DVB-T Implementation Plan

Department: Technical Department – BT&P
Focus Area: DVB-T Transmission system
Process Area: Curaçao
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MEMBER

Bureau Telecommunicatie en Post

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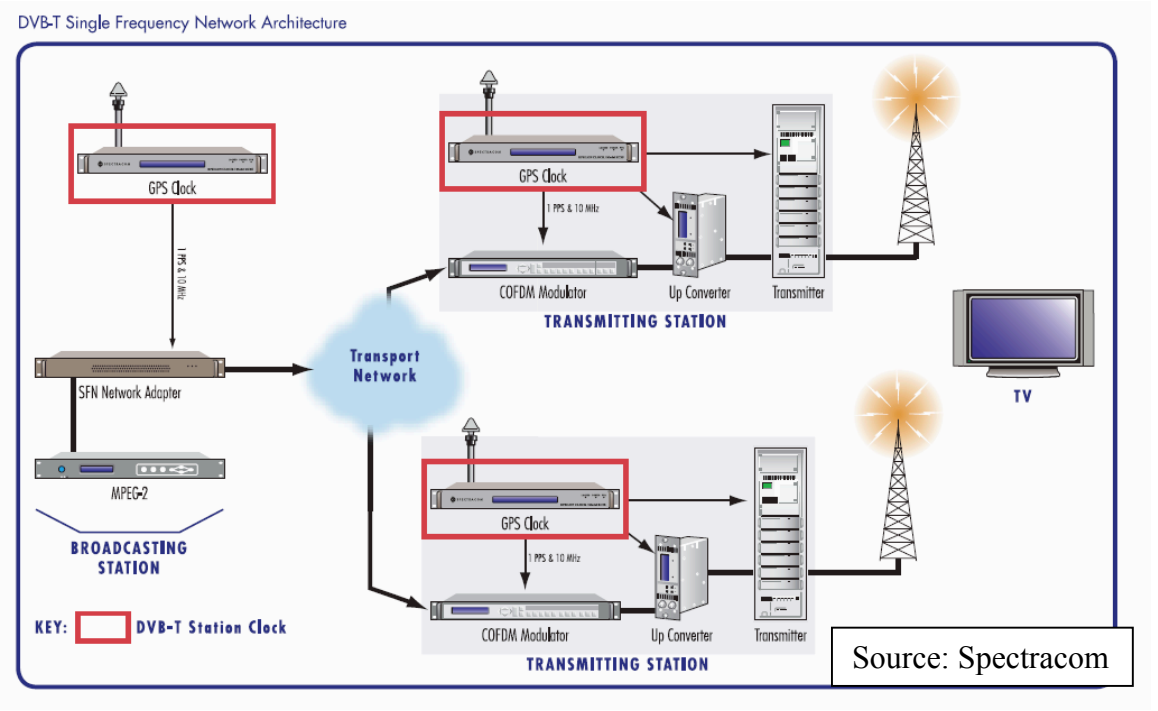
1. DVB-T Network Architecture

The intended network configuration for deployment in the Netherlands Antilles is the Single Frequency network (SFN). All transmitters of the network use the same frequency channel. The transmitters provide a common coverage area and can't be operated independently; they must carry identical multiples content. In a SFN, all the individual transmitters must be synchronized with one another. Every modulator must perform every operating step completely synchronously with all the other modulators in the network. For each instant of time, every transmitter must broadcast the same digital data at the same exact frequency. This can be achieved by using common time and frequency reference (GPS reference) on each concerned site.



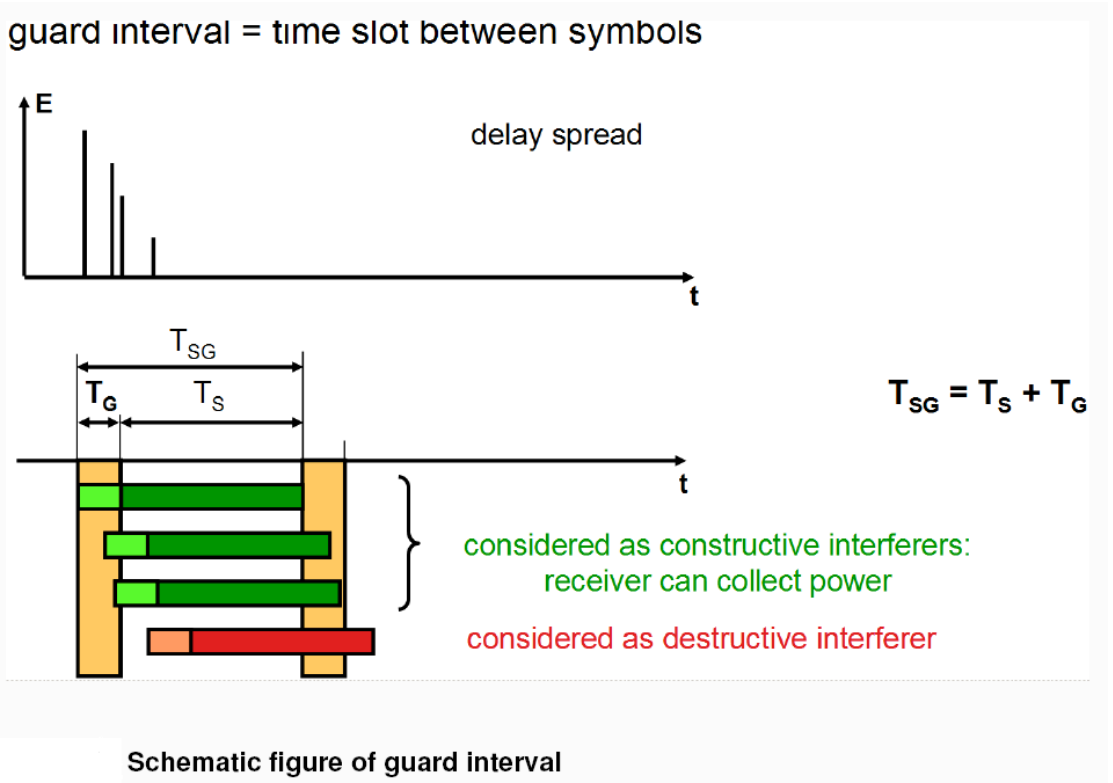
2. DVB-T Specifications

The DVB-T system parameters must be determined and planned in such a way to best fit the overall needs of the broadcaster and at the same time deliver good quality signals to guarantee the best viewer experience. The DVB-T system parameters like guard interval, modulation scheme, error protection ratio and channel bandwidth are crucial factors in determining the performance or data capacity in terms of available bit rate (MB/s). The following technical parameters are recommended for unified local implementation and deployment, providing a useful data rate of over 20 MB/s.

Modulation Scheme	64QAM
Designator	8k mode
Channel Bandwidth	8 MHz
Video Compression	MPEG-2/4
Inner Code Rate	¾ (2/3)

Guard Interval **¼ (224 us)**

The introduction of a guard interval allows the "constructive collection" of different signal contributions. The guard interval in DVB-T is the basis for building SFNs. It allows for signals arriving at the receiver from several transmitters with delays up to the length of the guard interval. A DVB-T network can benefit from the superposition phenomenon in which signals arriving at a receiver location from different transmitter locations will lead to better reception. Nevertheless, this statement is true only as long as the spread in the times of arrival of the signals is not too large. These signals must arrive within the given time frame. The Guard-Interval also provides a measure that allows taking advantage of reflections up to a certain delay spread between the different signal contributions.



Schematic figure of guard interval

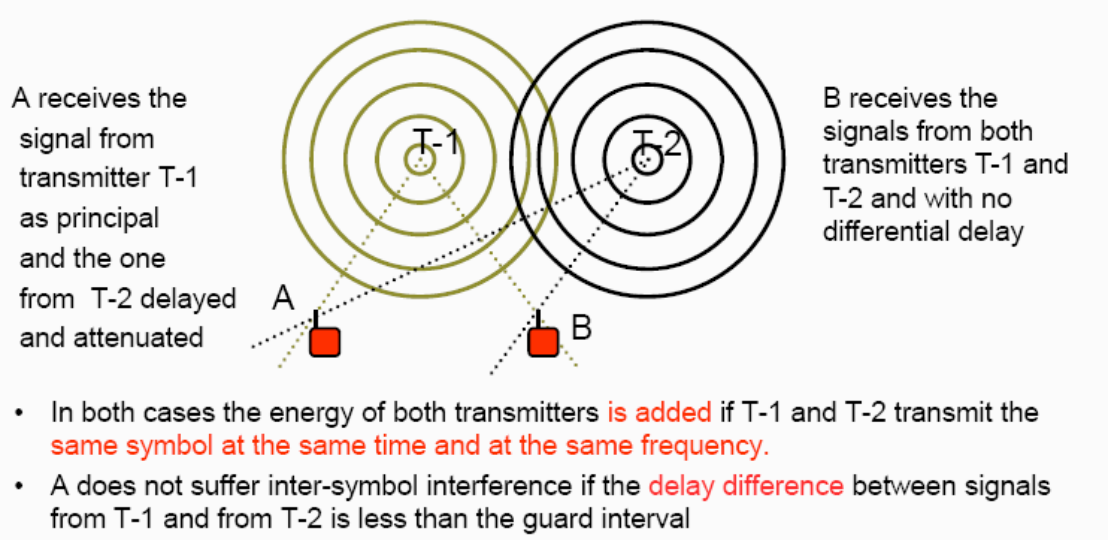
3. Principle of a Single Frequency Network (SFN)

A DVB-T receiver has to cope with the adverse conditions of the broadcast transmission channel. In general, signals arriving at a receiver by different paths have different time delays which results in the effect of inter-symbol interference, degradation in reception. A well designed system with a multipath capability allows for constructive combination of these signals.

There is a strict requirement with respect to the maximum distance between transmitters. This distance is related to the length of the guard interval and the velocity of light, i.e. the associated signal delay. Inter-symbol interference can only be avoided

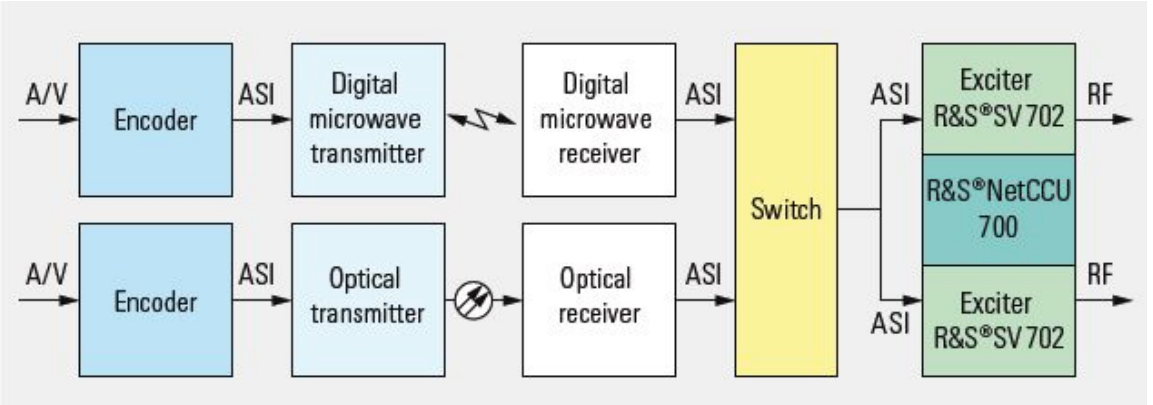
Source: Rohde & Schwarz

if in the case of multipath reception, the delay on any path is no longer than the length of the guard interval. It is, therefore, of particular importance that all aspects and configurations of the SFN are calibrated correctly.



4. Transport Network (Primary Distribution Network)

The program contribution is injected from the play-out center in which the MPEG-2/4 encoders and multiplexers are located, e.g. via optical fiber or microwave link. The Asynchronous Serial Interface (ASI) is the streaming data format that carries an MPEG Transport Stream (MPEG-TS). An ASI signal can carry multiple standard definition (SD) or high definition (HD) programs that are already compressed. The ASI signal is the final product of video compression, either MPEG-2 or MPEG-4, ready for transmission to a transmitter or microwave system or optical fiber. It can also be converted to RF and then transmitted over fiber where each channel is transmitted at a separate wavelength.



5. Transmission Sites (Secondary Distribution Network)

Each transmitter site is carefully planned in order to guarantee over 99.4% populated area coverage. The minimum required field strength of 56 dB(uV/m) is used by the network planning criteria to design the transmission system that ensure adequate signal field strength is provided to receivers within the coverage area of a transmitter. Effectively, the minimum field strength given for planning purposes is to be interpreted as the field strength that is to be provided at 10 meter height in order to assure good reception for fixed outdoor reception (roof-level).

The following sites are pointed out in order to set-up the secondary (broadcasting) distribution network. The power indicated is relevant for the Effective Radiated Power (ERP).

Transmission Site	Power [ERP]
Seru Pretu	200W
Cocori	200W
Seru Gracia	200W
Habitat	50W
Lagun	50W
Westpunt	50W

6. DVB-T Standards

Digital Video Broadcasting	
Document: EN 302 296 Electromagnetic Compatibility and Radio Spectrum Matters;	
ETSI	Transmitting Equipment for the Digital Television Broadcast Service, Terrestrial (DVB-T)
Document: EN 300 744 Digital Video Broadcasting (DVB);	
ETSI	Framing Structure, Channel Coding and Modulation for Digital Terrestrial Television
Document: TR 101 190 Digital Video Broadcasting (DVB);	
ETSI	Implenetation Guidelines for DVB Terrestrial Services; Transmission Aspects
Document: TR 101 290 Digital Video Broadcasting (DVB);	
ETSI	Measurement Guidelines for DVB Systems
Document: TS 101 191 Digital Video Broadcasting (DVB);	
ETSI	DVB mega frame for Single Frequency Network (SFN) synchronization
Document: Planning criteria for digital terrestrial television services in the VHF/UHF bands - ITU-R BT.1368 Document: The basic elements of a worldwide system for digital terrestrial television broadcasting ITU-R BT1299 Document: Measuring sideband emissions of DVB-T transmitters for monitoring purposes - ITU-R SM.[sideband] Document: Spectrum shaping limits for digital terrestrial television broadcasting - ITU-R BT.1206 Document: DVB-T coverage measurements and verification of planning criteria - ITU-R SM.1875	

7. Parameters for Coverage Calculations

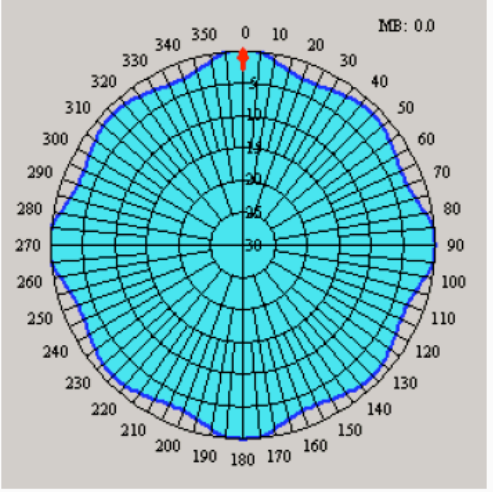
The below listed parameters were used for the coverage calculations for the different reception modes (fixed and portable). The frequency depended parameters (antenna gain, feeder loss) are listed for the frequency 634 MHz in the UHF range.

Parameter	**GE06 Final Acts Link Budget**			
Reception scenario	Fixed	portable outdoor	Fixed	portable outdoor
Modulation	**64 QAM**	**64 QAM**	**64 QAM**	**64 QAM**
Code Rate	**2/3**	**2/3**	**3/4**	**3/4**
MPE-FEC				
Bandwidth [MHz]	8	8	8	8
Channel	40	40	40	40
Frequency [MHz]	626	626	626	626
Noise Figure [dB]	7	7	7	7
C/N [dB]	**19,5**	**21,8**	**21,2**	**23,6**
Antenna Gain [dBd]	10,8	0	10,8	0
Feeder Loss [dB]	3,8		3,8	
Antenna directivity (angle dependent) [dB]	0-16	0	0-16	0
Sigma Location Probability [dB]	5,5	5,5	5,5	5,5
Building Penetration Loss [dB]				
Sigma Building Penetration [dB]				
Receive Antenna Height (m)	**10**	**10**	**10**	**10**
Height loss (10m -→ 1,5m) [dB]		**16,8**		**16,8**
Coverage Probability (%)	95	95	95	95
Location Correction [dB]	9	9	9	9
Minimum FST [dBuV/m]	**54**	**80**	**56**	**82**

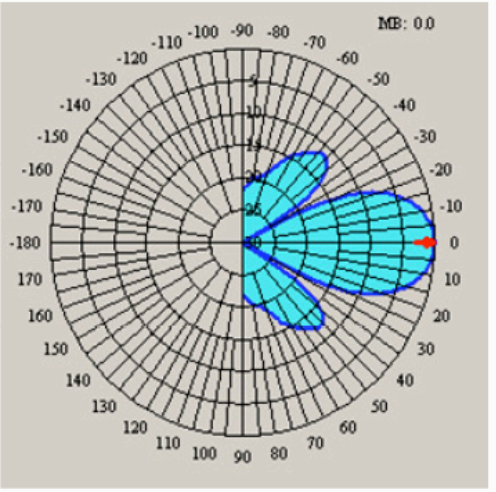
8. Antenna Pattern

The antenna is depicted in the following pictures. This standard antenna was used for each station as the start configuration

Horizontal Antenna Pattern



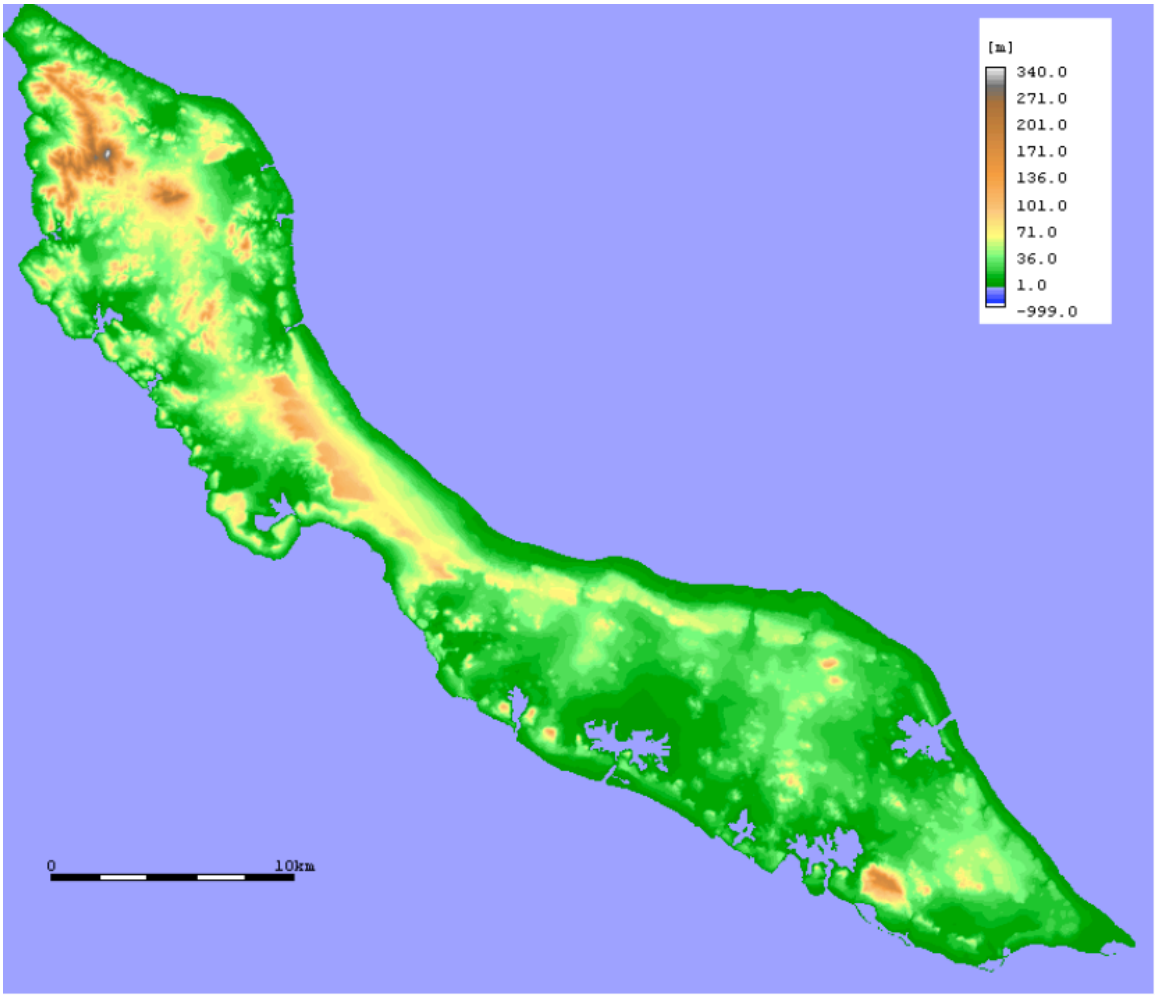
Vertical Antenna Pattern



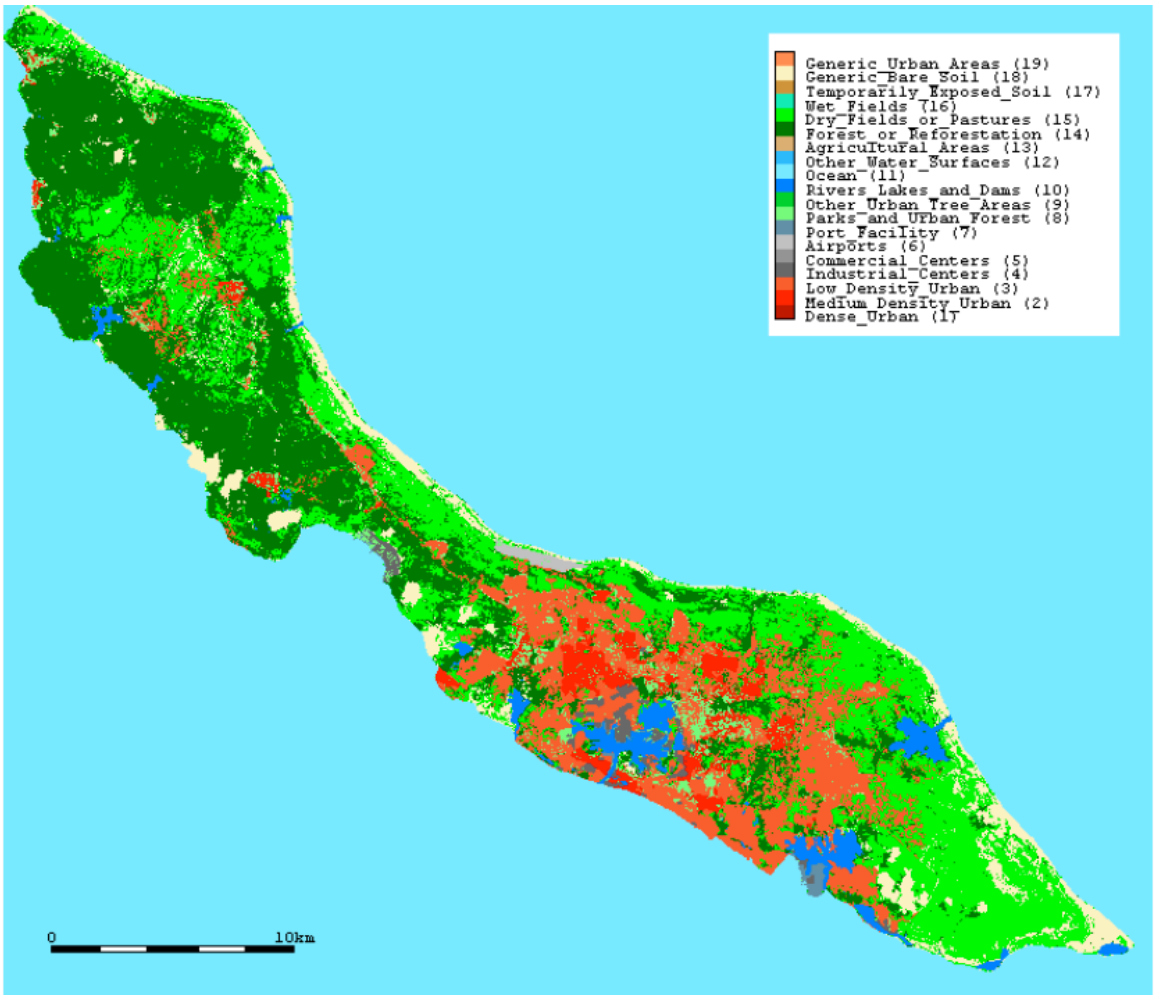
9. Calculation Areas and Maps

For the investigation different target areas are specified. The size of the calculation areas are determined in order to ensure that the whole network coverage is taken into account. All calculations were done with a topographical and morphological map with a resolution of 15 m. In order to determine the covered population by the different services a population map is used

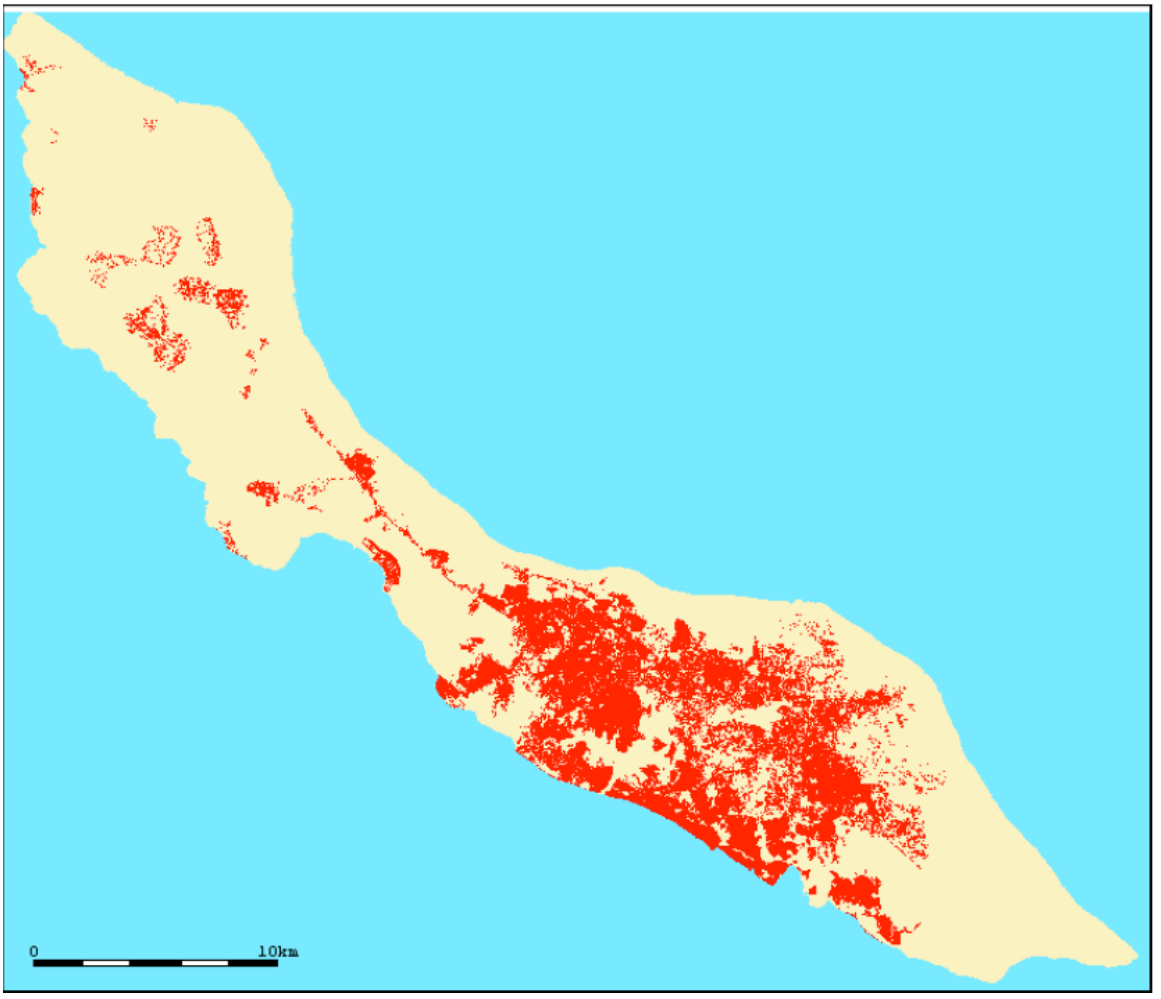
The figures below are showing exemplary excerpts of the topographical map and land-usage map.



