

Unik.no x references.jnoll.net x

references.jnoll.net

Presentations given by Josef Noll

1. "Målbær Sikkerhet for tingenes internet" ^Δ, ISF medlemsmøte, 20. Nov 2013, Oslo
2. "Providing Internet Access to Emerging Economies - The Business of Free Access" ^Δ, Keynote at the The Third International Conference on Mobile Services, Resources, and Users. MOBILITY 2013, 27.-22. November 2013, Lisboa, Portugal
3. "Mobility 2020 - Change of Paradigm" ^Δ, Panel contribution at the Third International Conference on Mobile Services, Resources, and Users. MOBILITY 2013, 27.-22. November 2013, Lisboa, Portugal
4. Mario Hoffmann, Josef Noll, "The Life Management Initiative - Towards User-centric and Personalized Service Provisioning" ^Δ, Keynote at The Sixth International Conference on Advances in Human oriented and Personalized Mechanisms, Technologies, and Services, CENTRIC 2013, 27.10.-1.11.2013, Venice, Italy
5. Josef Noll, Zahid Iqbal, Martin Folkestad, "Attribute based access to industrial life-cycle data, the semantic dimension" ^Δ, Workshop ISO 15926 and Semantic Technologies 2013, 5.-6. September 2013, Sogndal, Norway
6. "Measurable Security for the Internet of Things" ^Δ, Semantic Days 2013, 29-30. May 2013, Stavanger, Norway
7. "Measurable Security for the Internet of Things" ^Δ, 7. Strategic Workshop, 21.-23.May 2013, Marbella, Spain
8. "Measurable Security - a discussion of potential approaches" ^Δ, FFI Seminar on Advances in ICT, 24.-25.Apr2013, Jeløya,
9. "Measurable Security in Mobile Networks" ^Δ, Invited Talk at the IDC Enterprise Mobility Series, 28.Nov 2012, Budapest, Hungary
10. "Security, Privacy and Dependability in Mobile Networks" ^Δ, Keynote at the The Second International Conference on Mobile Services, Resources, and Users. MOBILITY 2012, 21.-25. October 2012, Venice, Italy
11. Internet of Things - Finding its Way to Industry" ^Δ, IFEA Wireless Summit, Oslo, 17.-18. April 2012
12. Secure Interoperability - The Challenge for the Internet of Things" ^Δ, FFI ICT Seminar, Jeløya, Apr 2012
13. Internet of Things - a Scandinavian Perspective" ^Δ, 4th CMI conference *Internet of Things - our environments becomes intelligent*, 24.-25. Nov 2011, Copenhagen
14. Security challenges in the Internet of Things" ^Δ, ITEA/Artemis Co-Summit, Panel on *Trends in ICT Security*, 24.-26. October 2011, Helsinki
15. Integrating context- and content-aware mobile services into the cloud" ^Δ, CWI/CTIF seminar on *Mobile Cloud Computing and wireless applications*, 24.-25. October 2011, Aalborg University in Copenhagen
16. Security, Privacy and Dependability in the Internet of Things (IoT)" ^Δ, WWRF#27,

CNET: 9 LOS + 9 NLOS rays
 test area: Munich (vector data of houses)

Chapter 4

Prediction model	METRO200 (970 points)		METRO201 (355 points)		METRO202 (1031 points)		average STD (dB)
	STD (dB)	mean (dB)	STD (dB)	mean (dB)	STD (dB)	mean (dB)	
Eriksen	6.7	0.3	7.1	2.3	7.5	1.4	7.1
CNET	6.9	-2.1	9.5	-3.6	5.6	-0.2	7.3
PTT (RT)	14.6 ¹⁾	-6.1 ¹⁾	15.5 ²⁾	-6.7 ²⁾	12.3 ³⁾	-1.1 ³⁾	14.1
PTT (TLM)	13.8	0.8	21.7	6.7	12.9	6.5	16.1
COST-WI ⁴⁾	7.7	10.8	5.9	15.4	7.3	16.3	7.0
Uni-Valencia ⁵⁾	8.7	0.2	7.0	-6.6	10.3	-7.4	8.7
CSELT	10.4	21.8	12.3	16.1	13.3	20.6	12.0
PTT (MCOR)	7.0	-3.3	6.2	-0.1	7.6	-1.1	6.9
Villa Griffone Lab	6.3	-1.7	10.9	-6.3	6.8	-5.5	8.0
Uni-Karlsruhe	8.5 ⁶⁾	-4.3 ⁶⁾	9.1	2.4	8.6 ⁶⁾	-1.0 ⁶⁾	8.7

¹⁾calculations at 425 points only; ²⁾calculations at 264 points only; ³⁾calculations at 774 points only; ⁴⁾assumed terrain parameters: building height: 20m, street width: 13m, building separation: 26m; ⁵⁾no 3D effects are considered; ⁶⁾2D-vertical propagation plane only;

Tab. 4.5.2 Performance of the propagation models at 947 MHz; standard deviation and mean value (prediction - measurement).

ray tracing (old V)

analytical LOS + NLOS

Wolf Thurn model ray tracing

Questions:

- Model comparison for 1800 MHz

Comparison of radio prop. models

free space $\sim \frac{1}{R^2}$

Walfish-Ichimura

?

CNET

Joseph's calendar x UNIK4700 - CWI x cwi.unik.no/image: x CNET outdoor prop x W Radio propagation x www2.it.lut.fi/kurs: x https://www.goog: x

www2.it.lut.fi/kurssit/04-05/010651000/Luennot/Chapter4.pdf

Propagation Prediction Models 133

The diagram shows six propagation phenomena with labels and distance markers d_1 , d_2 , and d :

- Reflection:** A wave reflects off a horizontal surface. Distances d_1 and d_2 are marked from the source to the reflection point and then to the receiver.
- Diffraction:** A wave passes over a single building. Distances d_1 and d_2 are marked from the source to the top edge of the building and then to the receiver.
- Multiple diffraction:** A wave passes over a series of buildings. Distance d is marked from the source to the final receiver.
- Scattering:** A wave hits a rough, irregular surface and scatters in multiple directions. Distances d_1 and d_2 are marked for two different paths.
- Absorption:** A wave enters a building and is absorbed. Distance d is marked from the source to the point of absorption.
- guided wave:** A wave is trapped between two parallel horizontal surfaces, propagating along them. Distance d is marked along the direction of propagation.

Fig. 4.3.4 Propagation phenomena.

Indoor

Mainly reflection from and transmission through walls, partitions, windows, floors, and ceilings are used to predict propagation within buildings (Sec. 4.6 and Sec. 4.7). Wave guiding in corridor or in hallways are more difficult to model and thus are usually not considered. Although diffraction effects have been sometime identified (Sec. 4.7.5), diffraction at edges from walls or windows is usually not taken into account due to the difficulties related to the requirement on the input database and due to the resulting large computation time.

Handwritten notes:

- Red circle around "Indoor" with an arrow pointing to the text below.
- Red arrow pointing from "absorption is 'real part'" to the "Absorption" diagram.
- Red text "phase shift" written near the "Absorption" diagram.
- Red text "absorption" written below the "Absorption" diagram.

This type of file can harm your computer. Do you want to keep [40]Section 4-5 Prop....pdf anyway? Keep Discard Show all downloads...

models. These models, valid for flat terrain, are based on the approaches of Walfisch-Bertoni [24], Ikegami [48] and Hata [49].

COST 231 - Hata-Model

Path loss estimation is performed by empirical models if land cover is known only roughly, and the parameters required for semi-deterministic models cannot be determined. Four parameters are used for estimation of the propagation loss by Hata's well-known model: frequency f , distance d , base station antenna height h_{Base} and the height of the mobile antenna h_{Mobile} . In Hata's model, which is based on Okumura's various correction functions [50], the basic transmission loss, L_b , in urban areas is:

$$L_b = 69.55 + 26.16 \cdot \log \frac{f}{\text{MHz}} - 13.82 \cdot \log \frac{h_{\text{Base}}}{\text{m}} - a(h_{\text{Mobile}}) + (44.9 - 6.55 \cdot \log \frac{h_{\text{Base}}}{\text{m}}) \cdot \log \frac{d}{\text{km}} \quad (4.4.1)$$

where:

1) "log" means " $\log_{10}$ "

Handwritten notes:

- implemented earlier* (in red)
- free space - 20 log f [MHz] - 20 log d [km]* (in green)
- + add.* (in red, pointing to the distance term)

Propagation Prediction Models 135

$$a(h_{\text{Mobile}}) = (1.1 \cdot \log \frac{f}{\text{MHz}} - 0.7) \frac{h_{\text{Mobile}}}{\text{m}} - (1.56 \cdot \log \frac{f}{\text{MHz}} - 0.8) \quad (4.4.2)$$

This type of file can harm your computer. Do you want to keep [40]Section 4-5 Prop....pdf anyway? Keep Discard Show all downloads...

Josef's calendar x UNIK4700 - CWI x cw.unik.no/image x CNET outdoor prop x W Radio propagation x www2.it.lut.fi/kurss x https://www.goog x

www2.it.lut.fi/kurssit/04-05/010651000/Luennot/Chapter4.pdf

Propagation Prediction Models 135

$$a(h_{\text{Mobile}}) = (1.1 \cdot \log \frac{f}{\text{MHz}} - 0.7) \frac{h_{\text{Mobile}}}{m} - (1.56 \cdot \log \frac{f}{\text{MHz}} - 0.8) \quad (4.4.2)$$

The model is restricted to:

f : 150 ... 1000 MHz
 h_{Base} : 30 ... 200 m
 h_{Mobile} : 1 ... 10 m
 d : 1 ... 20 km

COST 231 has extended Hata's model to the frequency band $1500 \leq f(\text{MHz}) \leq 2000$ by analysing Okumura's propagation curves in the upper frequency band. This combination is called "COST-Hata-Model" [51]:

$$L_b = 46.3 + 33.9 \log \frac{f}{\text{MHz}} - 13.82 \log \frac{h_{\text{Base}}}{m} - a(h_{\text{Mobile}}) + (44.9 - 6.55 \log \frac{h_{\text{Base}}}{m}) \log \frac{d}{\text{km}} + C_m \quad (4.4.3)$$

where $a(h_{\text{Mobile}})$ is defined in equation (4.4.2) and

$$C_m = \begin{cases} 0 \text{ dB} & \text{for medium sized city and suburban} \\ & \text{centres with medium tree density} \\ 3 \text{ dB} & \text{for metropolitan centres} \end{cases} \quad (4.4.4)$$

The COST-Hata-Model is restricted to the following range of parameters:

f : 1500 ... 2000 MHz
 h_{Base} : 30 ... 200 m
 h_{Mobile} : 1 ... 10 m
 d : 1 ... 20 km

The application of the COST-Hata-Model is restricted to large and small macro-cells, i. e. base station antenna heights above roof-top levels adjacent to the base station. Hata's formula and its modification must not be used for micro-cells.

COST 231 - Walfisch-Ikegami-Model

Furthermore COST 231 proposed a combination of the Walfisch [24] and Ikegami [48] models. This formulation is based on different contributions from members of the "COST 231 Subgroup on Propagation Models" [51]. It

This type of file can harm your computer. Do you want to keep [40]Section 4-5 Prop....pdf anyway? Keep Discard Show all downloads...

136 Chapter 4

is called the COST-Walfisch-Ikegami-Model (COST-WI). The model allows for improved path-loss estimation by consideration of more data to describe the character of the urban environment, namely

- heights of buildings h_{Roof} ,
- widths of roads w ,
- building separation b and
- road orientation with respect to the direct radio path ϕ .

The parameters are defined in Figs. 4.4.1 and 4.4.2. However this model is still statistical and not deterministic because only characteristic values can be inserted and no topographical data base of the buildings is considered.

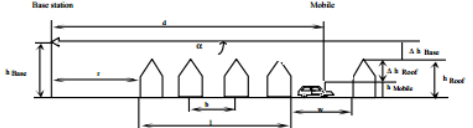


Fig 4.4.1 Typical propagation situation in urban areas and definition of the parameters used in the COST-WI model and other Walfisch-type models [24], [45], [52].

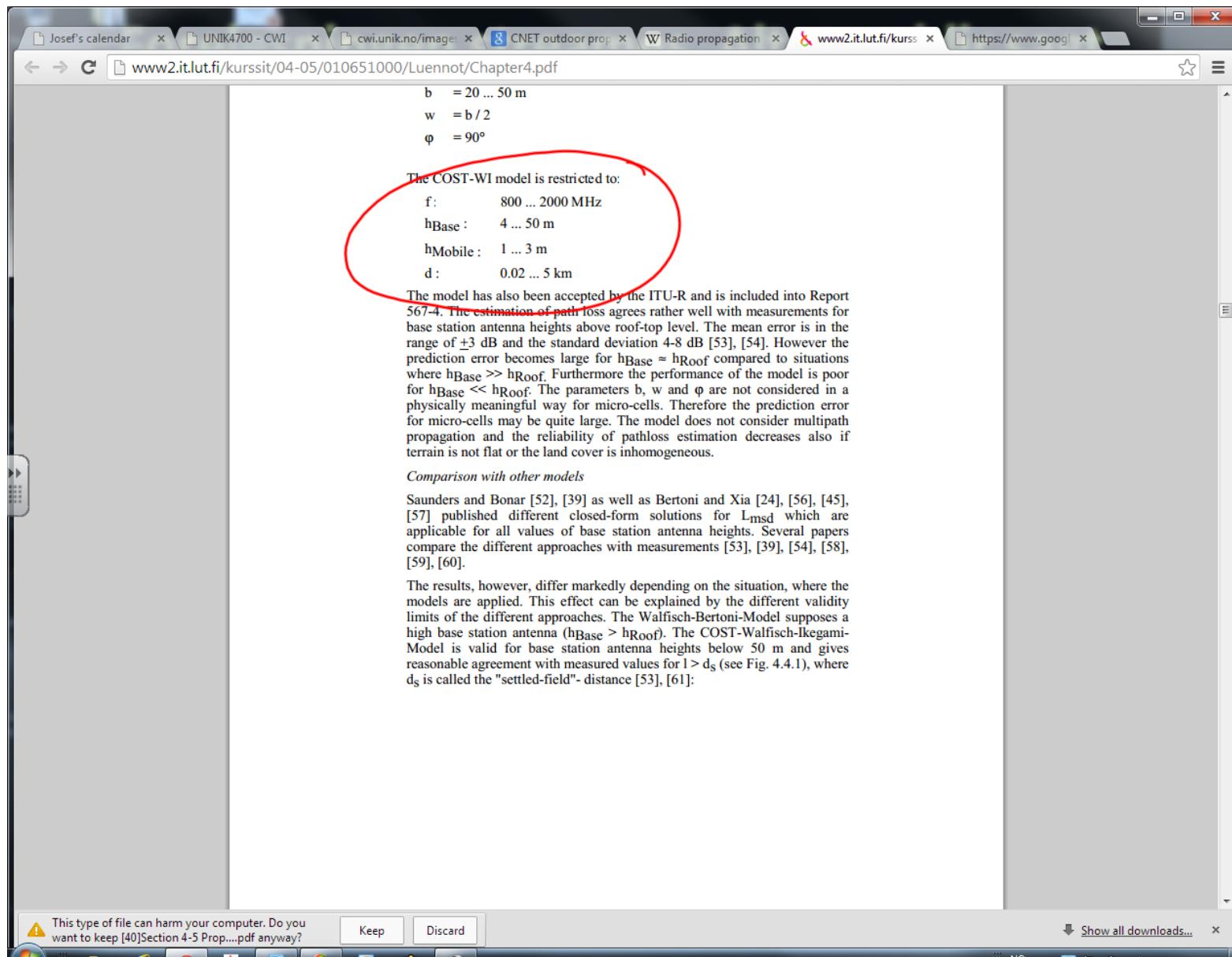
The model distinguishes between line-of-sight (LOS) and non-line-of-sight (NLOS) situations. In the LOS case -between base and mobile antennas within a street canyon - a simple propagation loss formula different from free space loss is applied. The loss is based on measurements performed in the city of Stockholm:

$$L_b(\text{dB}) = 42.6 + 26 \log(d/\text{km}) + 20 \log(f/\text{MHz}) \quad \text{for } d \geq 20 \text{ m} \quad (4.4.5)$$

where the first constant is determined in such a way that L_b is equal to free-space loss for $d = 20 \text{ m}$. In the NLOS-case the basic transmission loss is composed of the terms free space loss L_0 , multiple screen diffraction loss L_{msd} , and roof-top-to-street diffraction and scatter loss L_{rts} .

$$L_b = \begin{cases} L_0 + L_{rts} + L_{msd} & \text{for } L_{rts} + L_{msd} > 0 \\ L_0 & \text{for } L_{rts} + L_{msd} \leq 0 \end{cases} \quad (4.4.6)$$

This type of file can harm your computer. Do you want to keep [40]Section 4-5 Prop....pdf anyway? Keep Discard Show all downloads...



which is defined by a recursive expression as a function of the nodal points and corresponding street orientation angles of the path between transmitter and receiver. The dual-slope behaviour [94] of the distance dependence of the path loss is also included in the proposed model. In addition, the distance dependence of the COST-WI model is applied to consider over-roof-top propagation in case of NLOS.

CNET micro-cell model

This model is based on an analytical, semi-deterministic approach for the consideration of reflected and diffracted waves [100]. Only below roof-top propagation around buildings and street crossings with four corners are regarded. The angle of crossing streets can be arbitrary. Nine reflections in a LOS case and nine reflections in a following NLOS case are included. Ground reflections and street corner diffraction between the line-of-sight and the non-line-of-sight street are regarded as well. The Uniform Theory of Diffraction is used for the street corner diffraction calculation, wherein the finite conductivity of the walls is introduced through heuristic coefficients.

Swiss Telecom PTT micro-cell ray tracing model

Micro-cell environments are described by a two-dimensional layout of buildings which are given to the software program in terms of vectors defining the building walls. Arbitrary two-dimensional building geometry can be handled. Additionally, the permittivity and conductivity of each building wall can be considered if available. In operational use the electrical characteristics are usually taken to be the same for all buildings in a given area. Specular reflection and diffraction are the propagation phenomena taken into account [101]. Ground reflection, scattering and over-roof-top propagation which are expected to dominate in areas far from the transmitter are neglected so far. The software computes all reflected and diffracted rays up to some predetermined order. This is performed according to an efficient implementation of the image theory which takes advantage of the assumed

Handwritten notes:

CNET



based on free space propagation + "channel" + reflections

This type of file can harm your computer. Do you want to keep [40]Section 4-5 Prop....pdf anyway? Keep Discard Show all downloads...

Josef's calendar x UNIK4700 - CWI x cw.unik.no/image: x CNET outdoor prop x W Radio propagation x www2.it.lut.fi/kurss x https://www.goog x

www2.it.lut.fi/kurssit/04-05/010651000/Luennot/Chapter4.pdf

CNET 1 of 15

*CNET
refere*

PIMRC'95, Toronto, Canada, September 1995, pp. 140-143

- [100] J. Wiart, "Microcell modelling when base station is below roof tops," *Proc. 44th IEEE Vehicular Technology Conference VTC'94*, Stockholm, Sweden, May 25-28, 1994, pp. 200-204
- [101] K. Rizk, J. F. Wagen, F. Gardiol, "Ray tracing based path loss prediction in two microcellular environments," in *Proc. Personal, Indoor and Mobile Radio Conference PIMRC'94*, pp. 384-388, The Hague, The Netherlands, 18-23 September, 1994
- [102] D. J. Cichon, T. C. Becker, W. Wiesbeck, "A ray launching approach for indoor and outdoor applications," *COST 231 TD(94)32*, Lisbon, Portugal, January 1994
- [103] D. J. Cichon, W. Wiesbeck, "Indoor and outdoor propagation modeling in pico cells," in *Proc. Personal, Indoor and Mobile Radio Conference PIMRC'94*, pp. 491-495, The Hague, The Netherlands, September 1994
- [104] D. J. Cichon, T. Kürner, W. Wiesbeck, (in German) "Modellierung der Wellenausbreitung in urbanem Gelände," ("Wave propagation modelling in urban area"), *FREQUENZ*, vol. 47, no. 1-2, pp. 2-11, 1993
- [105] N. Cardona, F. Navarro, P. Möller, "Applicability of Walfisch-type urban propagation models," *COST 231 TD(94)134*, Darmstadt, Germany, September 1994
- [106] P. Möller, N. Cardona, D. J. