

TV White Space Interference/Coexistence Management

Topics

- Thoughts on coexistence
- iQ.link[®]XG
- iQ.clear[®]XG

Thoughts on Coexistence

- White Space database will provide lists of available channels based upon FCC criteria
 - Ultimately, analysis may be performed in the device
 - Database will then provide only data to the device
- Either database or device can perform coexistence analyses
- Possible coexistence analyses
 - Refine list of available channels
 - Near real-time frequency planning among local devices

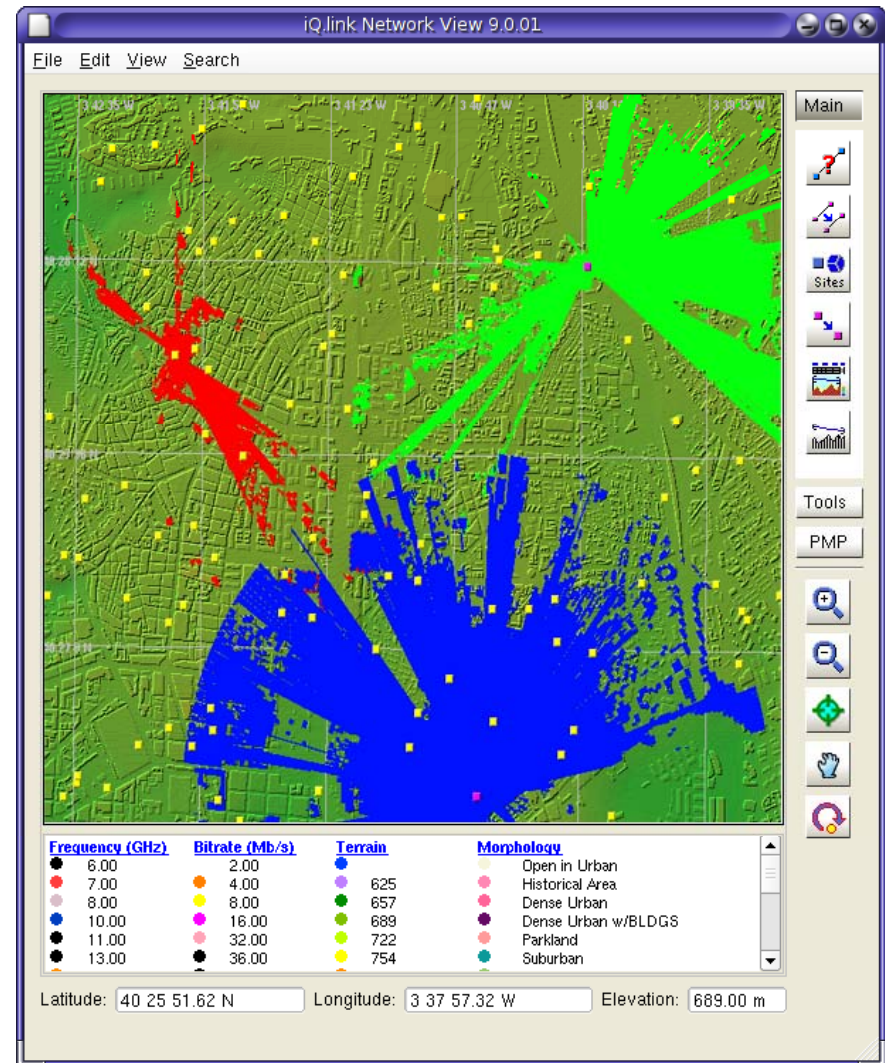
iQ.link[®] XG

- Next generation microwave fixed network / backhaul planning software tool:
 - Line of sight analysis to make sure links are clear of any obstacles
 - Availability & performance assessment to build reliable links
 - Comprehensive Interference analysis to make efficient use of the spectrum and avoid interference
 - Secure management of microwave link network data (sites, links, radios, antennas, waveguides, attenuators, etc..)
 - Full microwave spectrum support for backhaul and fixed access in a broad range of wireless systems including Cellular, PCS, GSM, UMTS, TETRA, 3G, WiMax, LTE and more.
 - Availability and performance assessment using the latest ITU models



iQ.link[®]XG – Network View

- Graphical top-down view of network topology
- Display Terrain, Morphology, Building, Vector
- Supports numerous GIS formats
- LOS Analysis
- PMP Coverage & C/I
- Panning, zooming