Topographical map



Morphological map



Populated area map

The population data is based on the Morphological Map. The population area represents morpho classes with population (Industrial Centers, Commercial Centers, Low Densitiy Urban, Medium Density Urban and Dense Urban) shown in red in the map above. The sand color is land and blue is water.

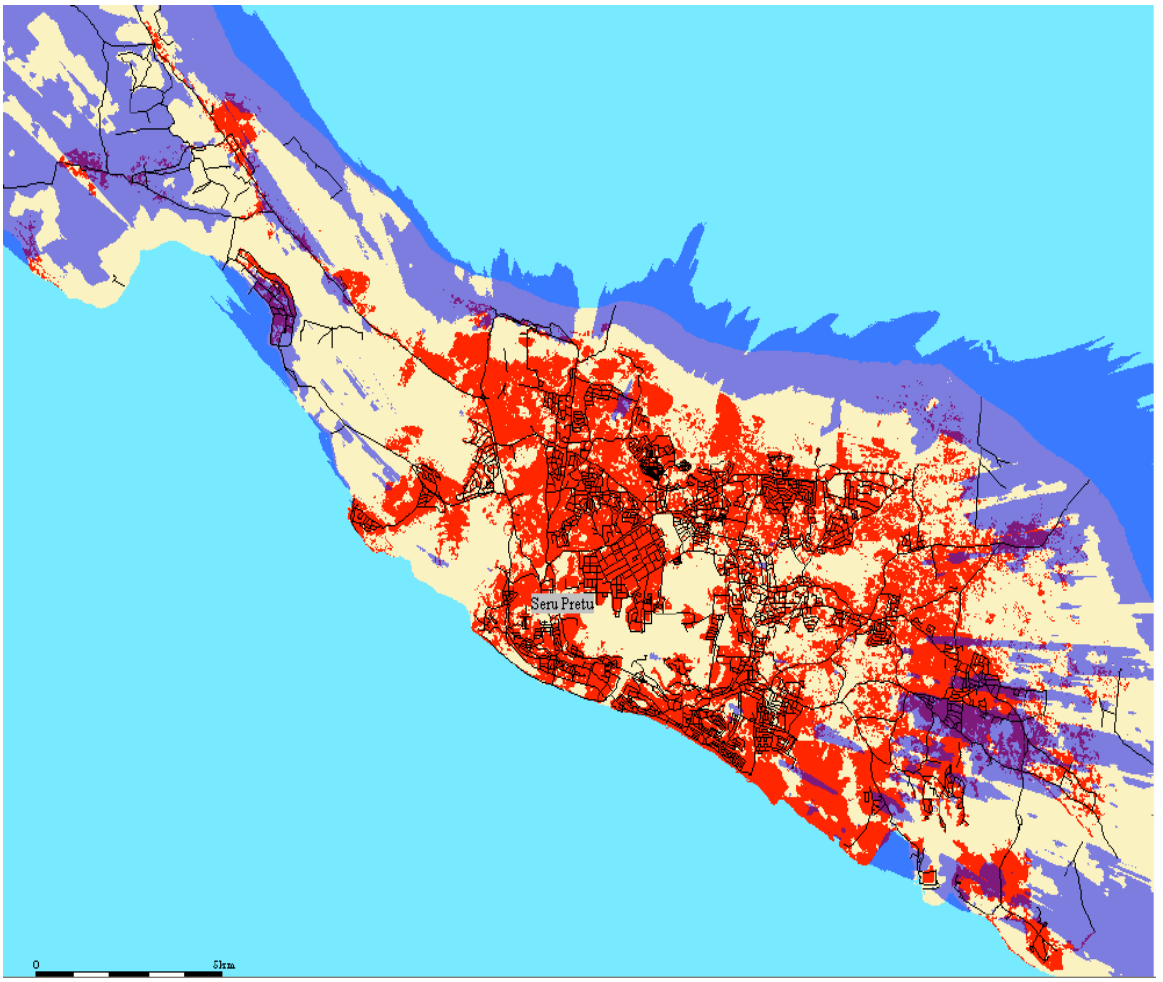
10. Coverage Analyses

The first step to find out which transmitter provides the highest potential to cover an area was to draw a 60 dBµV/m contour. This contour was taken from the field strength result calculated with the IRT 2D model. The value 60 dBµV/m represents roughly the minimum field strength requirement for fixed reception.

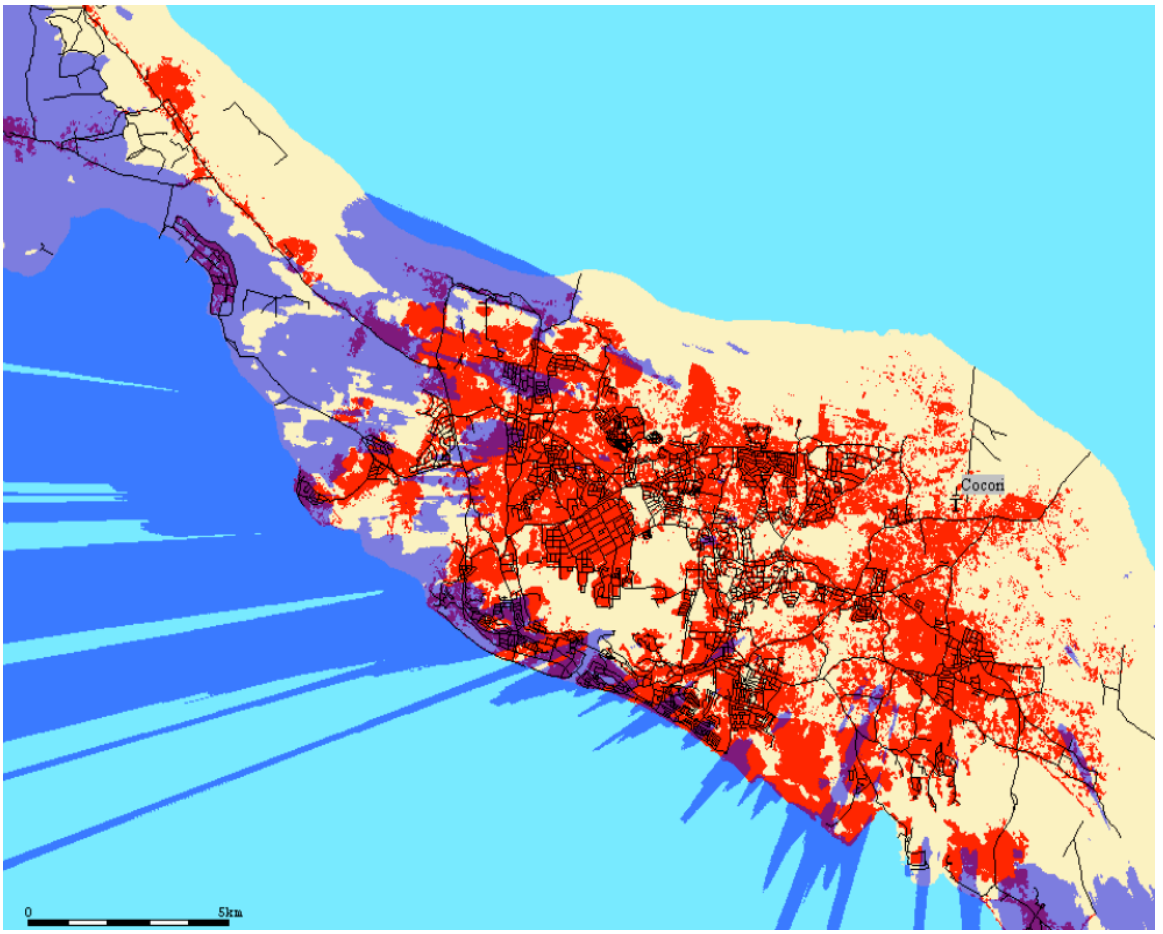
A detailed coverage analysis of each transmitter is performed. After this a total coverage analysis is performed. The total coverage is then analyzed further to identify areas for coverage improvements.

In the following figures the coverage results are superimposed on a population map. The populated areas are shown in red, the sand color is land and blue represents water.

