



iQ·link[®]

Key Features



Table of Contents

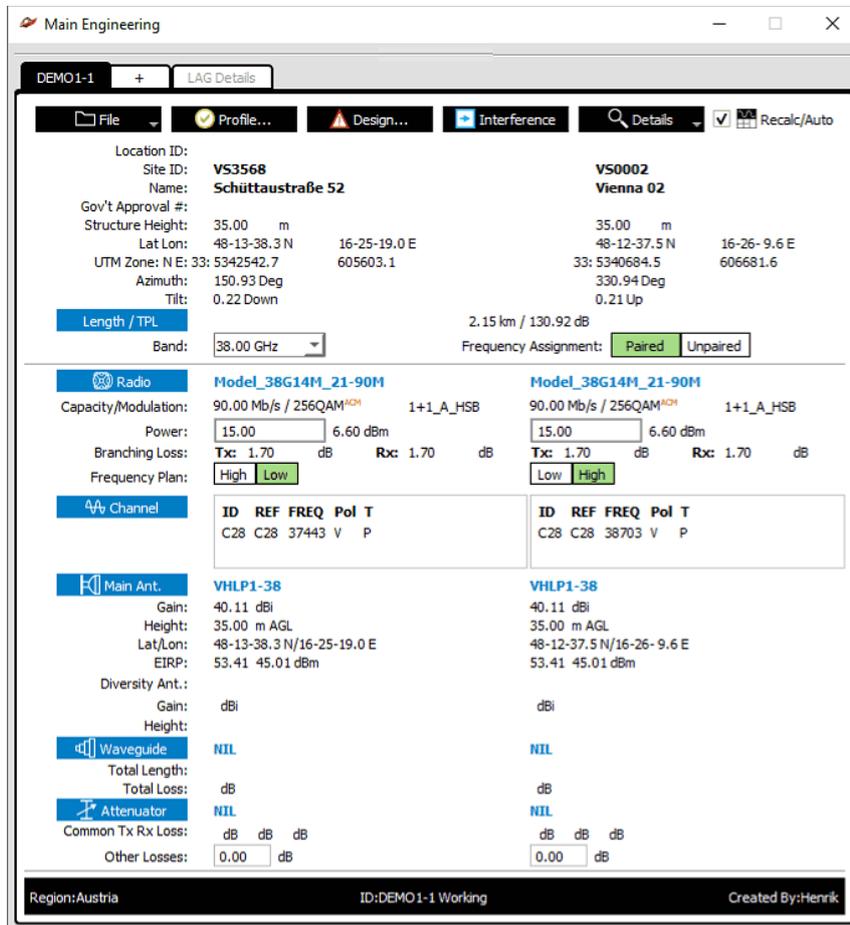
1. Quick Link Budget Design	3
2. Radio State Analysis Graphics	4
3. Comprehensive support for Adaptive Modulation (ADM) radios	4
4. Comprehensive Network View & Live integration with Google Earth	5
5. Detailed Path Profile Analysis	7
6. Availability and Performance Assessment	9
7. Interference Analysis	10
8. Bulk Link Design	11
9. Automatic Frequency Planning (AFP)	13
10. Near and Non-Line of Sight (nLOS) Propagation Model	13
11. Point-to-Multipoint / Fixed Wireless Access Design Functionality	14
12. Utility Programs	14
13. Reports	15
14. Third Party Application Integration	15

1. Quick Link Budget Design

iQ-link enables rapid creation of Point-to-Point (PtP) or Point-to-Multipoint (PMP) links.

Links may be saved as working designs (nominal), primary designs or confirmed (password protected, on-air) links.

This engineering window provides a one-page summary of all of the necessary microwave link elements, enabling the user to build the link and make changes without the need to sort through a clutter of multiple windows.



Main Engineering

DEMO1-1 + LAG Details

File Profile... Design... Interference Details Recalc/Auto

Location ID: VS3568 VS0002
 Site ID: Schüttaustraße 52 Vienna 02
 Name: VS0002
 Gov't Approval #: VS0002
 Structure Height: 35.00 m 35.00 m
 Lat Lon: 48-13-38.3 N 16-25-19.0 E 48-12-37.5 N 16-26-9.6 E
 UTM Zone: N E: 33: 5342542.7 605603.1 33: 5340684.5 606681.6
 Azimuth: 150.93 Deg 330.94 Deg
 Tilt: 0.22 Down 0.21 Up

Length / TPL: 2.15 km / 130.92 dB
 Band: 38.00 GHz Frequency Assignment: Paired Unpaired

Radio Model_38G14M_21-90M Model_38G14M_21-90M
 Capacity/Modulation: 90.00 Mb/s / 256QAM^{60M} 1+1_A_HSB 90.00 Mb/s / 256QAM^{60M} 1+1_A_HSB
 Power: 15.00 6.60 dBm 15.00 6.60 dBm
 Branching Loss: Tx: 1.70 dB Rx: 1.70 dB Tx: 1.70 dB Rx: 1.70 dB
 Frequency Plan: High Low Low High

ID	REF	FREQ	Pol	T
C28	C28	37443	V	P
C28	C28	38703	V	P

Main Ant. VHLP1-38 VHLP1-38
 Gain: 40.11 dBi 40.11 dBi
 Height: 35.00 m AGL 35.00 m AGL
 Lat/Lon: 48-13-38.3 N/16-25-19.0 E 48-12-37.5 N/16-26-9.6 E
 EIRP: 53.41 45.01 dBm 53.41 45.01 dBm
 Diversity Ant.:
 Gain: dBi dBi
 Height: dBi dBi

Waveguide NIL NIL
 Total Length: dB dB
 Total Loss: dB dB

Attenuator NIL NIL
 Common Tx Rx Loss: dB dB dB dB dB dB
 Other Losses: 0.00 dB 0.00 dB

Region:Austria ID:DEMO1-1 Working Created By:Henrik

2. Radio State Analysis Graphics

The job of the microwave design engineer is becoming more and more challenging as modern IP radios become more complex with multiple modulations and power adjust features. Comsearch has developed an innovative graphical user interface to present the radio's options to the designer in the most intuitive way possible.



Not only will you get the most out of your radio and microwave link design, but you will avoid potentially very costly mistakes of a poor design. This feature makes it easier to deploy microwave backhaul in settings that require special attention—namely, small cells and links with the most sophisticated radios. Highlights include:

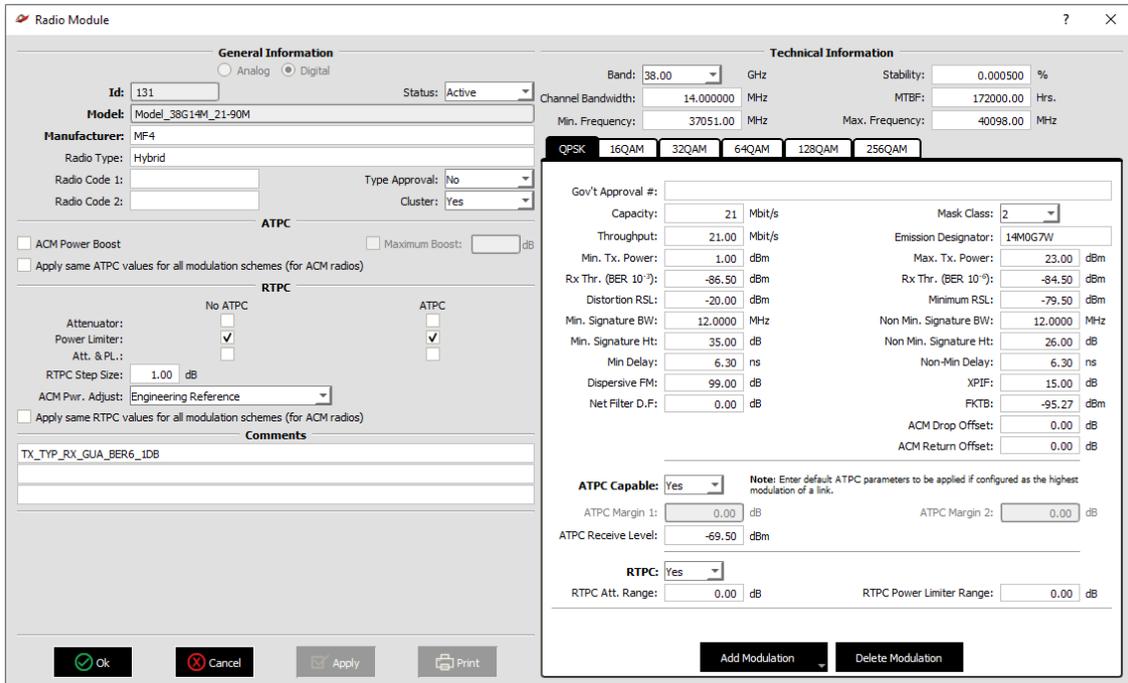
- The Maximum, Minimum and Configured Transmit power for each modulation is immediately visible.
- As radio power, attenuator, ATPC Rx targets are adjusted, the resulting RSL, Fade Margin and Availability of each modulation is updated in real time.

3. Comprehensive support for Adaptive Modulation (ADM) radios

The result of numerous discussions and meetings with major operators and equipment manufacturers, iQ-link offers the most comprehensive functionality to support the design of microwave links with adaptive modulation radios including:

- Simple and flexible import of numerous Adaptive Modulation radios through the use of a standardized spreadsheet format
- Highly customizable link designs with Voice/Data analysis (High Priority/Low Priority traffic)
- Option to report Outage/Unavailability statistics based on the specified Priority and Non-Priority traffic distribution
- Full Consideration of:
 - ADM Power Adjust
 - ADM Power Boost
 - Modulation Downshift offset
 - Modulation Upshift offset
- Full implementation of ADM with Automatic Transmit Power Control (ATPC)
- Availability and Performance calculations for all modulations

- Detailed interference analysis with the ability to automatically detect the worst-case modulation combination of interfering transmitter and victim receiver



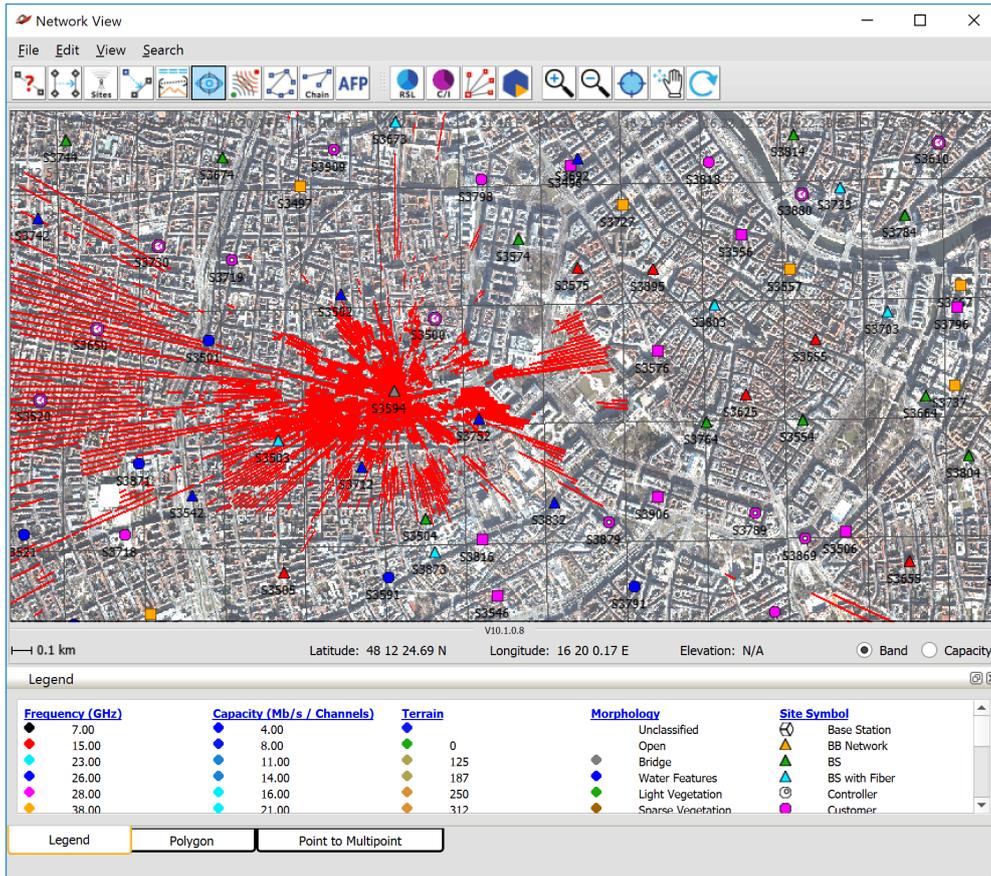
4. Comprehensive Network View & Live integration with Google Earth

Network View provides a multi-faceted interface that allows the user to graphically represent all or any part of the microwave network.

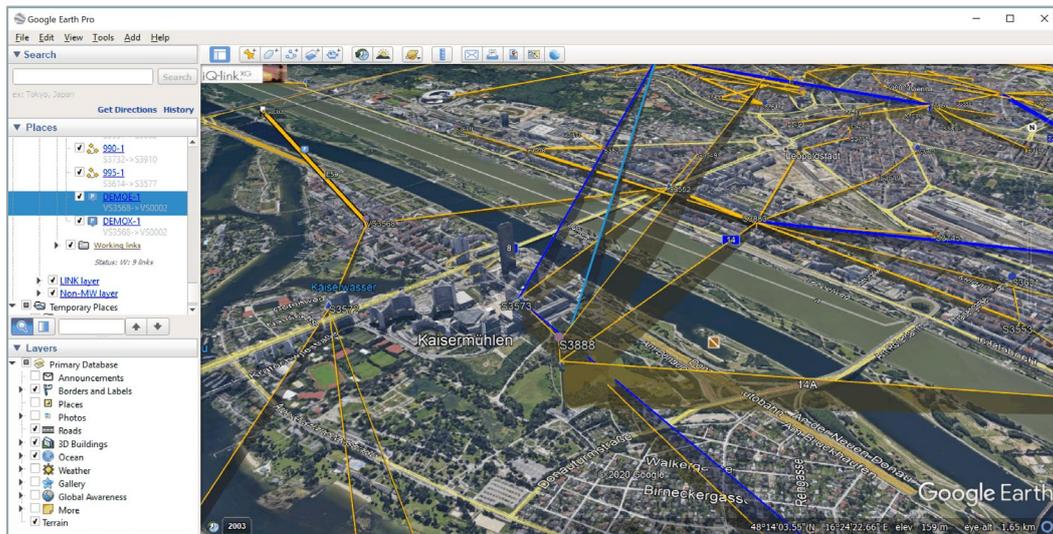
Links and sites can be displayed, as well as information regarding each component, including frequencies, capacities, channelization plans, high-low configuration, and other details of the system. The Network View module provides a rapid overview of the network architecture and allows the engineer to perform many rapid engineering assessments such as quick point-to-point link clearance analysis and global line-of-sight studies from a single site with overlap region definition from multiple sites.

Users have the ability to visualize environmental factors such as terrain, morphology, and clutter layers, as well as buildings, map, aerial imagery, vector data and other layers.

Several Engineering functions can be accomplished directly from this utility including quick and detailed link profiles, rapid Line of Sight (LOS) analysis and reporting, site creation, chain reliability calculations and Coverage and C/I analysis for PMP / Fixed Wireless Access systems.



Additionally, iQ-link offers a direct LIVE integration with Google Earth. As links are planned and saved in iQ-link, they automatically appear in Google Earth! Anyone in your organization – from engineers to the marketing department – can have a detailed view into the network:



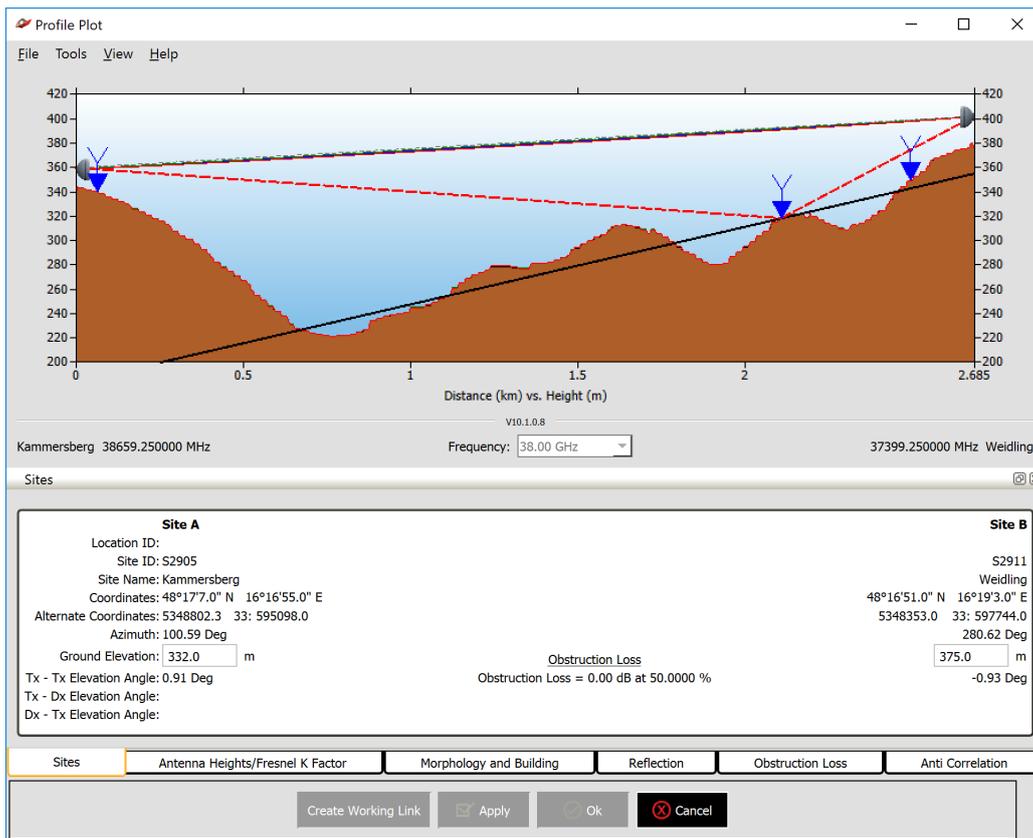
5. Detailed Path Profile Analysis

iQ·link’s Profile Module generates a terrain profile between two sites to determine the line-of-sight (LOS) characteristics of the proposed link. The terrain profile can also incorporate clutter data such as buildings and vegetation.

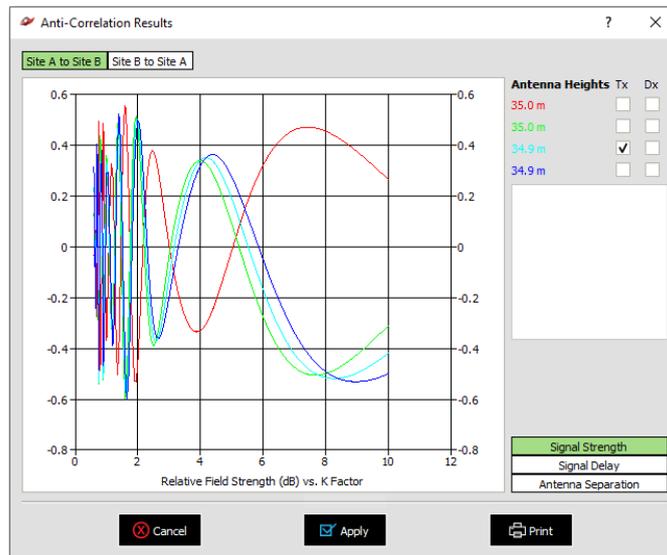
Digitized terrain profiling allows the microwave design engineer to accurately optimize antenna heights for proper path clearance, while avoiding potentially harmful reflections.

Results of the profile are shown both graphically and numerically for flat earth and up to three values of earth curvature (K-factor) and link clearance (Fresnel zone) criteria. The K-factors and Fresnel zone values are user-specified and can be easily changed as necessary.

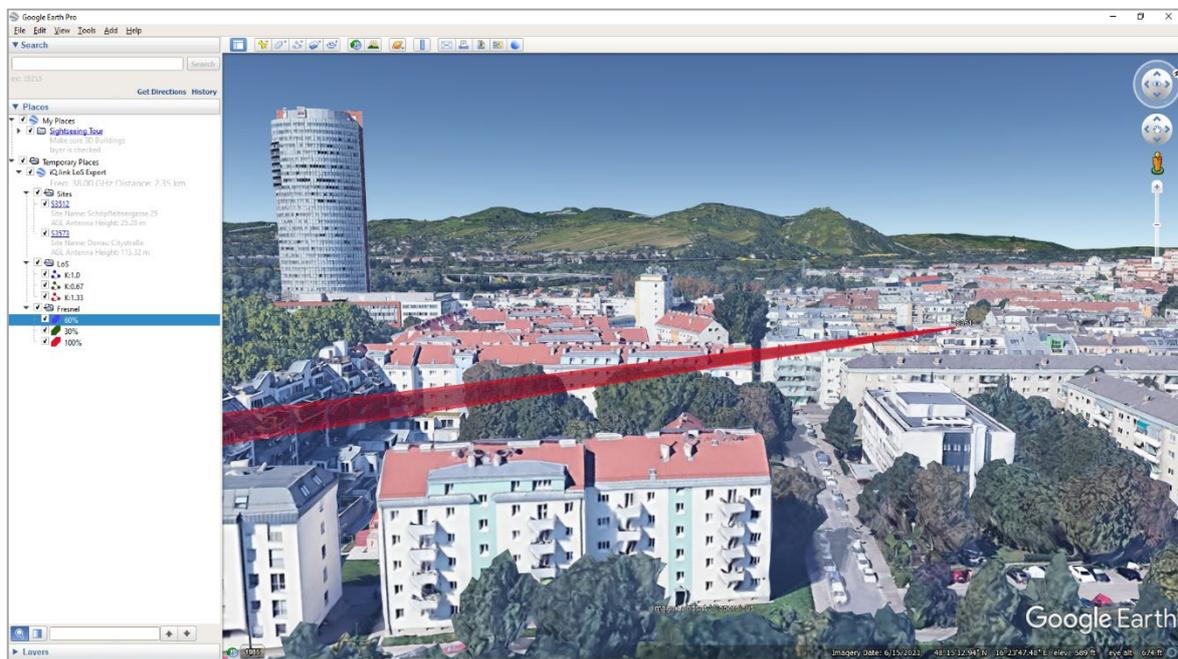
Morphology, user-definable clutter and even high-resolution building data can be incorporated into the path profile.

