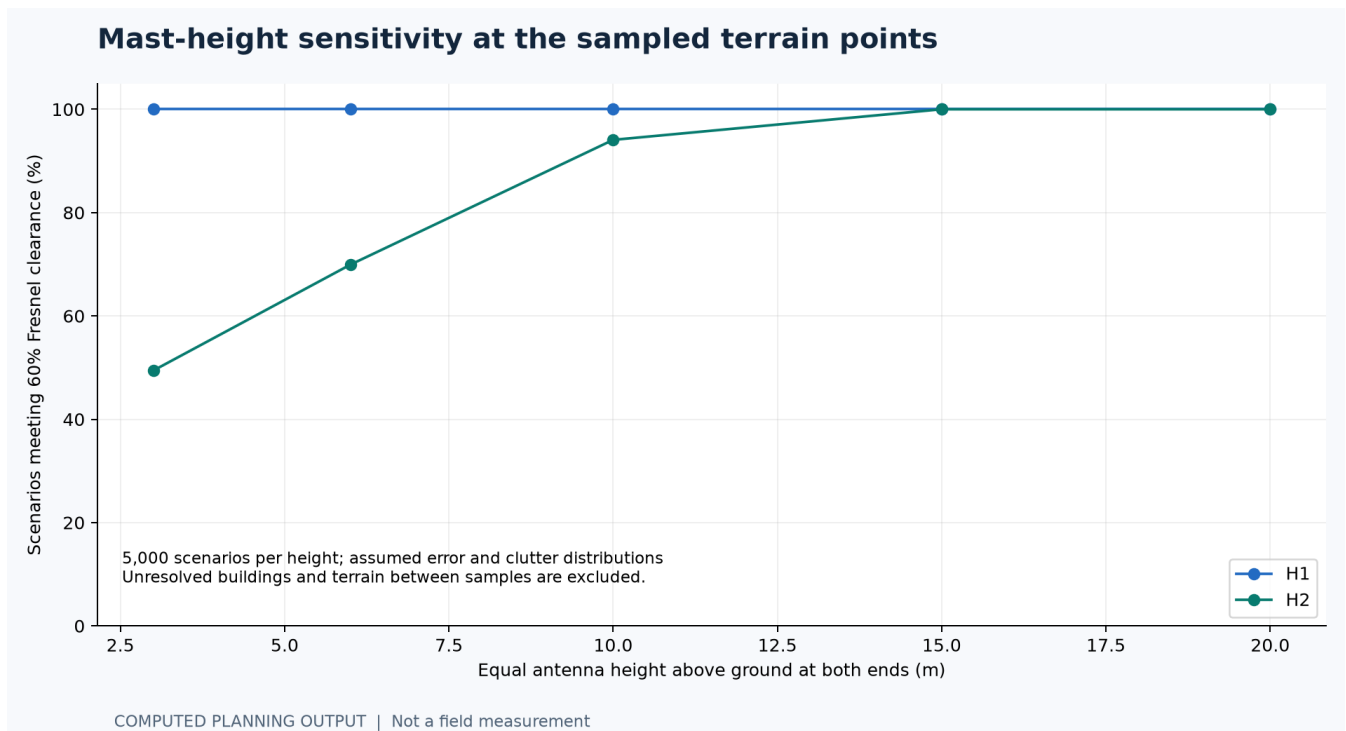
Sensitivity to EIRP cap at MCS15. Caps are examples, not regulatory advice.

Mast-height sensitivity and design boundaries

The Monte Carlo screen varies assumed DEM error, clutter up to 15 m and effective Earth factor in 5,000 scenarios per height. A scenario pass fraction is not uptime, a measured obstruction probability or a confidence level. Endpoint elevation error is fixed and terrain between samples is unresolved.

Increasing H2 mast height improves this sampled-point screen, but neither 10 m nor 15 m is a certified height. Surveyed clearance, safe access, foundation/mast structure, wind loading and permissions determine the final installation.

The legacy annual rain/multipath outage figures are withdrawn from current conclusions: local climate, propagation-model applicability and annual versus worst-month time basis were not established.



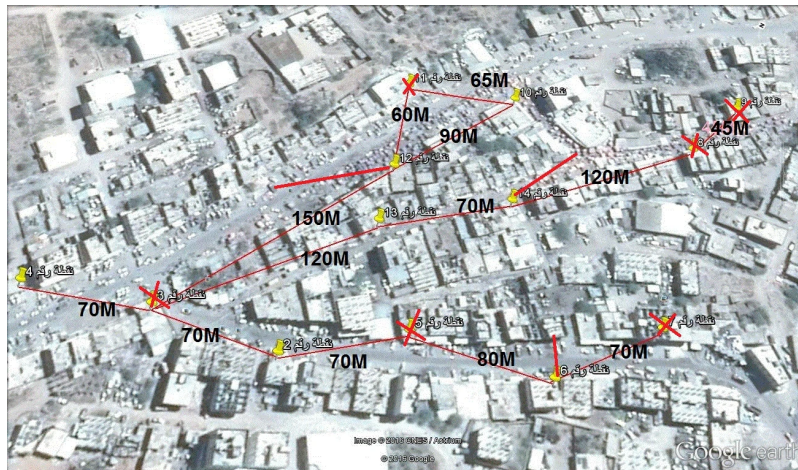
Actual output of the scenario sensitivity calculation.

Seven-zone distribution and client coverage

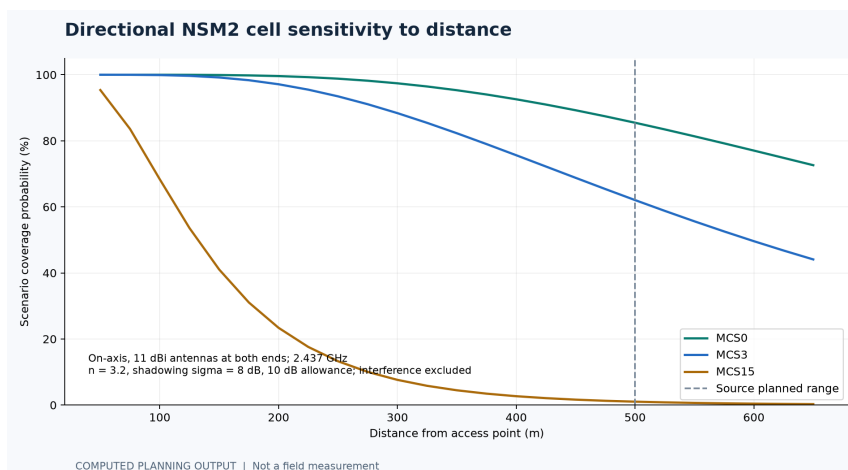
The original map identifies seven retained zones. The equipment totals are 16 NanoStation M2 units, six local PowerBeam units and one sector line. A NanoStation has a directional antenna; a nominal 500 m reach is not omnidirectional coverage or a guaranteed high-rate boundary.

The 5 GHz sector and 2.4 GHz NanoStation operate in different bands and cannot directly associate over RF. Confirm the sector radio, its exact SKU and any Ethernet interconnection. Coverage below assumes on-axis 11 dBi antennas at both ends, an $n = 3.2$ path-loss exponent and 8 dB shadowing; none is fitted to local measured coverage.

Zone	Source equipment	Source line total
1	2 NSM2 + one M5 sector (15 dBi / 120 deg as written)	\$430
4 / 6 / 12 / 14	Each: one PowerBeam + 2 NSM2	\$250 each
10 / 13	Each: one PowerBeam + 3 NSM2	\$330 each



Original zone map from the project document. CNES / Astrium and Google attribution retained; coordinate bar excluded.



Calculated directional-cell sensitivity, not a geospatial measured heatmap.

Equipment reference imagery

These are authentic manufacturer product-family illustrations reproduced from official Ubiquiti datasheets. They identify the hardware families and are not photographs of the installed sites. Exact SKU identification still requires an inventory or device label.

PowerBeam PBE-M5-400: 25 dBi integrated antenna. RocketDish RD-5G34: 34 dBi antenna with approximately 3 degree beamwidth, requiring a compatible radio. NanoStation M2: directional 2.4 GHz MIMO device.



PowerBeam family



RocketDish family



NanoStation family

The existing VB.NET RF and Fresnel project posters remain available on the website. They are source document previews; the new calculation plots and UISP captures are separately labelled. No new VB.NET execution or field configuration screenshot is claimed.

Network operation and relay-site power

Separate management, backhaul and subscriber traffic. Record the actual router configuration and Internet-line health checks. For co-located MIMO radios, keep both polarisation chains matched; determine channel and physical separation through spectrum and desensitisation measurements rather than a fixed universal spacing.

The remote relay load is assumed as two 8 W radio allowances plus 10% conversion/cable overhead: 17.6 W, or 422.4 Wh/day. Actual injector/DC conversion and auxiliary consumption must be measured.

Component / input	Scenario sizing
Solar resource / system efficiency	4.5 peak sun hours / 70% (assumptions)
PV with 1.5 design multiplier	201 W, rounded scenario about 200 W
3-day LiFePO4 bank at 12 V	155 Ah; 80% usable depth; 85% efficiency
3-day lead-acid bank at 12 V	248 Ah; 50% usable depth; 85% efficiency
Controller calculation	About 21 A at recommended PV; select by voltage/current ratings
PoE feed	Regulated compatible 24 V passive PoE from 12 V bank
Excluded loads	Routers, switches, monitoring and future expansion

A system near 200 W is the mathematical scenario, not a verified winter design. Check minimum-month insolation, recharge after prolonged low sun, temperature derating, battery condition and all loads. Grounding, surge protection, weatherproofing and structural work require site inspection.

Historical source subtotal: backhaul \$1,380 + zone equipment \$2,090 + two core routers \$420 = \$3,890. Cable, modems, accessories, uncertain currency lines, missing radio quantities and solar items prevent a complete present-day project total.

Engineering audit and remaining evidence

The review corrects the following issues while preserving the project implemented status and the original documentation. The full audit in the repository records completion evidence for each remaining item.

Review area	Previous issue	Current treatment
Radio table	PowerBeam previously approximated from Rocket TX power	Use actual device-specific MCS0-15 tables
MIMO rate	MCS0-7 rate doubled without two-stream sensitivity	Explicit MCS8-15; MCS15 is 130 Mbps PHY
Annual outage	Unverified climate and probability time basis	Withdraw annual-minute claims pending valid inputs
Co-site isolation	Fixed spacing and blanket cross-polarisation	Preserve both MIMO chains; measure desensitisation
Power/EIRP	Maximum TX treated as initial operating setting	Verify permitted EIRP; use sensitivity scenarios
Mast height	Coarse DEM used for firm height advice	Treat 6/10/15 m as scenarios; survey and structural review
Distribution	2.4 GHz and 5 GHz roles insufficiently defined	Confirm radio pairs, Ethernet interconnect and sector SKU
Solar feed	12 V bank did not show the 24 V PoE conversion	Include regulated compatible 24 V passive PoE
Budget	Subtotal presented close to a complete project cost	Label historical subtotal; identify unpriced/uncertain items

The main remaining evidence is site photographs, surveyed antenna positions/heights, device inventory, actual settings, per-chain signal/noise, channel scans, traffic tests and power/uptime logs. Product-family images and planning screenshots cannot substitute for those records.

Field acceptance record and references

Use this evidence register during verification of the installed system. Agree service throughput, latency, packet loss and availability targets with the operator before applying pass/fail decisions. A seven-day log is an initial stability screen, not annual availability proof.

Check	Record required	Evidence	Public status
Survey	Mounting point, AMSL/AGL heights, obstacles and endpoint approaches	Survey drawing / photos	Not supplied
RF settings	Actual SKU, firmware, frequency, width, TX and country setting	Configuration exports	Not supplied
Signal	RSSI each chain, noise, SNR, MCS, CCQ/airMAX quality under load	Timestamped airOS captures	Not supplied
Payload	Each hop and end to end, both directions; record load and duration	iperf3 + ping/loss records	Not supplied
Co-site	Operate both links together and compare noise/RSSI/rate	Isolation/desensitisation test	Not supplied
Coverage	Record AP/client bearings, heights and zone boundary readings	Zone validation map	Not supplied
Power	Measure all loads and test battery autonomy/failover	Power and recovery record	Not supplied
Stability	Log rates, signal, resets and interruptions for at least seven days	Monitoring export	Not supplied

Original requirements: Author-supplied Atma to Al-Sharq requirements PDF/DOCX: equipment and historical prices, page 1; zone map, page 2.

PowerBeam M5 400: https://dl.ui.com/datasheets/powerbeam/PowerBeam_DS.pdf

Rocket M5: https://dl.ui.com/datasheets/rocketm/RocketM_DS.pdf

NanoStation M2: https://dl.ui.com/datasheets/nanostationm/nsm_ds_web.pdf

RocketDish: <https://techspecs.ui.com/uisp/wireless/rd-5g>

UISP Design Center: <https://ispdesign.ui.com/>

Elevation dataset: <https://open-meteo.com/en/docs/elevation-api>

Free-space propagation: <https://www.itu.int/rec/R-REC-P.525/en>

Terrestrial LOS design: <https://www.itu.int/rec/R-REC-P.530/en>

Map attribution: <https://www.openstreetmap.org/copyright>