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COMMUNICATIONS AUTHORITY OF KENYA

6 GHZ COEXISTENCE STUDIES IN KENYA AND THE FUTURE DEVELOPMENTS

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DSA
DYNAMIC • SPECTRUM • ALLIANCE

PRESENTATION OUTLINE

1. 6 GHz –Battleground or Opportunity?
2. Long-Term Simulations (FS)
3. Short-Term Simulations (FS)
4. Fixed Satellite Services (FSS)
5. Conclusions

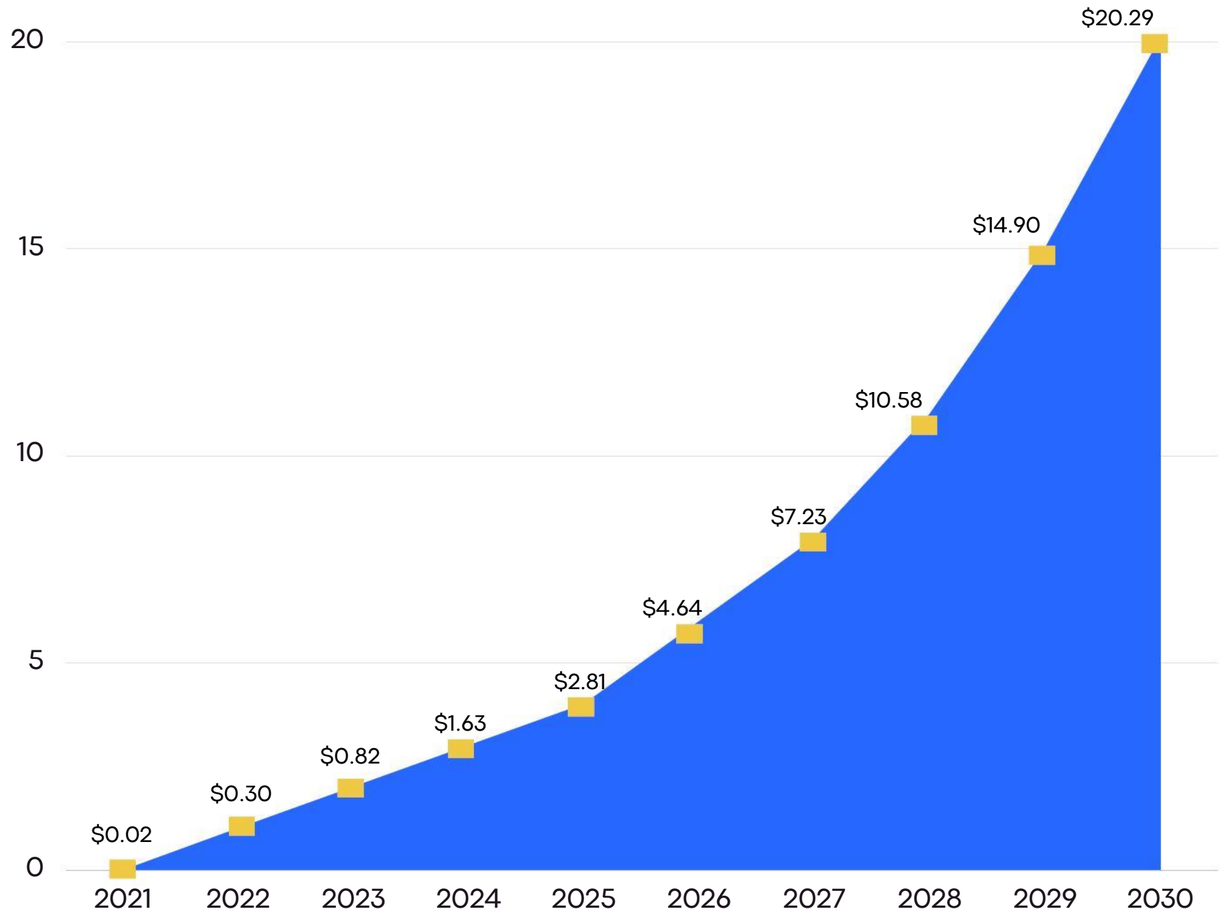
6 GHz : "Battleground" vs "Opportunity"?

- Adopting a balanced approach is key.
- Density of fixed links differs across counties in the 6 GHz band.
- Usage of FS also differs across the counties (urban, sub-urban and rural)
- Migration of Fixed Links??

- FSS UL protection is a global issue and thus agreement is important.
- A huge OPPORTUNITY exists - If sharing studies apply and use recently developed and accurate models for clutter loss, building entry loss and propagation etc.

WI-FI 6E VALUE FOR KENYA

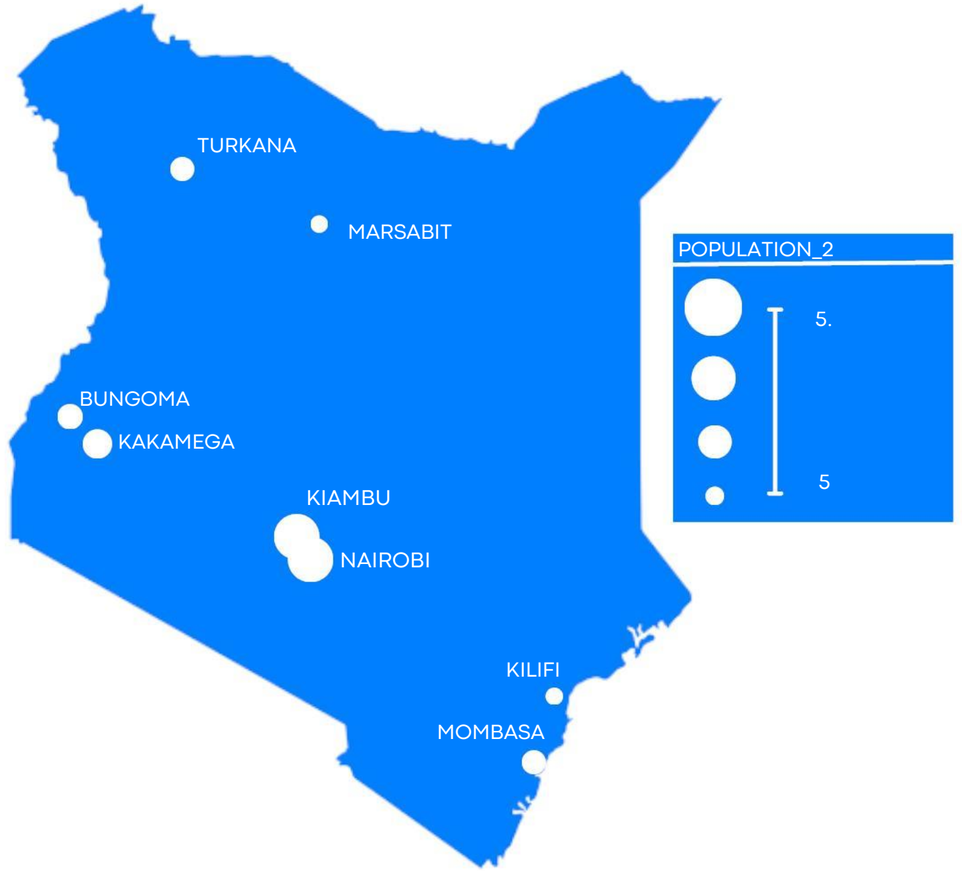
Telecom Advisory Services estimates an economic value of US $20.29 billion between 2021 and 2030 for the full 6 GHz band for Kenya.



Source – Telecom Advisory Services

Coexistence Considerations for Kenya

- Urban, Sub-urban, rural scenarios.
    - Nairobi and (Nairobi + Kiambu) considered as urban scenarios.
    - (Mombasa+Kilifi) and (Kakamega+Bungoma) considered for sub-urban scenarios.
    - Marsabit+Turkana considered as the rural scenario.
- Other variables: Busy Hour factor, 6 GHz factor, RF Activity factor per person, overlap factor, Instantaneously transmitting devices



Kenya’s population by 2025 (Similar consideration for Europe)

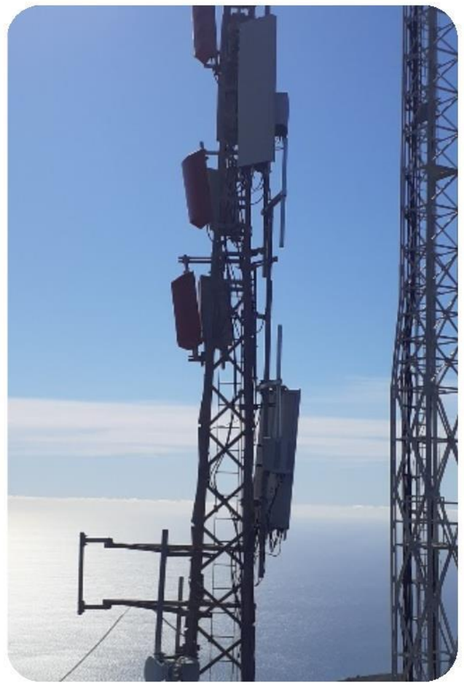
Incumbent Considerations

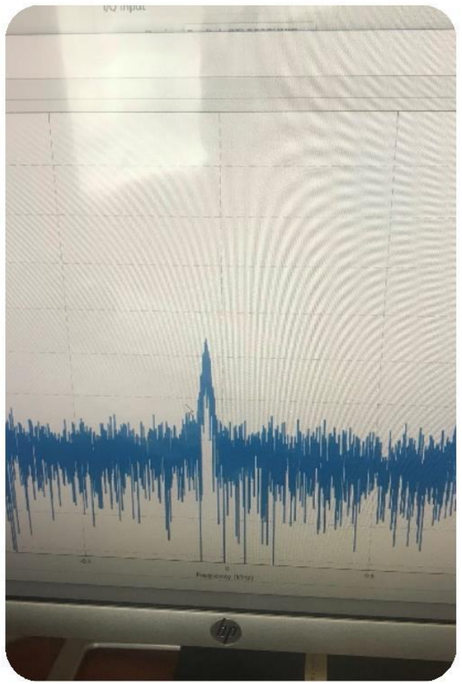
The 6 GHz band (5925-7125 MHz), however lucrative, is host to the following primary services in Kenya ;

- Fixed Microwave Services (FS) – Used for point-to-point microwave links. Users include MNOs to carry traffic for wireless backhaul between base stations and wireline network.

- Fixed Satellite Services (FSS) – Used for earth-to-space – incumbents use the band for mostly content distribution to television and radio broadcast.

Frequency Range (GHz)	Allocated Usage	Incumbent Services
5.850-7.075	Fixed	Fixed point-to-point links. *Fixed Satellite Services (earth to* space)
5.850-7.075	Mobile	Mobile services
7.075 – 7.250	Fixed	Fixed point-to-point links
7.075 – 7.250	Earth to space exploration	Earth exploration satellite services
7.075 – 7.250	Mobile	Mobile services





The Simulation Approach

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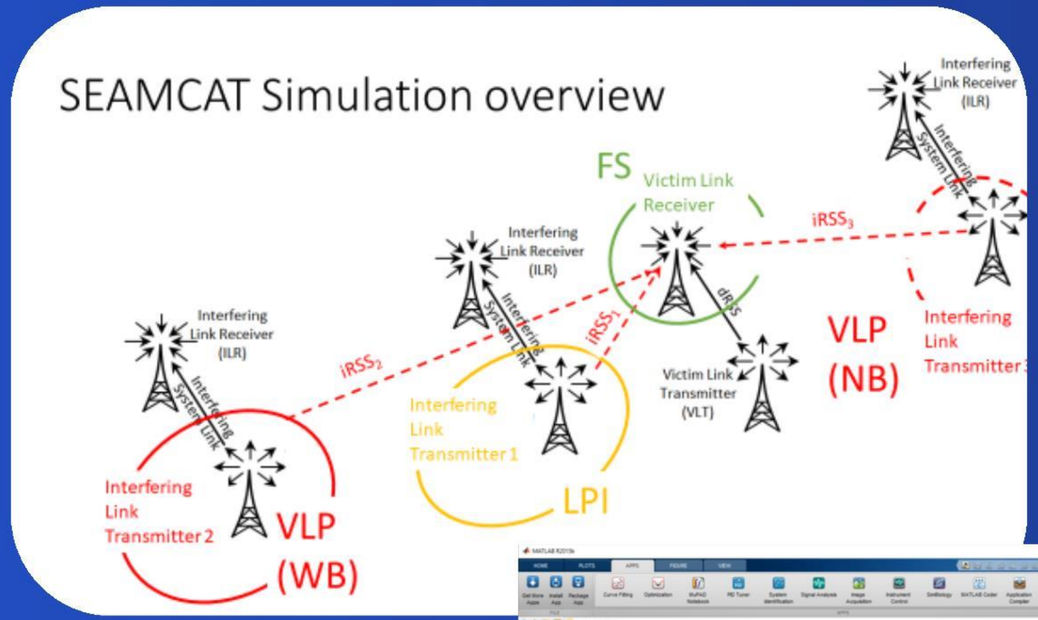
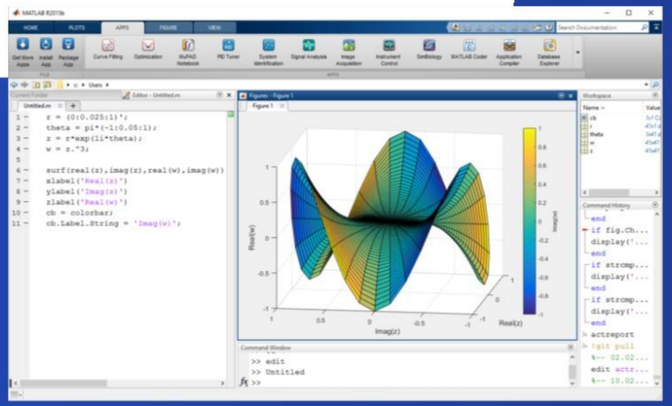
- **SEAMCAT – a tool used by CEPT in the short-term 6 GHz coexistence in Europe, used in the Kenyan scenario as well. Reference documents include both ECC 302 and 316 reports as well as work in Mexico, USA and other studies.**

- **Simulations done based on Monte-Carlo analysis and factored both short-term and long-term interference scenarios for Kenya.**





- Although CA has already published considerations in the lower part of the 6 GHz band, these studies considered both lower and the upper part of the band for all scenarios – urban,suburban and rural.

Tools Use

2. Simulation Scenarios (Long-term)

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- Nairobi

- Sub-urban (2)

- Urban

- Rural

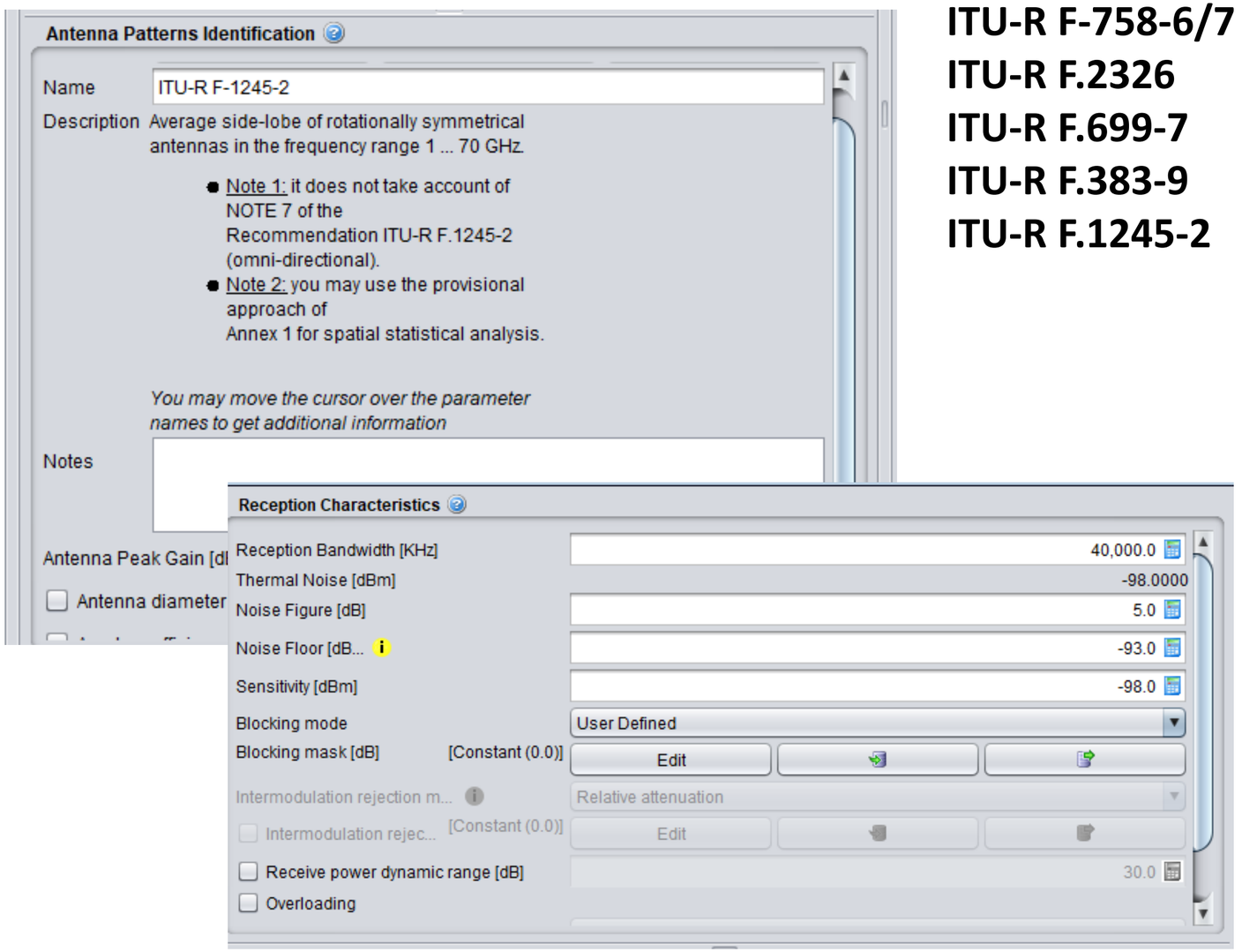
- Long-term interference criterion: I/N = -10 dB – relates to co-primary status while I/N = -20 dB – relates to the systems that do not have a co-primary status.

- For long term interference criterion to be met – I/N = -10 dB should not be exceeded for more than 20% of the time.

Scenario 1 - Urban: Nairobi & (Nairobi + Kiambu)
Incumbent: Fixed Services (FS)

System Parameters for PP FS Systems in allocated bands between 3 and 7.2 GHz (6 GHz)	
Modulation	64-QAM
Centre Frequency	6734.29
Average Receive Bandwidth	40
Feeder/Mulplier loss between antenna and receive input (dB)	Between 0 and 6.3 (1.8 used)
Antenna Gain range (dBi)	32.6 and 47.4 (ITU-R F.758-7) - 40 used
Antenna Peak Gain	38.7
Antenna pattern	ITU-R F.1245-3
Antenna pointing (Azimuth, elevation)	Assumptions made based on Kenyan Data
Antenna height (m)	Assumed between 48 M and 100 (Mode: 48)
Emmision mask	
Receiver Noise Figure (N.F.) in dB	4.5 to 5 (ITU-R F.758-7)
Receiver noise power density typical (=NRX) (dBW/MHz)	−139.5… −139
Nominal long-term interference power density (dBW/MHz)	−139.5… −139 + I/N
e.i.r.p. range (dBW)	15.8…48.8
Protection requirement (dB)	I/N = −10 and −20 (Recommendation ITU-R F.758)
Link Length	Between 6.78 and 80.64 Mode 74.55

Incumbent: SEAMCAT Interface



Reference Documents

ITU-R F-758-6/7
ITU-R F.2326
ITU-R F.699-7
ITU-R F.383-9
ITU-R F.1245-2

ILT: Wi-Fi 6E

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- Deployment Model – Nairobi + Kiambu

Parameter	Mid
Total Population of Nairobi 2025	8,447,177
Wireless devices operating in licence exempt spectrum	80%
Busy Hour Population	62.70%
6 GHz Factor	64.39%
Market Factor	32%
RF Activity Factor	1.97%
Overlap Factor	12.28%
Instantaneously Transmitting Devices within a 40 MHz FS Channel	2112
Outdoor	42
Indoor	2070

- Deployment Model - Nairobi

Parameter	Mid
Total Population of Nairobi 2025	5,398,290
Wireless devices operating in licence exempt spectrum	80%
Busy Hour Population	62.70%
6 GHz Factor	64.39%
Market Factor	32%
RF Activity Factor	1.97%
Overlap Factor	12.28%
Instantaneously Transmitting Devices within a 40 MHz FS Channel	1349
Outdoor	26
Indoor	1323

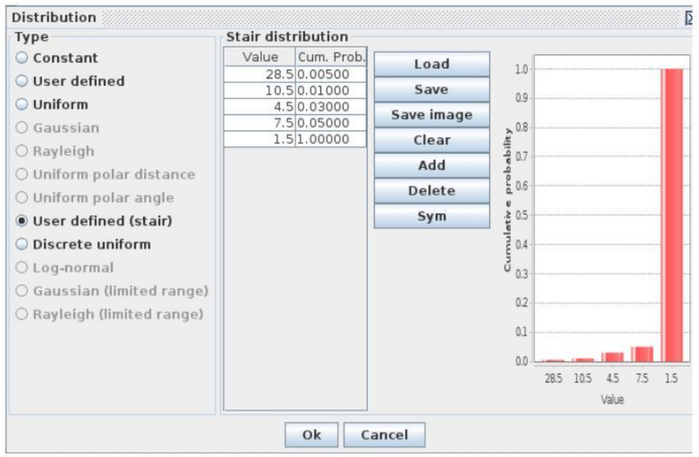
- Parameters

Band	Range	Spectrum
2.4 GHz	[2400-2483.5]	83.5
5 GHz	[5150-5350], [5470-5725],[5725-5875]	580
6 GHz	[5925-7125]	1200
6 GHz Factor	64.39%	

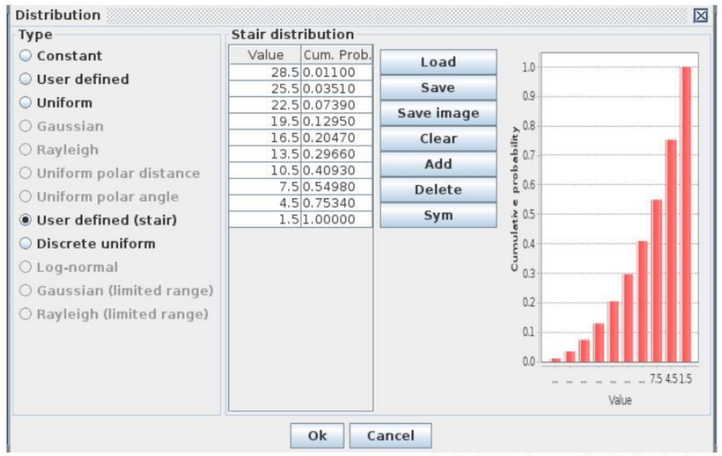
- Power Distribution (Max e.i.r.p = 25mW

Average Household Size (Nairobi)	Population Density (Nairobi)
3	17875

- VLP Height Distribution

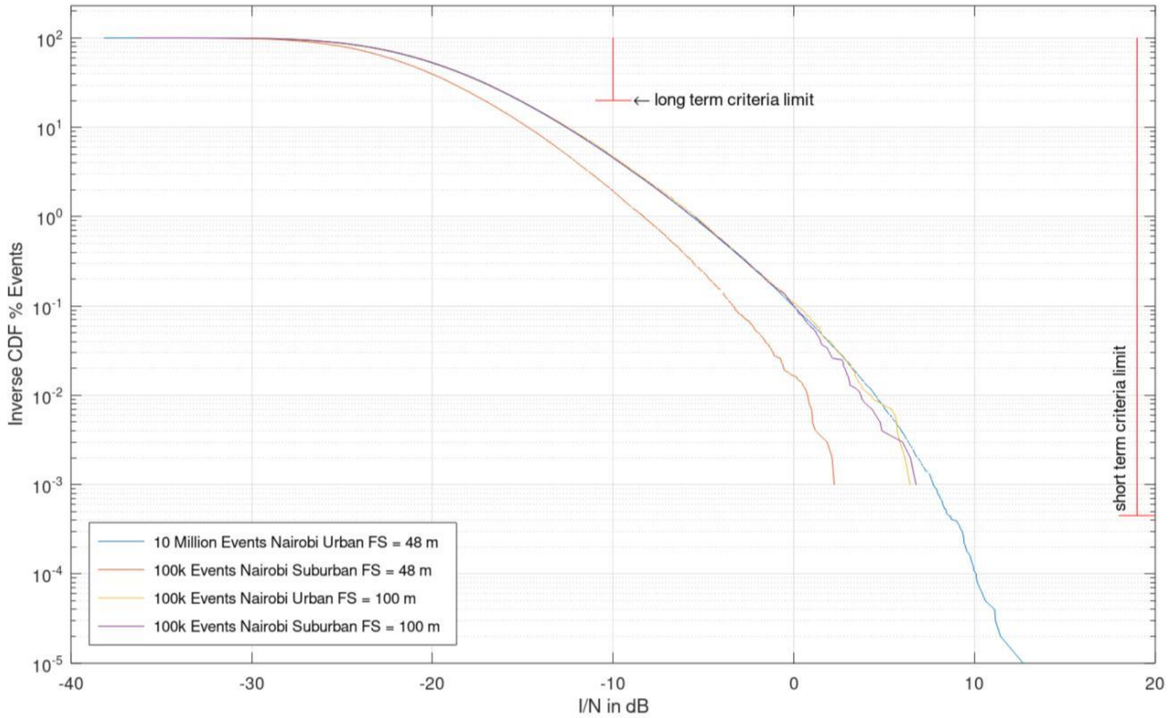


- LPI Height Distribution

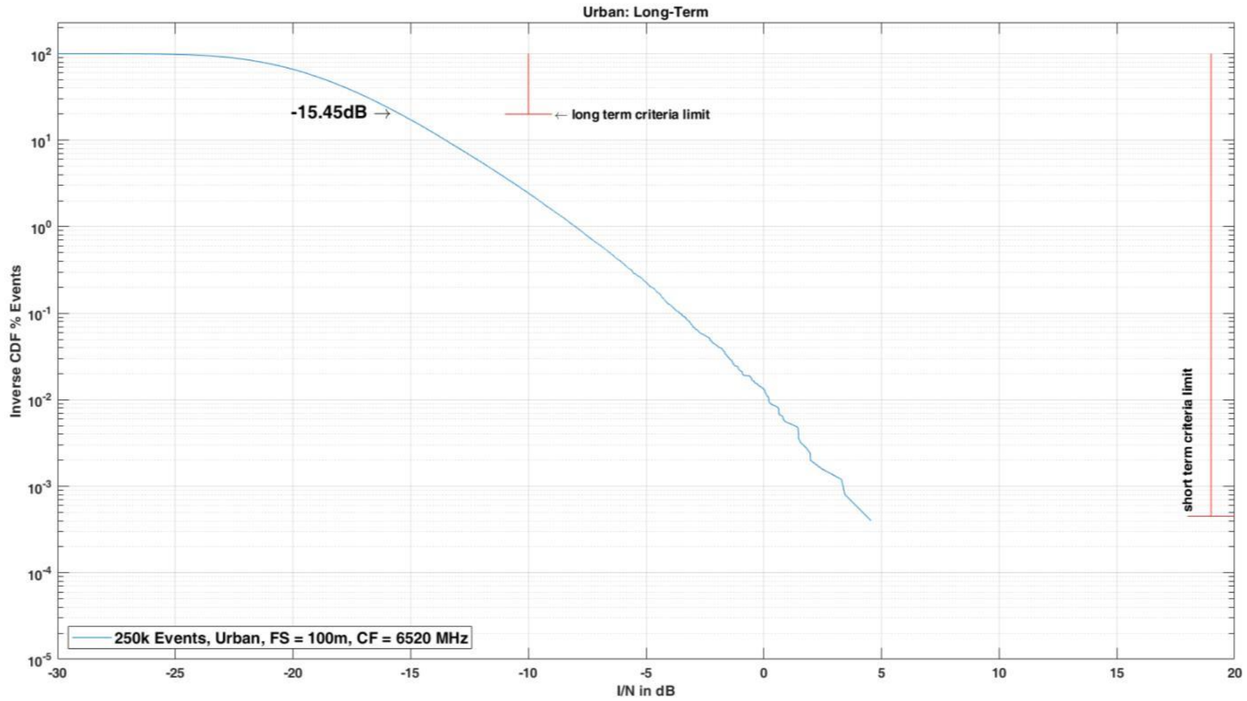


Average Household Size (Average of Nairobi + Kiambu)	Population Density per Sq. Km (Average of Kiambu + Nairobi)
5	18,563

Results:
Urban (Nairobi)



Results:
Urban (Nairobi + Kiambu)



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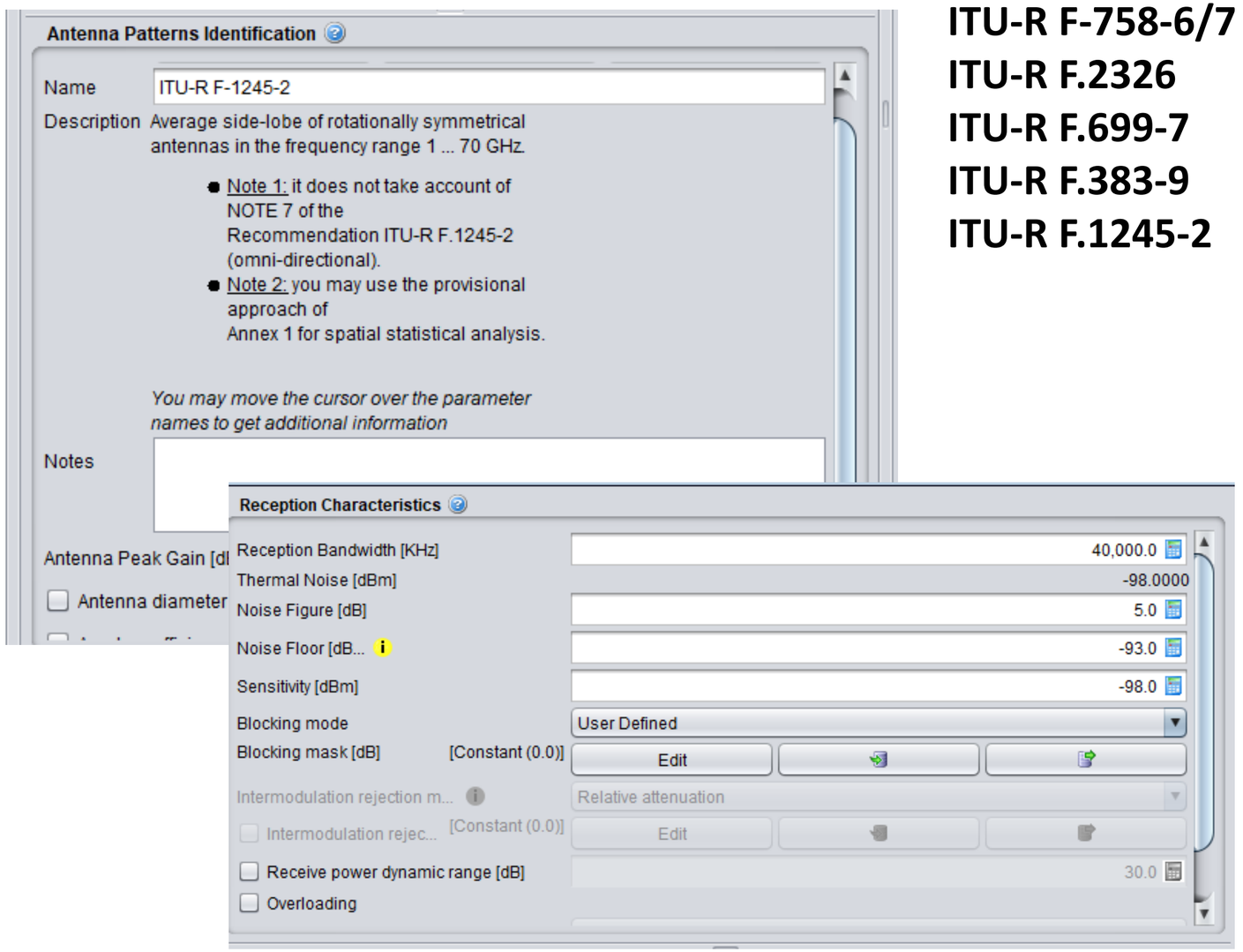
Scenario 2: Sub-urban (Mombasa + Kilifi)
Incumbent: Fixed Services (FS)

System Parameters for PP FS Systems in allocated bands between 3 and 7.2 GHz (6 GHz)	
Modulation	64-QAM
Centre Frequency	6460
Average Receive Bandwidth	40
Feeder/Mulplier loss between antenna and receive input (dB)	Between 0 and 6.3 (1.8 used)
Antenna Gain range (dBi)	32.6 and 47.4 (ITU-R F.758-7) - 40 used
Antenna Peak Gain	38.2
Antenna pattern	ITU-R F.1245-3
Antenna pointing (Azimuth, elevation)	Assumptions made based on Kenyan Data
Antenna height (m)	Assumed between 48 M and 100 (Mode: 48)
Emmision mask	
Receiver Noise Figure (N.F.) in dB	4.5 to 5 (ITU-R F.758-7)
Receiver noise power density typical (=NRX) (dBW/MHz)	−139.5… −139
Nominal long-term interference power density (dBW/MHz)	−139.5… −139 + I/N
e.i.r.p. range (dBW)	15.8…48.8
Protection requirement (dB)	I/N = −10 and −20 (Recommendation ITU-R F.758)
Link Length	Between 6.78 and 80.64 Mode 74.55

Incumbent: SEAMCAT Interface



Reference Documents

ITU-R F-758-6/7
ITU-R F.2326
ITU-R F.699-7
ITU-R F.383-9
ITU-R F.1245-2

ILT: RLAN (Wi-Fi 6E)

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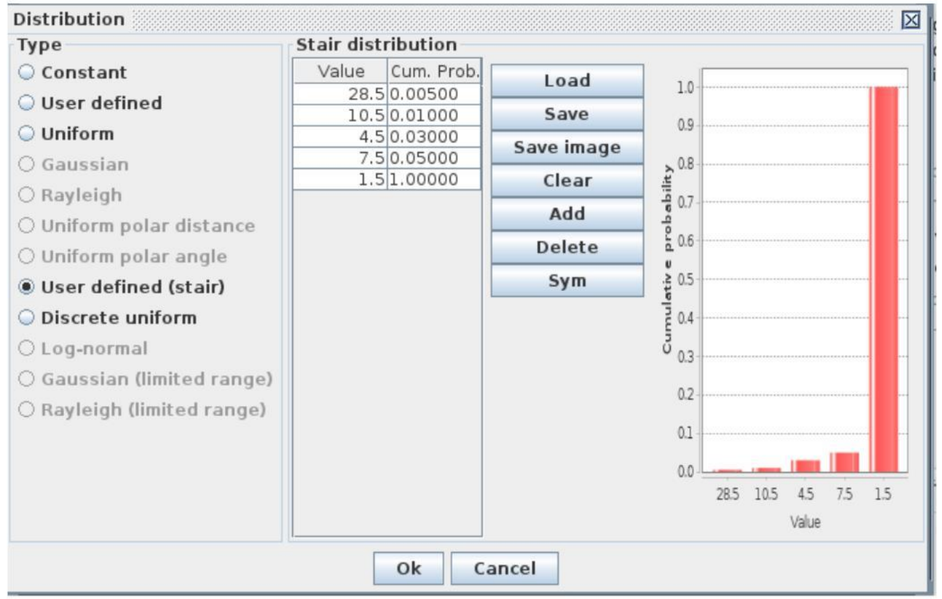
Deployment Model – Sub-urban

Parameter	Mid
Total Population of Mombasa and Kilifi 2025	3,357,069
Wireless devices operating in licence exempt spectrum	80%
Busy Hour Population	62.70%
6 GHz Factor	64.39%
Market Factor	32%
RF Activity Factor	1.97%
Overlap Factor	12.28%
Instantaneously Transmitting Devices within a 40 MHz FS Channel	839
Outdoor	16
Indoor	823

Average Household Size (Average of Mombasa+ Kilifi)	6	Population Density per Sq. Km (Average of Mombasa + Kilifi)	7,301

VLP Height Distribution



LPI Height Distribution

- 1.5 0.15337988208301473
- 4.5 0.36124003486995593
- 7.5 0.6023255867583656
- 10.5 1.0
-

RESULTS: Sub-Urban

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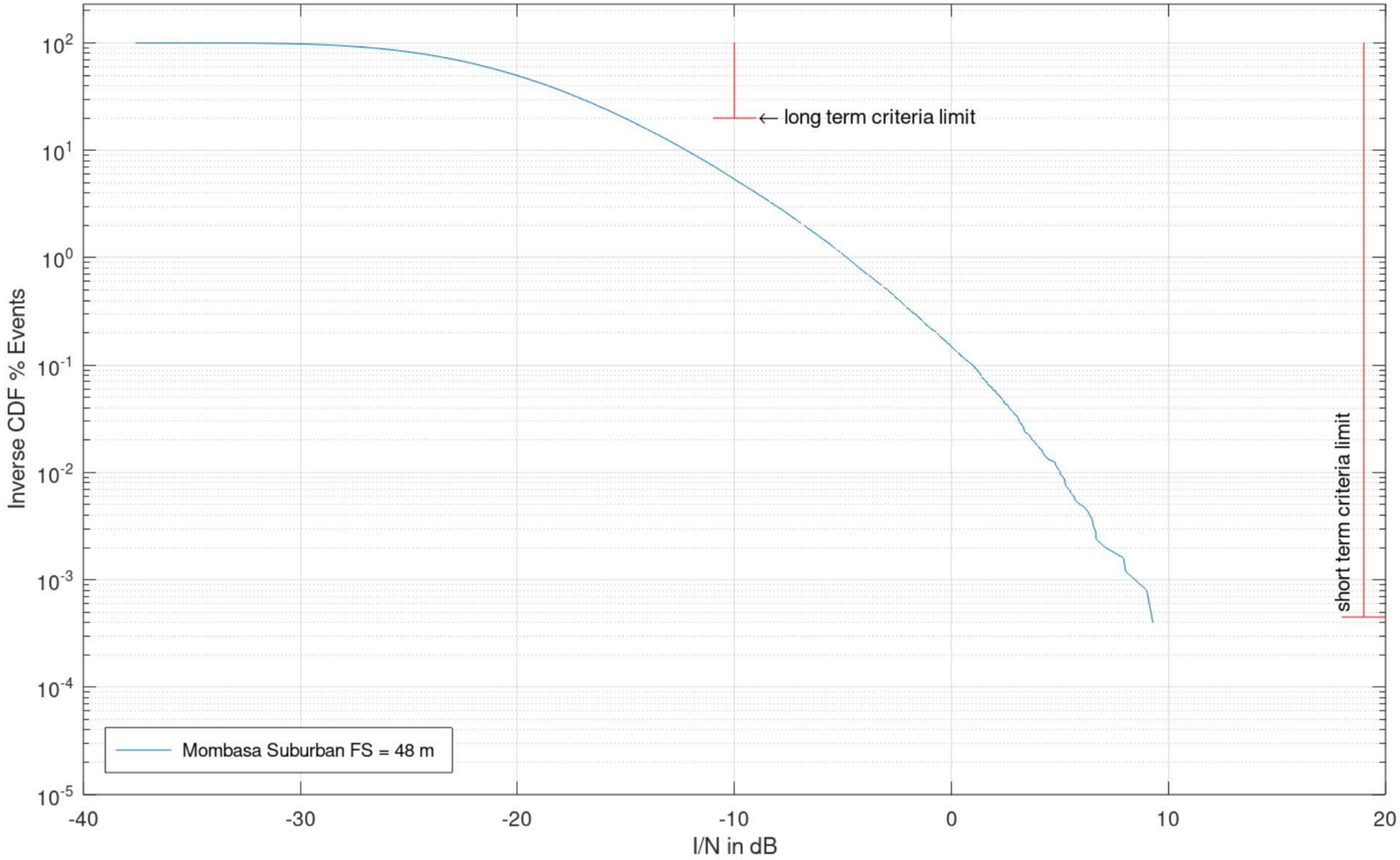
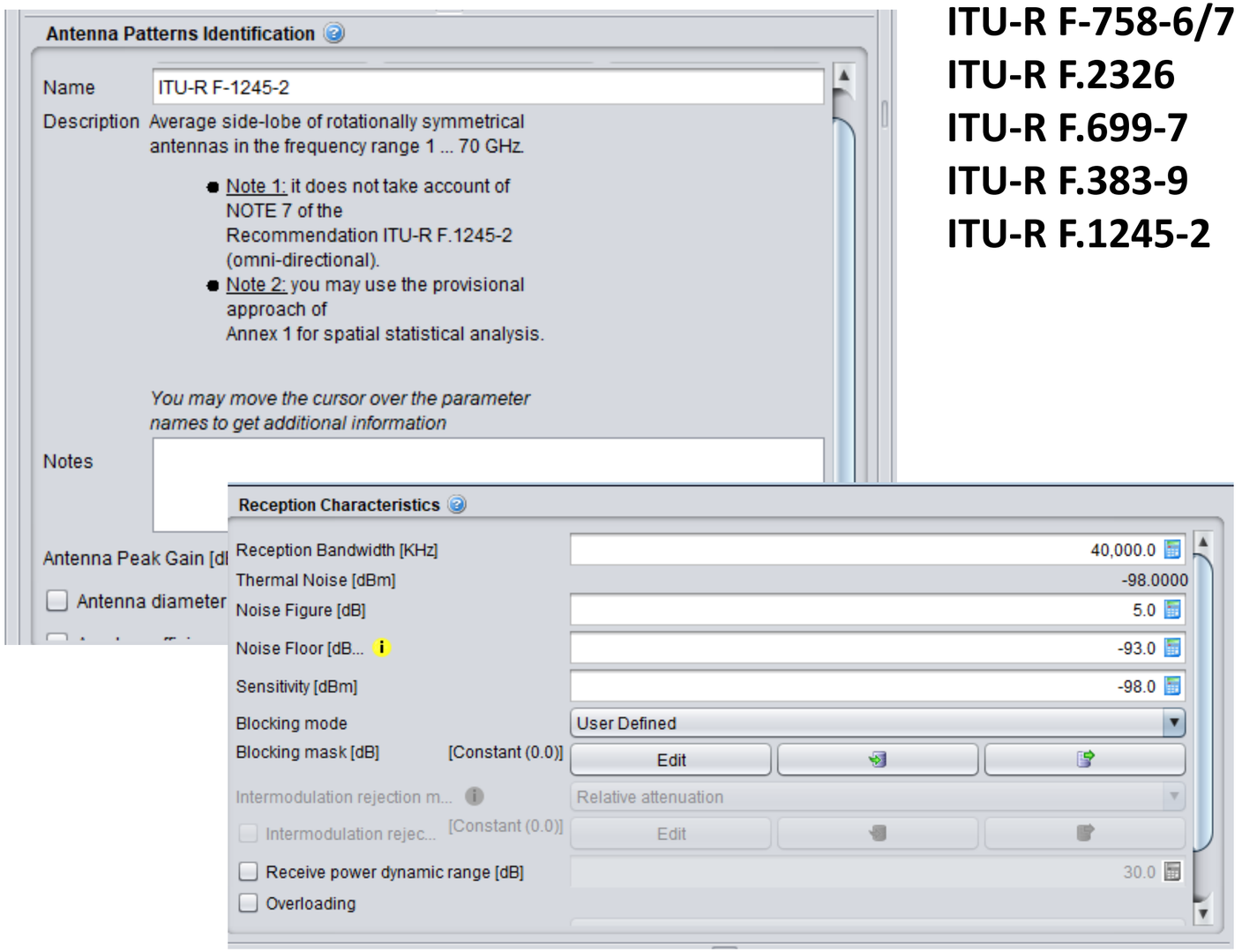


Scenario 3: Rural (Marsabit + Turkana)
Incumbent: Fixed Services (FS)

System Parameters for PP FS Systems in allocated bands between 3 and 7.2 GHz (6 GHz)	
Modulation	64-QAM
Centre Frequency	6780
Average Receive Bandwidth	40
Feeder/Mulplier loss between antenna and receive input (dB)	Between 0 and 6.3 (1.8 used)
Antenna Gain range (dBi)	32.6 and 47.4 (ITU-R F.758-7) - 40 used
Antenna Peak Gain	38.2
Antenna pattern	ITU-R F.1245-3
Antenna pointing (Azimuth, elevation)	Assumptions made based on Kenyan Data
Antenna height (m)	Assumed between 48 M and 100 (Mode: 48)
Emmision mask	
Receiver Noise Figure (N.F.) in dB	4.5 to 5 (ITU-R F.758-7)
Receiver noise power density typical (=NRX) (dBW/MHz)	−139.5… −139
Nominal long-term interference power density (dBW/MHz)	−139.5… −139 + I/N
e.i.r.p. range (dBW)	15.8…48.8
Protection requirement (dB)	I/N = −10 and −20 (Recommendation ITU-R F.758)
Link Length	Between 6.78 and 80.64 Mode 74.55

Incumbent: SEAMCAT Interface



Reference Documents

ITU-R F-758-6/7
ITU-R F.2326
ITU-R F.699-7
ITU-R F.383-9
ITU-R F.1245-2

ILT: Wi-Fi 6

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- Deployment Model – Rural

Parameter	Mid
Total Population of Marsabit + Turkana	1,748,776
Wireless devices operating in license exempt spectrum	80%
Busy Hour Population	62.70%
6 GHz Factor	64.39%
Market Factor	5%
RF Activity Factor	1.97%
Overlap Factor	12.28%
Instantaneously Transmitting Devices within a 40 MHz FS Channel	68
Outdoor	1
Indoor	67

- LPI Height Distribution = 1.5
- VLP Height Distribution = 1.5

RESULTS: RURAL

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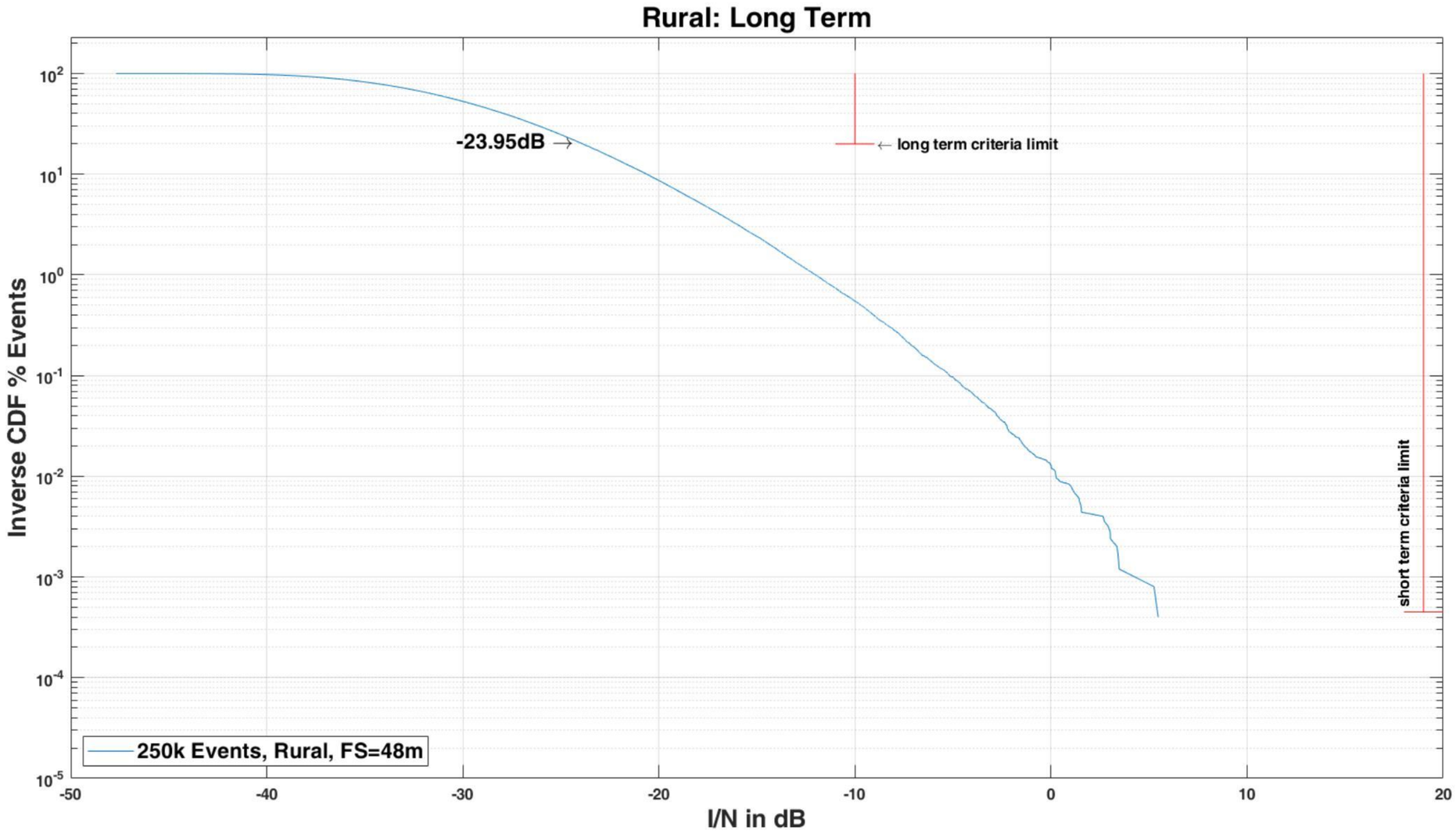

2. Simulation Scenarios (Short-term)

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- Nairobi

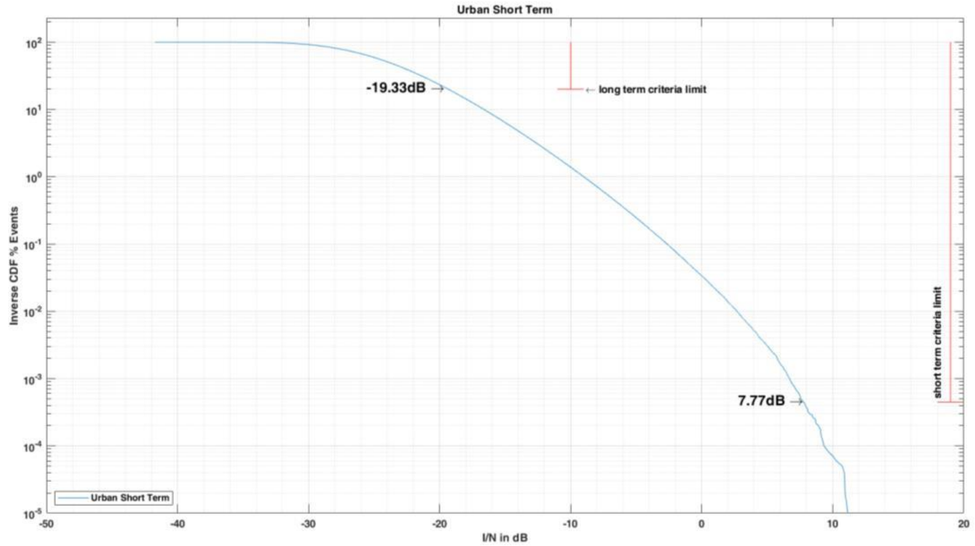
- Sub-urban (2)

- Urban

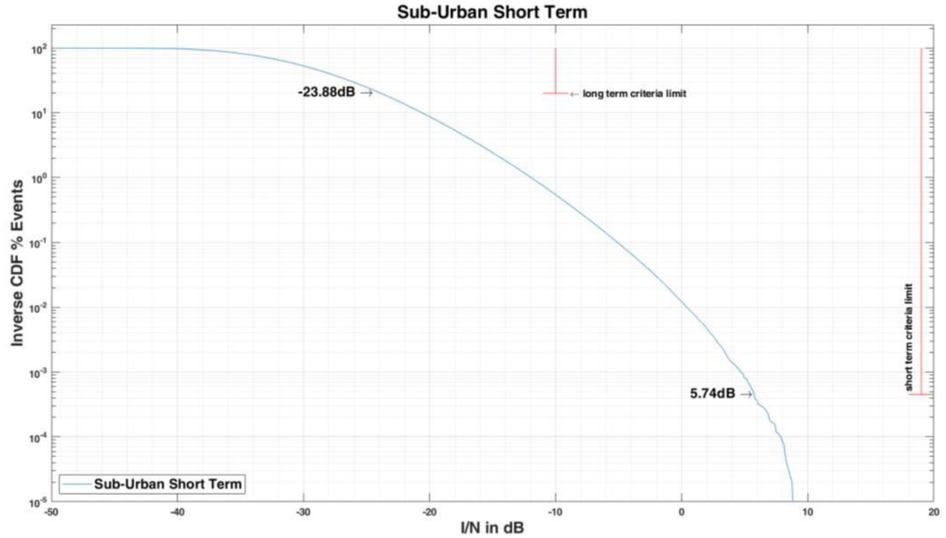
- Rural

- Short-term interference criterion: I/N = 19 dB –not exceeded for more than 4.5 · 10^–4% of the time (< 1% of time).

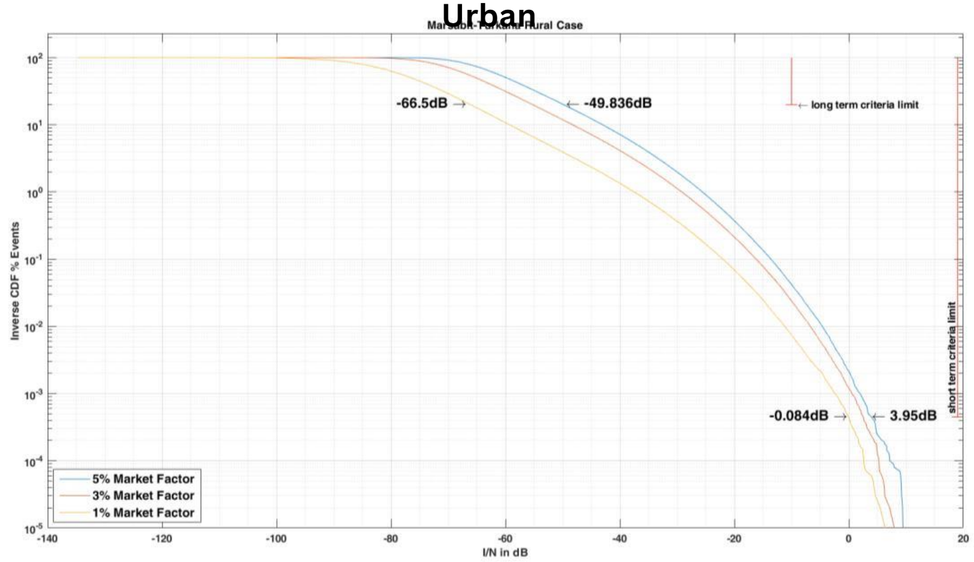
Results: Urban, Sub-urban and Rural



Urban



Sub-Urban



Rural

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4. Fixed Satellite Services (FSS)

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Incumbent: Fixed Satellite Services Considerations (FSS)

Parameter	Kenya	Africa	Europe	Middle East
Total Population in 2025	59,981,314	1,517,706,140	768,589,000	496,337,400
Wireless devices operating in licence exempt spectrum	80%	80%	80%	80%
Busy Hour Population	62.70%	62.70%	62.70%	62.70%
6 GHz Factor	64.39%	64.39%	64.39%	64.39%
Market Factor	32%	32%	32%	32%
RF Activity Factor	1.97%	1.97%	1.97%	1.97%
Overlap Factor	12.28%	12.28%	12.28%	12.28%
Instantaneously Transmitting Devices within a 40 MHz FSS Channel	14,998	379,499	192,184	124,108
Outdoor	299	7589	3843	2482
Indoor	14,699	371,910	188,341	121,626

5. CONCLUSION ON THE FINDINGS

- All the simulation results for both long-term and short-term scenarios show that th thresholds -10 dB for long-term and +19 dB for short-term are not exceeded for FS.
- The computations for FSS also show that the I/N for -10.5 dB is also not violated.
- Hence, WAS/RLAN can comfortably share the 6 GHz band with FS and FSS without causing any interference. Hence, no need to relocate the incumbent services and enable access of the Wi-Fi 6E in the 6 GHz band.

Future Steps..

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- The Coexistence Study report has already been handed over to the regulator: Communications Authority of Kenya.
- We have already joined the WRC-23 country preparations to contribute to the discussion to shape the future of usage of the 6 GHz Band.
- The near future looks to allow usage of the lower part of the 6 GHz band in the country awaiting further recommendations in regards to the upper part of the band.
- Research studies on standard power devices and AFC.

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THANK YOU!

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