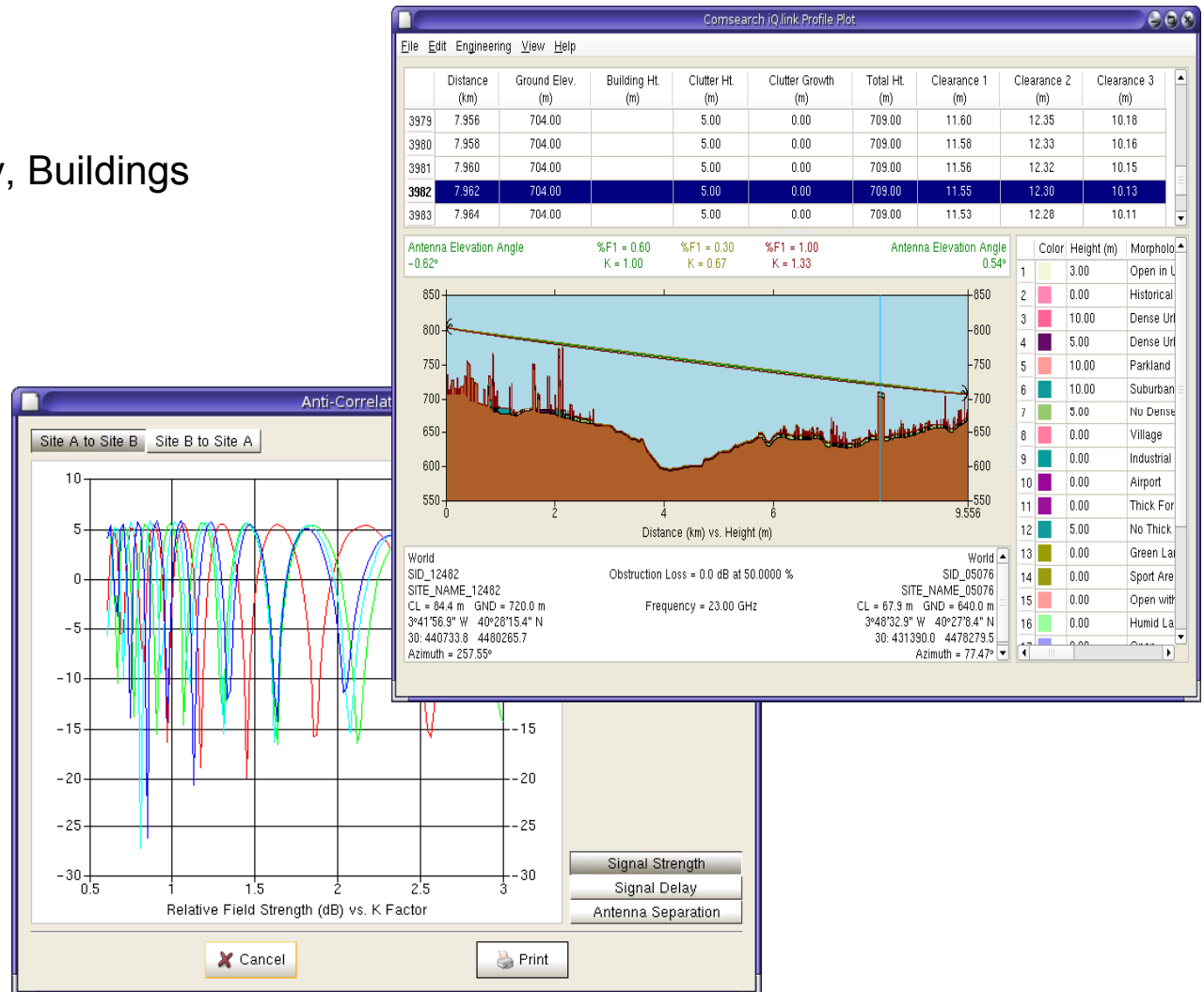
iQ.link[®]XG – Link Budget

- Quick link budget:
 - Sites (multiple, global coordinate systems supported)
 - Radios
 - Frequencies
 - Antennas
 - Waveguides
 - Attenuators
- Links may be saved as working designs (nominal), primary designs or confirmed (password protected, on-air) links.

The screenshot displays the 'IQ Link - Main Engineering - 9.0.01' software interface. It shows a configuration for a link between two sites, 'World' and 'World'. The interface is divided into several sections: Location ID, Radio, Channel, Main Ant., Waveguide, and Attenuator. The 'Radio' section shows two radio configurations, both 'TN 23G 75x2 128QAM-RAU2 N'. The 'Channel' section shows two channel configurations, both 'D1 D2'. The 'Main Ant.' section shows two antenna configurations, both 'VHLP2.5-220'. The 'Waveguide' section shows two waveguide configurations, both 'EW220'. The 'Attenuator' section shows two attenuator configurations, both 'VARIABLE'. The 'Attenuator Loss' section shows two attenuator loss configurations, both '0.00 dB 2.00 dB 0.00 dB'. The 'Other Losses' section shows two other losses configurations, both '0.50 dB'. The 'Created By' section shows 'unknown'. The 'Field Margin' section shows '0.00 dB'. The 'Free Space Loss' section shows '138.16 dB'. The 'Absorption Loss' section shows '1.47 dB'. The 'Total Prop. Loss' section shows '139.63 dB'. The 'Region' section shows 'Comsearch'. The 'ID' section shows 'IGL85_00006 Confirmed 22-OCT-2008 T N'. The 'Frequency Assignment' section shows 'Paired Unpaired'. The 'Band' section shows '23.0 GHz'. The 'Length' section shows '8.39 km'. The 'Azimuth' section shows '275.09 Deg'. The 'Tilt' section shows '0.70 Down'. The 'UTM Zone' section shows 'N E: 30:4461763.7 412485.2'. The 'Lat Lon' section shows '40-18- 6.5 N 4-01-47.2 W'. The 'Structure Height' section shows '25.00 m'. The 'Site ID' section shows 'SID_07125' and 'SID_07885'. The 'Name' section shows 'SITE_NAME_07125' and 'SITE_NAME_07885'. The 'Capacity' section shows '75x2 Mb/s 1+0'. The 'Power' section shows '16.00 dBm'. The 'Branching Loss' section shows 'Tx: 0.00 dB Rx: 0.00 dB'. The 'Frequency Plan' section shows 'High Low'. The 'Polarization' section shows 'V H V H V H V H'. The 'Gain' section shows '42.61 dBi'. The 'Height' section shows '25.00 m AGL'. The 'Lat/Lon' section shows '40-18- 6.5 N/4-01-47.2 W'. The 'EIRP' section shows '55.94 dBm'. The 'Diversity Ant.' section shows 'VHPI-220'. The 'Gain' section shows '34.80 dBi'. The 'Height' section shows '22.00 m AGL'. The 'Total Length' section shows '0.60 m'. The 'Total Loss' section shows '0.17 dB'. The 'Attenuator Loss' section shows '0.00 dB 2.00 dB 0.00 dB'. The 'Other Losses' section shows '0.50 dB'. The 'Created By' section shows 'unknown'. The 'Field Margin' section shows '0.00 dB'. The 'Free Space Loss' section shows '138.16 dB'. The 'Absorption Loss' section shows '1.47 dB'. The 'Total Prop. Loss' section shows '139.63 dB'. The 'Region' section shows 'Comsearch'. The 'ID' section shows 'IGL85_00006 Confirmed 22-OCT-2008 T N'. The 'Frequency Assignment' section shows 'Paired Unpaired'. The 'Band' section shows '23.0 GHz'. The 'Length' section shows '8.39 km'. The 'Azimuth' section shows '275.09 Deg'. The 'Tilt' section shows '0.70 Down'. The 'UTM Zone' section shows 'N E: 30:4461763.7 412485.2'. The 'Lat Lon' section shows '40-18- 6.5 N 4-01-47.2 W'. The 'Structure Height' section shows '25.00 m'. The 'Site ID' section shows 'SID_07125' and 'SID_07885'. The 'Name' section shows 'SITE_NAME_07125' and 'SITE_NAME_07885'. The 'Capacity' section shows '75x2 Mb/s 1+0'. The 'Power' section shows '16.00 dBm'. The 'Branching Loss' section shows 'Tx: 0.00 dB Rx: 0.00 dB'. The 'Frequency Plan' section shows 'High Low'. The 'Polarization' section shows 'V H V H V H V H'. The 'Gain' section shows '42.61 dBi'. The 'Height' section shows '25.00 m AGL'. The 'Lat/Lon' section shows '40-18- 6.5 N/4-01-47.2 W'. The 'EIRP' section shows '55.94 dBm'. The 'Diversity Ant.' section shows 'VHPI-220'. The 'Gain' section shows '34.80 dBi'. The 'Height' section shows '22.00 m AGL'. The 'Total Length' section shows '0.60 m'. The 'Total Loss' section shows '0.17 dB'. The 'Attenuator Loss' section shows '0.00 dB 2.00 dB 0.00 dB'. The 'Other Losses' section shows '0.50 dB'. The 'Created By' section shows 'unknown'. The 'Field Margin' section shows '0.00 dB'. The 'Free Space Loss' section shows '138.16 dB'. The 'Absorption Loss' section shows '1.47 dB'. The 'Total Prop. Loss' section shows '139.63 dB'. The 'Region' section shows 'Comsearch'. The 'ID' section shows 'IGL85_00006 Confirmed 22-OCT-2008 T N'.

iQ.link[®]XG – Profile

- Line of Sight analysis
 - Terrain, Morphology, Buildings
- Auto optimization of antenna heights
- Reflection analysis
- Anti-Correlation



iQ.link[®] XG – Design

- Availability and performance using latest ITU Models
 - Rain Attenuation (Crane and ITU)
 - Multipath (Vigants, Glauner and ITU)
 - Space Diversity optimization
 - Frequency Diversity
 - XPIC
 - ATPC
 - Adaptive Modulation



iQ.link Design 9.0.01

Link Id: IQL85_00006 Design Id: 0 Objectives: G.826 Prediction Method: P.530-9/10

Fade Margin Details

Site A		Site B	
Site Id/Location Id:	SID_07125 / World	SID_07885 / World	
Site Name:	SITE_NAME_07125	SITE_NAME_07885	
Obstruction Loss:		0.00 dB At 50.0000%	
Rx Filter Attenuation:	1.19 dB	1.19 dB	
Receive Level:	-42.94 dBm	-42.94 dBm	
Threshold:	10 ⁶ BER 10 ⁹ BER	-67.00 dBm	-67.00 dBm
Composite Fade Margin:	24.06 dB	24.06 dB	

Rain Rain Rate Selection

Rain Model / Zone: ITU-R P.837-3 19.3 mm/hr

Combined Rain and Sleet

Polarity: Vertical Horizontal

Multipath Details

Geoclimatic: 40132.025 x 10⁻⁹ Calculator

Roughness: 1.00 Default Calc. from Terrain

Climate: 1.00

Avg Ann Temp: 18.00 °C

Diversity

A->B Space Div. Improvement Factor: 42.2
B->A Space Div. Improvement Factor: 42.2

Frequency Diversity

A->B Diversity Improvement Factor: 40.5
B->A Diversity Improvement Factor: 40.5

Target Objective

Objective: 99.9900 %

Rain FFM Req'd: 15.76 dB Pwr Req'd: 6.51 dBm
Multipath CFM Req'd: 0.00 dB Pwr Req'd: -9.25 dBm

Results

Two Way

Performance (Worst Month)			Annual Unavailability		
SES (0.146484x10 ⁻³)	(%)	(sec)	SES (0.146484x10 ⁻³)	(%)	(sec)
Flat Multipath	0.000004	0.11	Rain	0.002742	864.62
Selective	0.000000	0.00	Hardware	0.069743	21994.19
Total	0.000011	0.30	Total	0.072485	22858.80
Objective	0.004000		Objective	0.075000	
ES (0.238419x10 ⁻⁶)	(%)	(sec)			
Flat Multipath	0.000007	0.18			
Selective	0.000000	0.00			
Rain	0.018660	490.37			
Total	0.018673	490.73			
Objective	0.150000				

Recalculate Info OK Print

iQ.link[®] XG – Interference Analysis

- Per-exposure and Cumulative analysis
- Easily choose frequencies free from interference
- Determine threshold degradation if interference occurs
- Uses detailed antenna radiation pattern envelops (Azimuth & Elevation)
- Maintain efficient use of the spectrum
- Uses detailed radio interference criteria. Inter-manufacturer objectives can be calculated with Tx Spectrum & Rx Selectivity or ETSI-TR101854 (Annex F)



VHP4-220A Antenna Pattern

Discrimination (dB) vs Degree (°)

iQ.link Radio Tx Spectrum

Tx Spectrum: dB vs MHz

iQ.link Interference Case Details 9.0.01

Environment Path Details

Site ID / Location ID:	SID_08295 / World	SID_00595 / World
Site Name:	SITE_NAME_08295	SITE_NAME_00595
Latitude Longitude:	39-08-45.5N 3-31-26.2W	39-15-17.5N 3-25-32.7W
UTM Zone: North East:	30: 4333105.6 454723.2	30: 4345145.2 463265.4
Gnd Elev & Length:	634.00 m	630.00 m
Path Azimuth:	35.02°	215.09°
Radio Model:	TN 23G 17x2 16QAM-RAU2 X	TN 23G 17x2 16QAM-RAU2 X
Capacity / BW:	17x2 Mb/sec / 14.00 MHz	17x2 Mb/sec / 14.00 MHz
Power:	18.00 dBm	18.00 dBm
Channel Number:	4003	4003
Frequency:	23051.00H MHz	22043.00H MHz
Antenna Model:	VHP2-220A	VHP4-220A
Antenna Height:	30.00 mAGL	30.00 mAGL
Antenna Coordinate:	39-08-45.5N 3-31-26.2W	39-15-17.5N 3-25-32.7W
Waveguide Loss:	0.00 dB	0.00 dB
Free Space / Abs. Loss:		143.07 dB / 2.56 dB
Receive Signal Level:	-42.45 dBm	-42.45 dBm
Threshold:	-80.00 dBm	-80.00 dBm

Calculation Results

Interference Calculation	OH Loss (dB)	Free Space Loss (dB)	Int Level (dBm)	S. TD Calc (dB)	S. TD Obj (dB)	C. TD Calc (dB)	C. TD Obj (dB)
1 A==>D	0.00	143.07	-98.14	3.53	1.00	3.53	3.00
2 D==>A	0.00	143.07	-94.63	1.57	1.00	4.52	3.00
3 B==>C	0.00	139.30	-92.18	7.75	1.00	7.75	3.00
4 C==>B	0.00	139.30	-88.67	4.35	1.00	8.96	3.00

Design Channel A: 3002/23058.00 B: 3002/22050.00 Interfering Path 1 of 2 IQL85_11329 Confirmed 22-OCT-2008

Site A SITE_NAME_08295 39 8 45.48 N / 3 31 26.23 W 30: 4333105.6 454723.2 Discrimination Angle: 32.30°	Site C SITE_NAME_08295 39 8 45.48 N / 3 31 26.23 W 30: 4333105.6 454723.2 Discrimination Angle: 327.70°
Site B SITE_NAME_08297 39 13 55.48 N / 3 31 7.23 W 30: 4342659.2 455234.0 Discrimination Angle: 0.00°	Site D SITE_NAME_00595 39 15 17.48 N / 3 25 32.73 W 30: 4345145.2 463265.4 Discrimination Angle: 0.00°

iQ.link[®]XG – Automatic Frequency Planning

- Batch interference analysis of large numbers of links
- Automatically resolve H/L conflicts
- User-defined link priorities

iQ.link AFP Link List / Priority

Band	Link ID	Status	Site ID	Location ID	Plan	Name
26.0	IQL85_00105-2	W	SID_06955	World	H	SITE_NAME_06955
26.0	IQL85_00413-2	W	SID_07009	World	H	SITE_NAME_07009
26.0	IQL85_00453-2	W	SID_06955	World	H	SITE_NAME_06955
26.0	IQL85_00659-2	W	SID_06955	World	H	SITE_NAME_06955
26.0	IQL85_00813-2	W	SID_05481	World	H	SITE_NAME_05481
26.0	IQL85_00814-2	W	SID_06979	World	L	SITE_NAME_06979
26.0	IQL85_02709-2	W	SID_03649	World	L	SITE_NAME_03649
26.0	IQL85_02728-2	W	SID_03673	World	L	SITE_NAME_03673

Select All Deselect All

Additional Priorities

Link Id: Ascending Descending Primary Secondary

Capacity: Ascending Descending Defined Primary Secondary

Site: Site A Site B Primary Secondary

Modulation: Ascending Descending Primary Secondary

Link Length: Ascending Descending Primary Secondary

Perform High-Low Conflict Check: Yes No

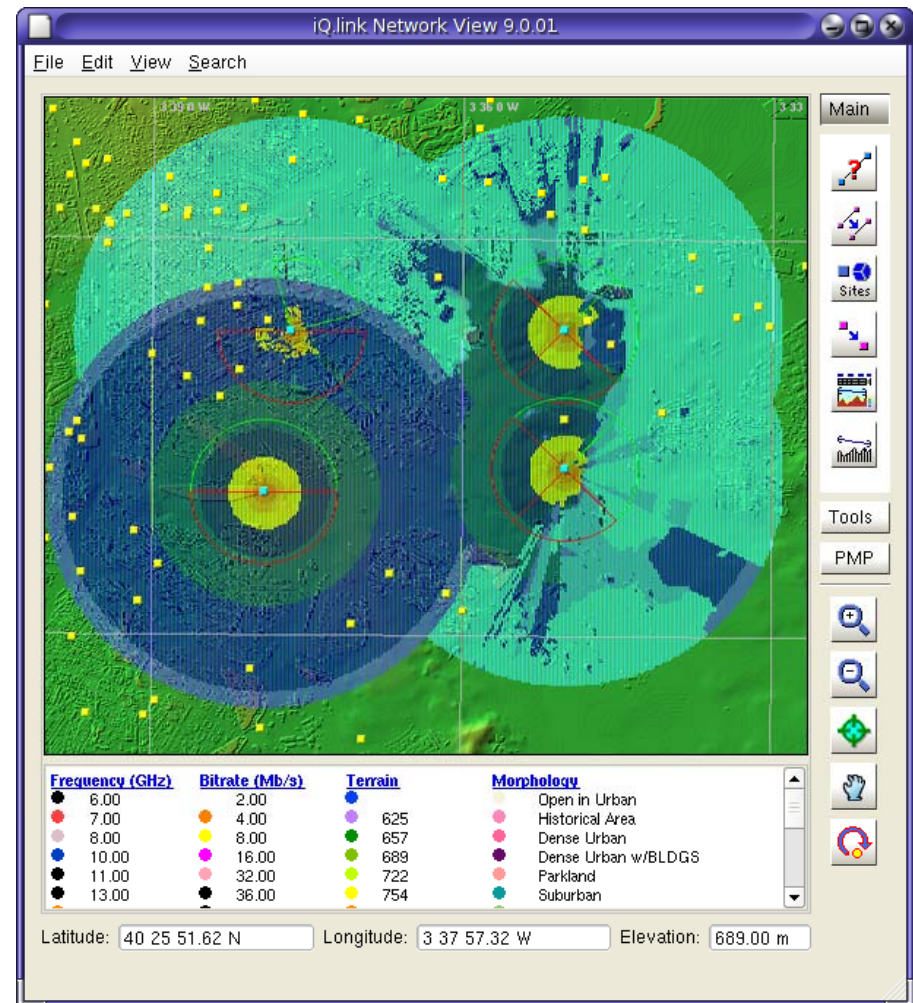
Attempt to resolve Conflicts Automatically: Yes No

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

Ok Cancel

iQ.link[®]XG – Point to Multipoint

- Design of Fixed PMP links
- Analysis between PTP and PMP
- Omni and sectored antennas
- Coverage and C/I
- Automatic subscriber connection