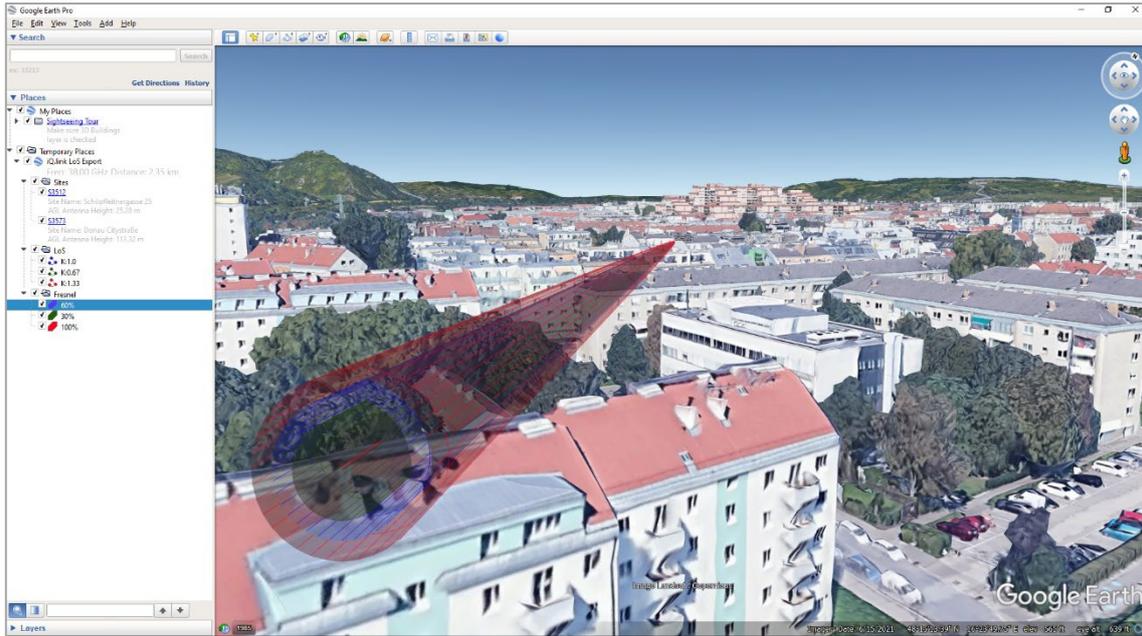


Anti-Correlation analysis provides the user with the ability to determine the ideal primary and diversity antenna spacing required in order to counter multipath propagation effects (based on ITU-R P.530).



The Path Profile can be exported in Google Earth's KMZ format, showing the 3D Fresnel Zone with layers corresponding to the Fresnel Zone percentage, allowing for an accurate visualization of the effect of an obstruction in the path.





6. Availability and Performance Assessment

iQ-link performs link availability and performance calculations using industry standard propagation and objective models including Vigants, Glauner, ITU-R P.530 (revisions 6 through 17) ITU-T G.821 and G.826, Crane, ITU-R P.837-3, ITU-R P.837-1, ITU-R P.837-3, ITU-R P.837-5/6, ITU-R P.837-7:

Design

Link Id: DEMO1 Design Id: 1 Objectives: General Prediction Method: P.530-15/16

Fade Margin Details

Site A: VS3568 / Schüttaustraße 52
 Site B: VS0002 / Vienna 02

Obstruction Loss: 0.00 dB At 50.0000%

Primary / Diversity / ATPC RSL: -39.10 / N/A / -48.50 dBm

Threshold/ACM Drop Level: 10⁻⁶ BER / 10⁻³ BER

Thr. Deg. A / Field Margin / Thr. Deg. B: 0.00 dB Manual 1.00 dB 0.00 dB Manual

Composite Fade Margin: 20.40 dB ⚠

Details...

Site B: VS0002 / Vienna 02

Obstruction Loss: 0.00 dB At 50.0000%

Primary / Diversity / ATPC RSL: -39.10 / N/A / -48.50 dBm

Threshold/ACM Drop Level: 10⁻⁶ BER / 10⁻³ BER

Thr. Deg. A / Field Margin / Thr. Deg. B: 0.00 dB Manual 1.00 dB 0.00 dB Manual

Composite Fade Margin: 20.40 dB ⚠

Rain

Rain Rate Method: ITU-R P.837-7

0.01% Rain Rate: 28.8 mm/hr Combined Rain and Wet Snow (UK)

Combined Rain and Wet Snow (P.530-16)

Polarity: Vertical

Diversity XPD

Frequency Diversity

Improvement Factors A -> B B -> A

Frequency Diversity NIL NIL

Space Diversity NIL NIL

Multipath Details

Geodimatic: 15260.304 x 10⁸ Calculator

Roughness: 1.00 Default Calc. from Terrain

Climate: 1.00

Avg Ann. Temp: 10.00 °C

Target Objective ACM Statistics

Objective: 99.9950 %

Rain FFM Req'd: 17.87 dB Pwr Req'd: 12.47 dBm

Multipath CFM Req'd: 0.00 dB Pwr Req'd: -5.40 dBm

Two Way

Unavailability: WM Annual

Outage: WM Annual

View All Modulations

Unavailability:	Rain	Uptime(%)	Downtime(%)	Downtime(sec)	Downtime(sec/km)
		99.996820	0.003180	1002.86	466.64
Outage:					
Flat Multipath		99.999995	0.000005	1.43	0.66
Selective		100.000000	0.000000	0.00	0.00
Total Outage		99.999995	0.000005	1.43	0.66
Unavail. + Outage		99.996815	0.003185	1004.28	467.31

Generic Voice Data

Recalculate Info OK Print

7. Interference Analysis

iQ-link's detailed, efficient interference analysis calculates the interference potential from a proposed new link against the database of all previously stored primary designs and confirmed links. Both Point-to-Point and Point-to-Multipoint systems are considered simultaneously.

A Cumulative interference analysis is offered in order to predict the amount of degradation caused by the cumulative interference of a maturing network.

Other options include the ability to utilize 3D antenna patterns when available, predict diffraction loss along interference paths due to obstacles and relax interference objectives due to correlated fading in bands where rain is the primary fading mechanism.

IA Culling Parameters

General Filters
 Search Radius: 40.00 km Count: 8 of 8 Links Filter
 Link Filter Options: Analyze all links
 Design Path Polarity: V H Both
 Assign Existing Polarity First?: Yes No
 Allow Polarity Change?: Yes No

Channel Selection
 Analyze Channels: Assigned Channels Only Partial Band Full Band
 Assign Existing Channels First?: Yes No
 Partial Band Filter (Site A / Site B): Min: C25 / C25 Max: C28 / C28 Channel Pool
 Frequency Window: 112 MHz(+/-)
 If more than 1 channel is available, then assign a channel based on the: Most Least Degradation, or First Channel in List

IRF Method Parameters
 Single TD Margin: 0.20 dB Cumulative TD Margin: 0.34 dB
 Default IRF Value: 0.00 dB Calculate IRF Curves on-the-fly

C/I Method Parameters
 Margin: 0.00 dB Default C/I Obj.: 37.00 dB
 Cumulative Degradation Limit: dB

OH Loss
 Calculate OH Loss: Yes No B - Maritime Temperature Over Land
 Profile Start Distance: 0.00 km Include Building Include Morphology
 Profile K Factor: 1.33

ATPC
 Use ATPC Criteria: Yes No
 Design Path Power: TXmax TX ATPC
 Environment Path Power: TXmax TX ATPC

Buttons: Calculate... Reset Quit

Interference Case Details

Environment Path Details

Site ID / Location ID: S3532/ Troststr. 125 53609/ 10., Knollgasse 19-21/Stg. 1
 Latitude Longitude: 48-10-22.0N 16-21-11.0E 48-10-29.0N 16-21-21.0E
 UTM Zone: North East: 33: 5336389.2 600593.4 33: 5336609.0 600796.1
 Gnd Elev & Length: 229.00 m 0.30 km 221.00 m
 Path Azimuth: 43.70° 223.70°
 Radio Model: UX - 3B - 3.5 - 4QAM - 2x2 UX - 3B - 3.5 - 4QAM - 2x2
 Capacity / BW / Mod.: 2x2 Mb/sec / 3.5 MHz / 4QAM 2x2 Mb/sec / 3.5 MHz / 4QAM
 Power: 15.00 dBm 15.00 dBm
 Channel / Frequency: A99 / 38662.75V MHz A99 / 37402.75V MHz
 Antenna Model / Hgt.: S81-380 (Gain: 0.00 dBi) / 24.00 mAGL S81-380 (Gain: 0.00 dBi) / 24.25 mAGL
 Antenna Coordinates: 48-10-22.0N 16-21-11.0E 48-10-29.0N 16-21-21.0E
 33: 5336389.2 600593.4 33: 5336609.0 600796.1
 Waveguide Loss: 0.00 dB 0.00 dB
 Free Space / Abs. Loss: 113.56 dB / 0.03 dB -128.59 dBm / -82.00 dBm
 RSL / Threshold: -128.59 dBm / -82.00 dBm -128.59 dBm / -82.00 dBm

Calculation Results

Include OH Loss: Yes No Exclude Environment Link In Future Analyses Prev. More

Profile	Interference Calculation	Radio Modulation	OH Loss (dB)	Loss Type	FSPL (dB)	Int Level (dBm)	C/I Calc (dB)	Int Obj	Int Mode	Margin (dB)
A->D	(256QAM)->(4QAM)		167.42	ITU	142.04	-292.40	-8.61 (CORR)	17.05 dB	T/I	141.76 (CORR)
D->A										
B->C										
C->B										

Buttons: Next Path Prev. Path Next Channel Prev. Channel Update Design Quit Print...

Design Channel A: C25/37401 B: C25/38661 Interfering Path 1 of 13 4961-1 Primary

Site A
 Schüttaustraße 52
 48 13 38.32 N / 16 25 19.02 E
 33: 5342542.7 605603.1
 Discrimination Angle: 69.28°

Site B
 Vienna 02
 48 12 37.50 N / 16 26 9.60 E
 33: 5340684.5 606681.6

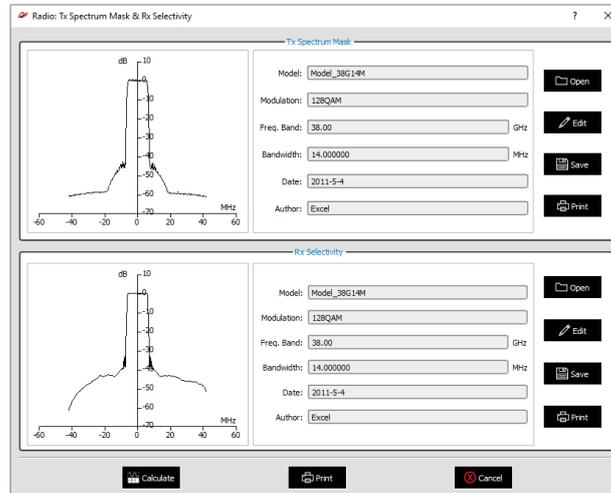
Site C
 10., Knollgasse 19-21/Stg. 1
 48 10 29.00 N / 16 21 21.00 E
 33: 5336609.0 600796.1

Site D
 Troststr. 125
 48 10 22.00 N / 16 21 11.00 E
 33: 5336389.2 600593.4
 Discrimination Angle: 356.46°

Tx Spectrum & Rx Selectivity

Detailed interference objectives between any combination of interfering and victim radios are quickly derived using Tx Spectrum masks and Rx selectivity curves provided by the manufacturer or ETSI defaults. The interference objective curves can be calculated on-the-fly, this results in a very fast interference analysis with no impact on performance or on the quality of the results.

Since the interference objectives matrix no longer needs to be precalculated and saved to the database, installation times for new radio models is greatly reduced. This is especially important in networks with a large number of radio models.



8. Bulk Link Design

iQ·link provides the user with the tools to perform Bulk Link designs, Obstruction Loss calculations, Interference Analysis, and Automatic Frequency Planning (AFP) by modifying the Link configuration in an

Excel or delimited text template and then importing them into iQ-link. This streamlined design workflow can translate into great savings in both time and resources.

The screenshot shows the 'Import Link Utility' window with the following configuration details:

- Open:** ASCII File, Excel File
- Action:** Import New LIPs
- File Name:** C:/Users/Henrik/Desktop/tmp/file.xlsx
- Coordinate System:** Geographic (Lat/Lon)
- Units:** Metric, English
- Header Included:**
- Calculate Obstruction Loss:**
- Climate:** A - Continental Temperate
- K Factor:** 1.33
- Buttons:** Include User Clutter, Include Building, Include Morphology
- Fresnel Zone:** 1.0
- Minimum Clearance (m):** 5.0
- Run AFP:**
- Run Design:**
- Run IRF:**

The import file cannot be validated until minimum column mapping is completed. Minimum is Site A and Site B Coordinates. Mapping requires right clicking on column header, and identifying the column from a pick list.

	Capacity A	Radio Model A	ADM_A	Low Mod. A	Ref. Mod. A	High Mod. A	Radio Conf. A	IDU Conf. A	Supervis
1	66	Model_38G14M_21-90M	Y	QPSK	64QAM	64QAM	1+1A_HSB		
2	999	FlexPort80	Y	BPSK-250	QPSK-1G	QPSK-1G	1+0		X
3	4x2	UX - 38 - 7 - 4QAM - 4x2	N	N/A	N/A	N/A			
4	4x2	UX - 38 - 7 - 4QAM - 4x2	N	N/A	N/A	N/A			
5	4x2	UX - 38 - 7 - 4QAM - 4x2	N	N/A	N/A	N/A	1+0		
6	8x2	UX - 23 - 14 - 4QAM - 8x2	N	N/A	N/A	N/A	1+1HSB		
7	2x2	UX - 38 - 3.5 - 4QAM - 2x2	N	N/A	N/A	N/A	1+0		
8	4x2	UX - 38 - 7 - 4QAM - 4x2	N	N/A	N/A	N/A	1+0		
9	4x2	UX - 38 - 7 - 4QAM - 4x2	N	N/A	N/A	N/A			

■ A row marked red indicates that the import data for the link is invalid. Check column 'Problems With The Row'.
■ A row marked yellow indicates that Site A and/or Site B exist in database.

Buttons: Validate Data, Import, Export, Close

9. Automatic Frequency Planning (AFP)

iQ·link provides the user with the ability to perform automatic frequency planning. Detailed criteria can be set so that the final result meets your network design needs. In addition, this module incorporates a sophisticated high/low conflict resolving algorithm. Combined with the speed of iQ·link native calculation algorithm, this feature can significantly improve on design efficiency and time.

AFP Link List / Priority

Band	Link ID	Status	Site ID	Location ID	Plan	Name	Site ID	Location ID	Plan	Name	Priority
38.00	1001-1	P	S3611		H	3, Radetzkystraße 21	S3588		L	3, Hainburgerstraße 33	0
38.00	1004-1	P	S4043		H	Ltg. 443 Mast Nr.1057	S3996		L	Am Sportplatz 2	0
38.00	1005-1	P	S3982		L	Neusiedlerstraße	S4043		H	Ltg. 443 Mast Nr.1057	0
38.00	1015-1	P	S3770		H	Porzellangasse 4	S3895		L	Am Hof 6a	0
38.00	1021-1	P	S2918		L	Steinfeldgasse 46	S2969		H	Wolfstraße 16-18	0
38.00	1029-1	P	S3747		H	Währinger Gürtel 122	S3876		L	Spittelau (AKH)	0
38.00	1070-1	P	S3556		H	Vorlaufstr. 5	S3895		L	Am Hof 6a	0
38.00	1071-1	P	S3727		H	Heßgasse 1	S3895		L	Am Hof 6a	0

Select All Deselect All

Additional Priorities

Link Id: Ascending Descending Primary Secondary

Capacity: Ascending Descending Defined

Site: Site A Site B

Modulation:

Link Length: Ascending Descending

Perform High-Low Conflict Check: Yes No

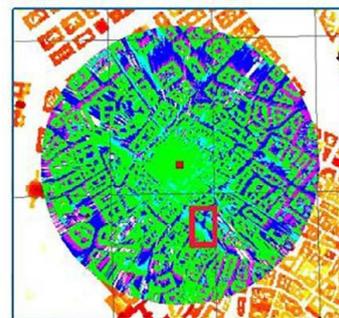
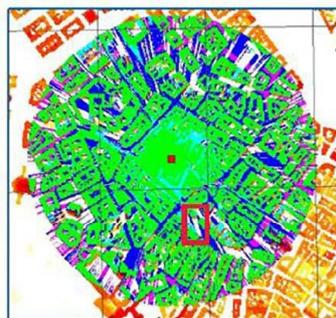
Attempt to resolve Conflicts Automatically: Yes No

Link Weighting: Link Density Capacity Density Link+Capacity Density Capacity+Link Density

OK Cancel

10. Near and Non-Line of Sight (nLOS) Propagation Model

Backhaul in a dense urban environment with small cells presents challenges that traditional Line of Sight (LOS) microwave cannot always address. RF studies have shown that non or near Line of Sight (nLOS) microwave can be a viable solution. Traditional microwave planning tools rely on obstruction loss algorithms from the ITU or NBS Technical Note 101. These were developed to handle a variety of terrain obstructions. However, they are not accurate for predicting losses when the signal is being obstructed by buildings and vegetation. Offered as an optional add-on to iQ·link, Comsearch has developed a unique and proprietary model that looks at the true obstruction environment along a path to better calculate losses. These models have been validated with a major radio vendor using existing network designs and integrated into iQ·link beginning with Version 9.5. Losses calculated by our nLOS model are not only highly accurate but are often significantly less than those predicted by traditional microwave obstruction loss models.



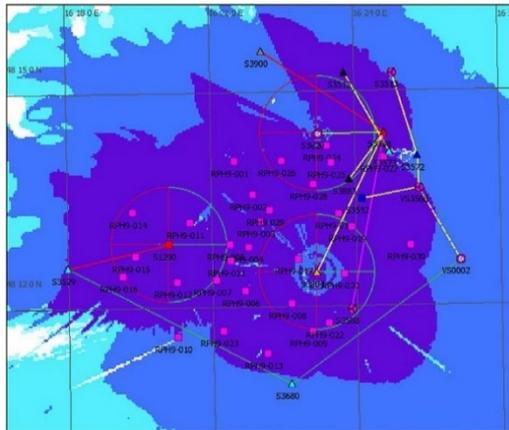
11. Point-to-Multipoint / Fixed Wireless Access Design Functionality

iQ·link supports the design of Hub-Subscriber links that are required to implement such networks as Fixed Wireless Access, Local Multipoint Distribution Service (LMDS), and other point-to-multipoint (PMP) applications.

The network view module offers a color-coded plot of receive signal level (RSL) and interference (C/I) which may be displayed for selected hub sites within the Network View. The user controls the color-coding scales. It is possible to visualize locations around hub facilities where acceptable coverage and interference-free operation are available.

Both omni-directional and sectorized antennas are supported with the ability to enter and utilize antenna pattern data in both the azimuth and elevation planes.

When combined with high-resolution terrain and building data, design and analysis of point-to-multipoint networks is fast and simple.



12. Utility Programs

iQ·link comes with a several utility programs so that administrative tasks can be performed easily and with controlled access.

Utility features include:

- Coordinate conversion
- Find-point algorithm
- Import for Sites, Antennas, Radios, Links and Network and Pathloss files.
- System Administration
- Google Earth KML Export
- Bulk Selective and Radial Line of Sight Manager
- Bulk Reengineering of Links
- Bulk Export and Delete Links

13. Reports

iQ-link offers several reports, which are built on HTML templates and Database Views. They can be fully customized, including the addition of your own company logo. These reports can be saved in PDF, EXCEL or CSV formats.

	Site A	Site B
Sites		
Location ID:	VS3568	VS0002
Site/Sector ID:	VS3568	VS0002
Name:	Schüttaustraße 52	Vienna 02
Gov't Approval #:		
Latitude:	48-13-38.3 N	48-12-37.5 N
Longitude:	16-25-19.0 E	16-26- 9.6 E
UTM Zone:	33:	33:
Northing Easting:	5342542.7 / 605603.1	5340684.5 / 606681.6
Ground Elevation:	163.00 m	155.00 m
Structure Height:	35.00 m	35.00 m
Antenna/Path Azimuth:	150.93 Deg	330.94 Deg
Mech./Elec./Path Tilt:	0.22 Down	0.21 Up
Path Length:	2.15 km	
Frequencies		
Band:	38.00 GHz	
Plan:	Low	High
Channel/Frequency Pol.:	C28 37443.000 V	C28 38703.000 V
Radios		
Make:	MF4	MF4
Model:	Model_38G14M_21-90M	Model_38G14M_21-90M
Bit Rate:	90.00 Mb/s / 256QAM ^{ACM} (1+1_A_HSB)	90.00 Mb/s / 256QAM ^{ACM} (1+1_A_HSB)
Bandwidth:	14 MHz	14 MHz
Emission:	14M0D7W	14M0D7W
Power:	15.00 (6.60) dBm	15.00 (6.60) dBm
Branching Loss:	Tx: 1.70 dB Rx: 1.70 dB	Tx: 1.70 dB Rx: 1.70 dB
Antennas		
Primary		
Make:	Andrew	Andrew
Model:	VHLP1-38	VHLP1-38
Gain:	40.11 dBi	40.11 dBi
Height:	35.00 m AGL	35.00 m AGL
Latitude/Longitude:	48-13-38.3 N/16-25-19.0 E	48-12-37.5 N/16-26- 9.6 E
EIRP:	53.41 (45.01) dBm	53.41 (45.01) dBm

14. Third Party Application Integration

iQ-link offers the option to integrate with third party applications for both unidirectional and bidirectional workflows.

This allows iQ-link to update external applications and vice versa.