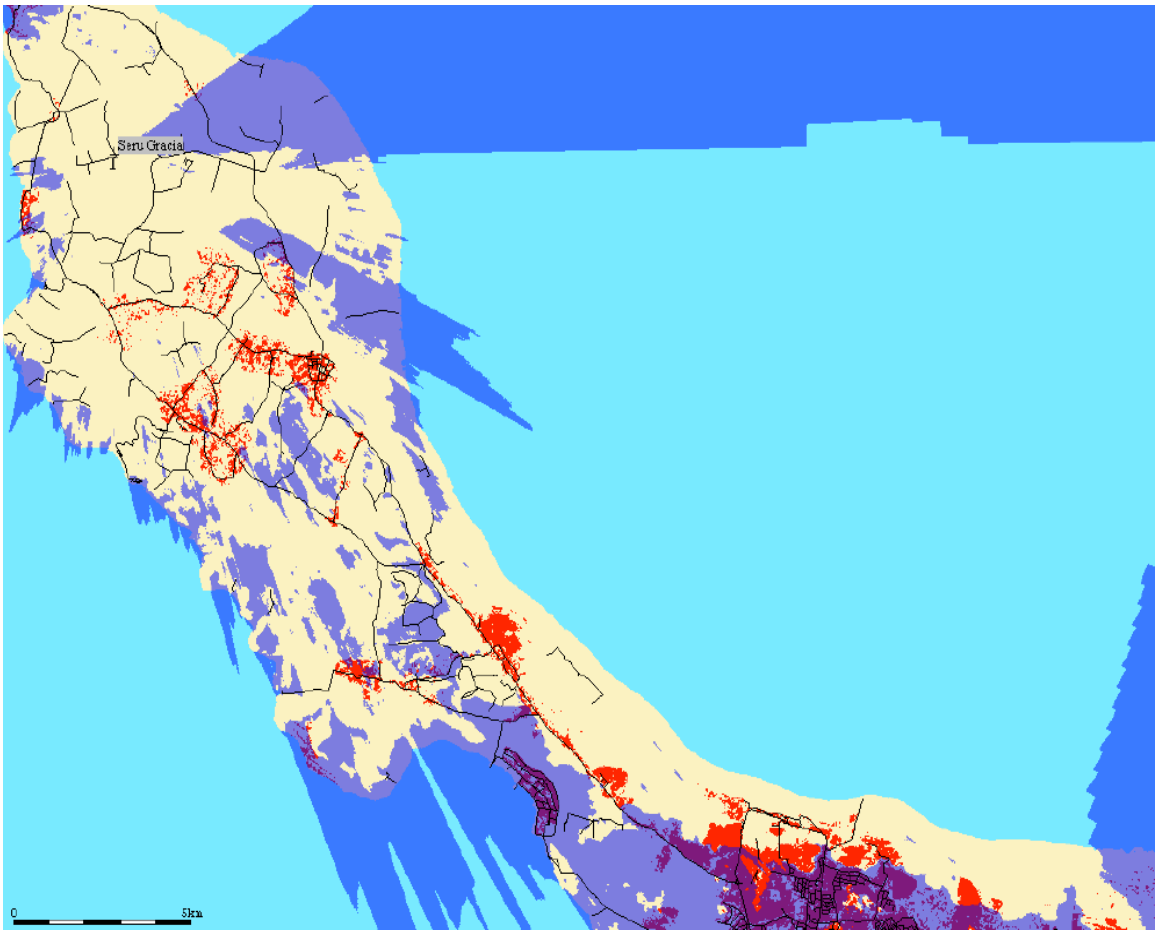
Coverage of the Seru Pretu transmitter



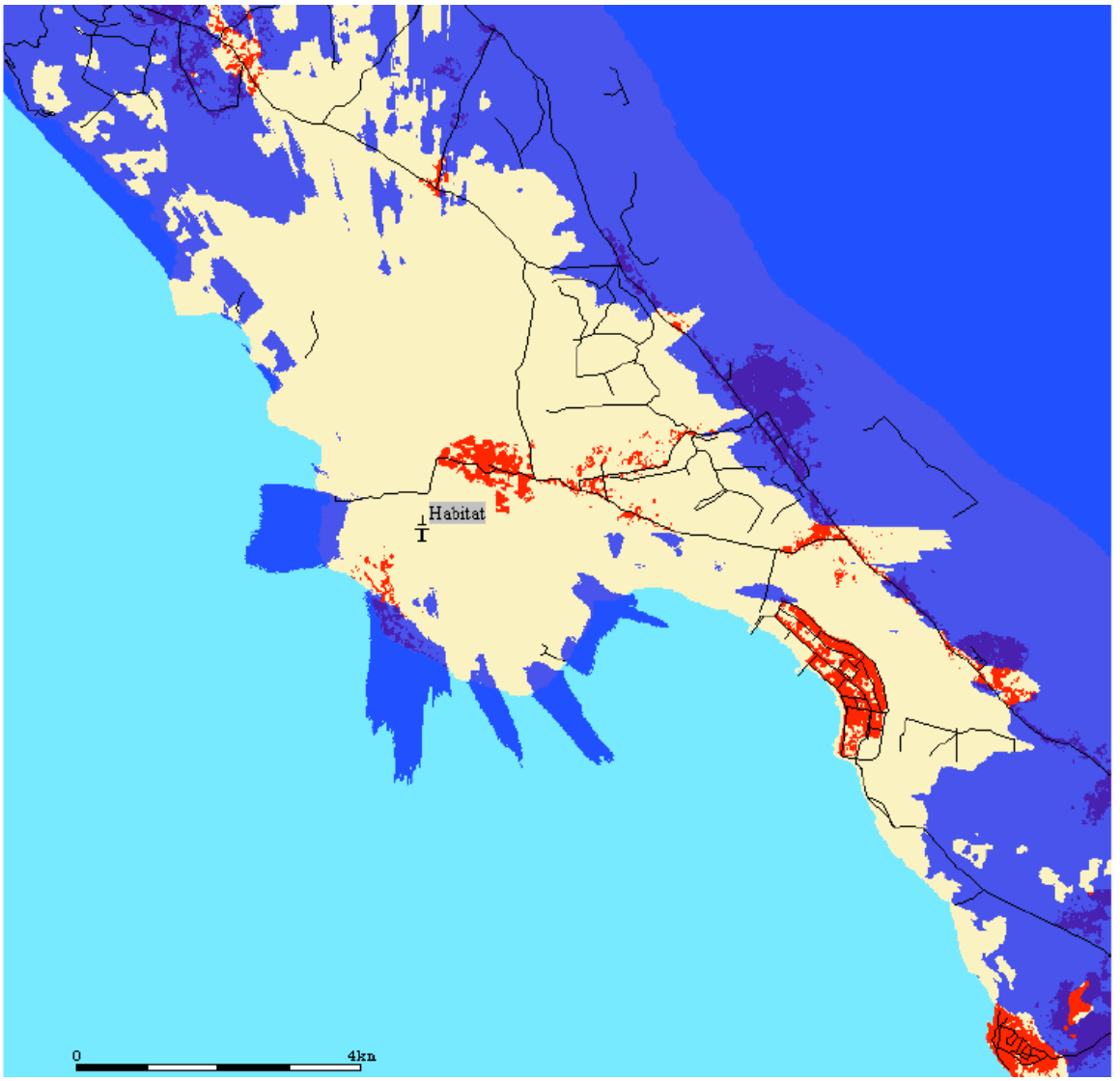
Coverage of the Cocori transmitter



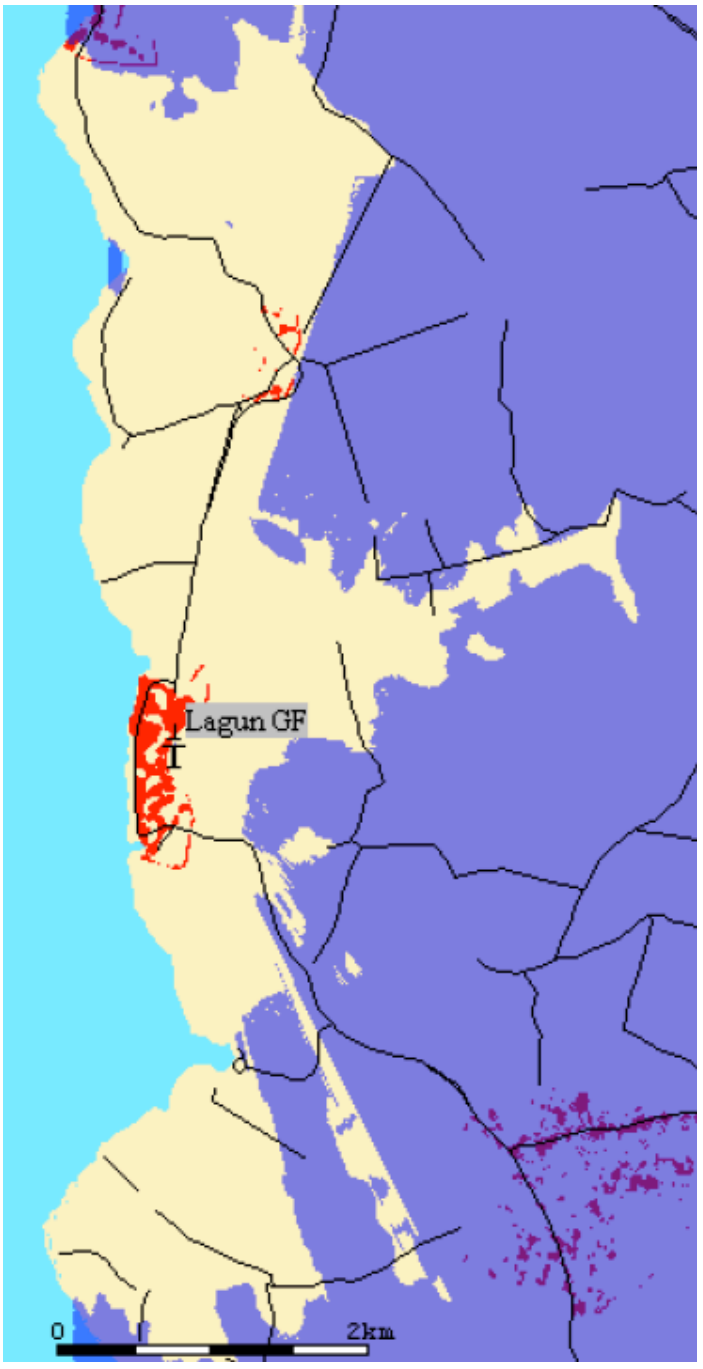
Coverage of the Seru Gracia transmitter



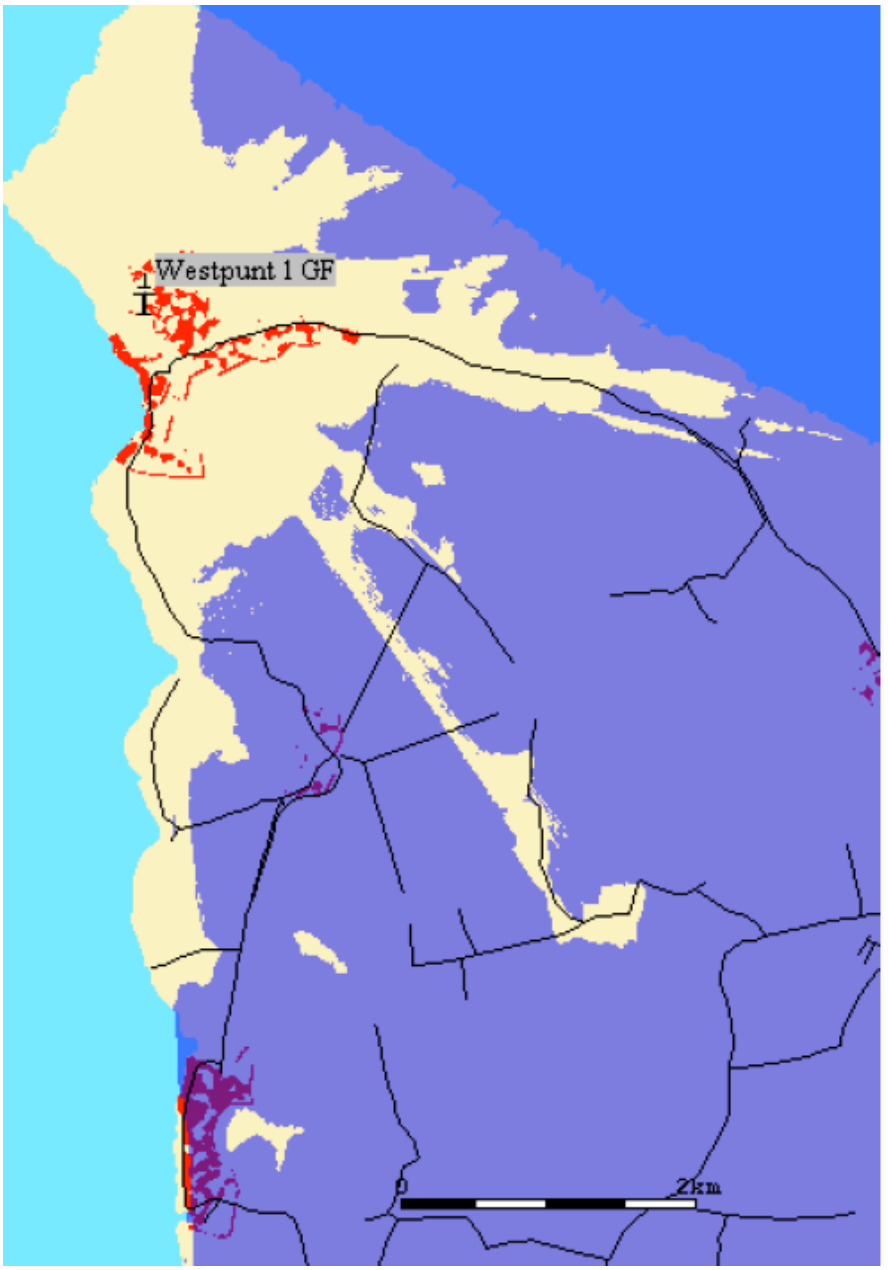
Coverage of the Habitat transmitter



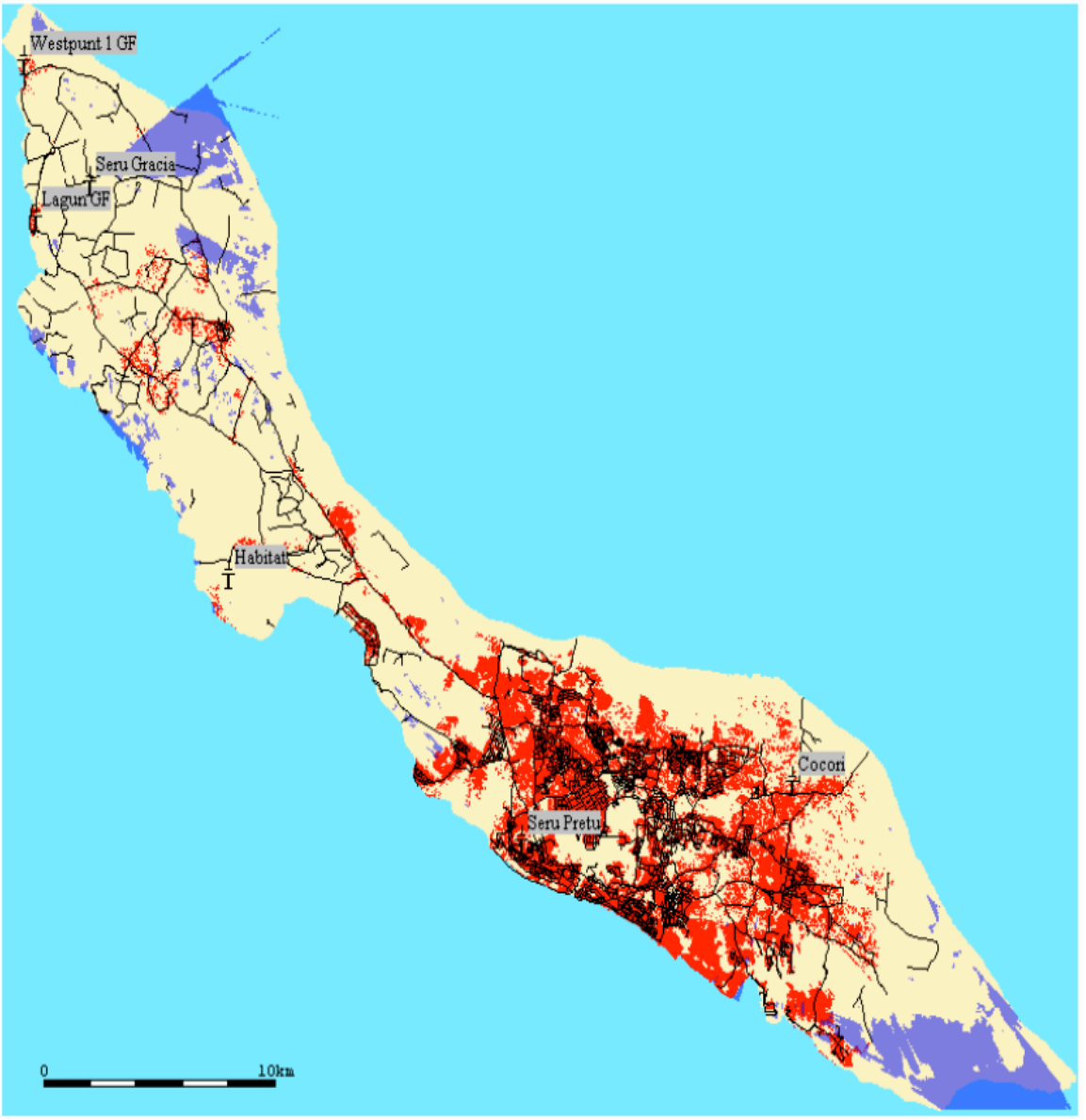
Coverage of the Lagun transmitter



Coverage of the West Punt transmitter



Final: Total Island Coverage



The final percentage of the populated areas and the percentage of the island area covered are given in the following table.

Populated Area Coverage (%)	Island Area Coverage (%)	Buildings covered (%)
99.4	91.8	99.7

11. Document Guidelines

- DVB-T Planning for Curacao – Technical Coverage Analyses – LS Telcom
- Geneva GE06 Final Acts; 2006 Agreement and Plan – ITU-R
- Technical Basis and Planning Configurations for DVB-T (RRC-06) – EBU
- Spectrum usage and requirements for future terrestrial broadcast applications - EBU
- ETSI and ITU-R DVB-T standards – Chapter 5