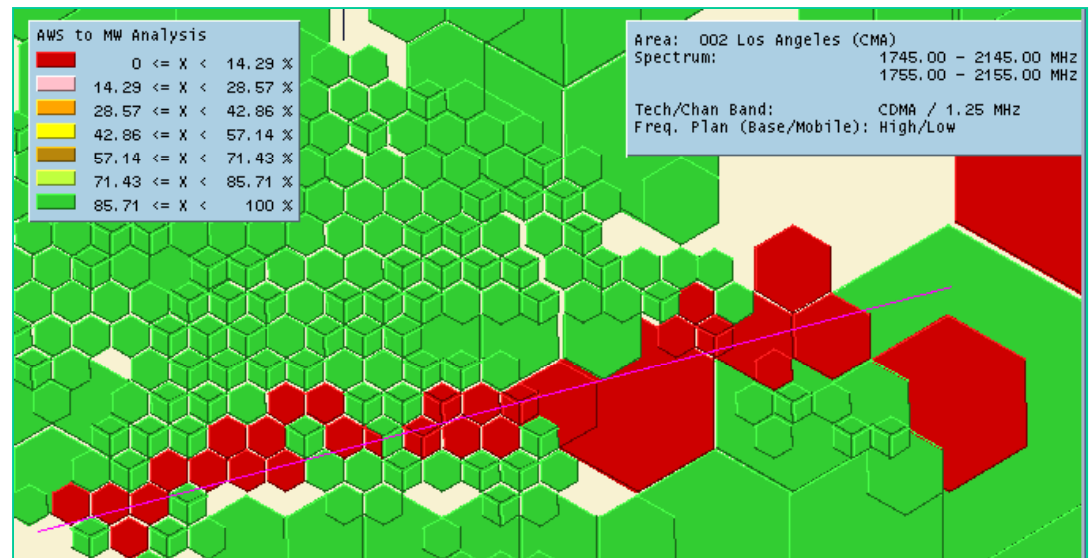
iQ.clear[®] XG

- Next generation spectrum sharing and interference analysis software tool to help plan the rollout of new wireless systems in encumbered spectrum
 - Import or automatically create cell layouts
 - User-defined interference parameters
 - Comprehensive interference analyses
 - Mobile system to microwave
 - Spectrum recommendation
 - Collocation
 - Microwave mobile system
 - Fully compliant with TIA Bulletin TSB-10F



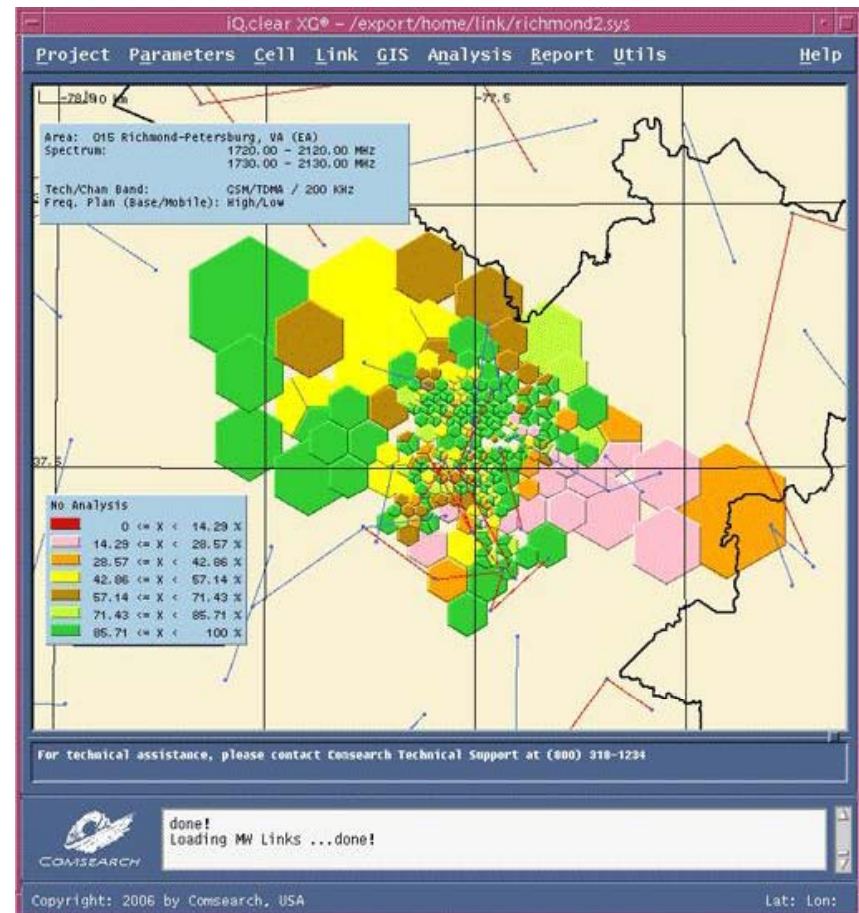
iQ.clear[®]XG – Cell Layout

- For pre-auction planning and spectrum valuation, the user can create two types of cell layouts:
 - A Uniform layout with a uniform radius across the market
 - A Traffic Based layout with cells dimensioned depending on the population to be covered using census data within the tool.
- For deployment, cells can be imported from various RF planning tools.

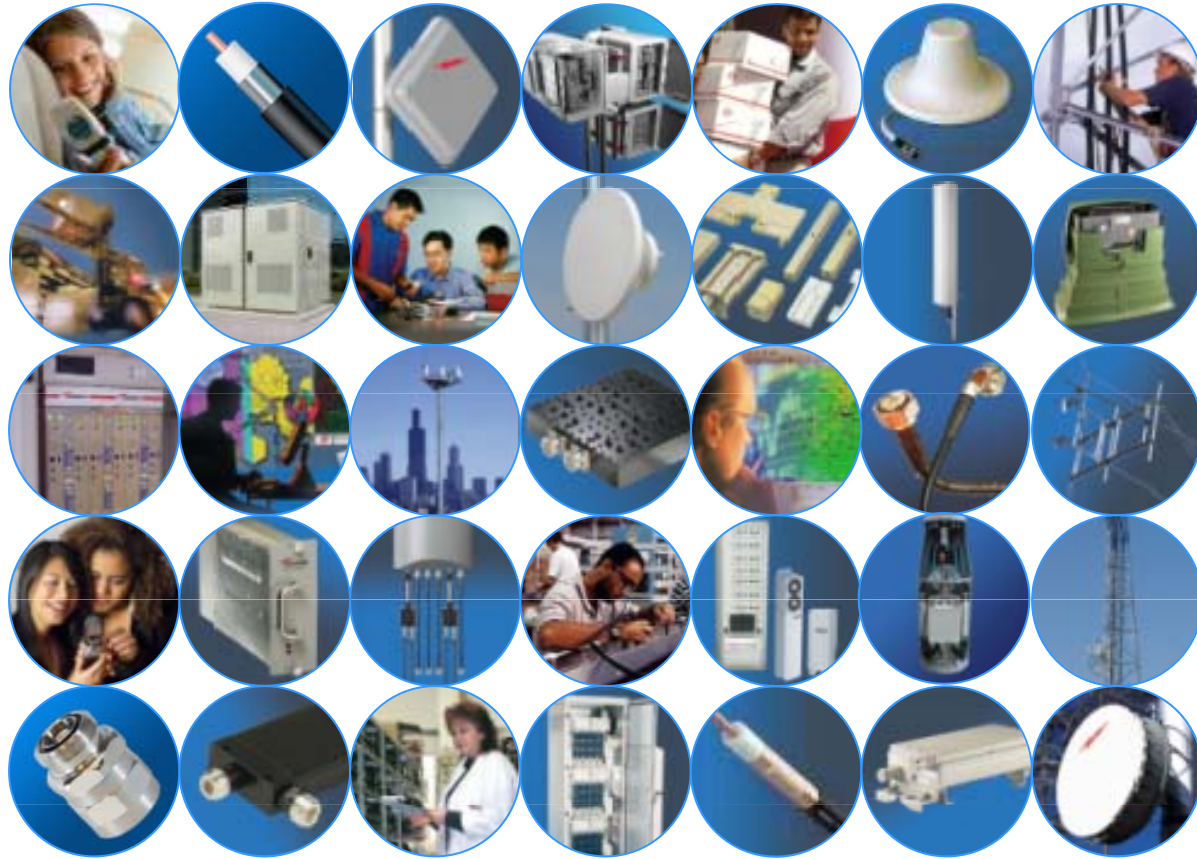


iQ.clear[®] XG – Interference Analysis

- Select a specific frequency block, technology, and bandwidth to be used in the analysis
 - 200 kHz GSM
 - 1.25 MHz, 3.75 MHz, or 5 MHz CDMA
- Define the parameters for the project including transmit power, antenna type, antenna height, maximum antenna gain, downtilt angle, EIRP, number of mobiles, and mobile distribution method
- Specify interference criteria parameters for both AWS and microwave systems including propagation model and link reliability.
- Propagation models include
 - Free Space Loss
 - OH-Loss
 - TR14.11
 - Extended Hata



Questions?



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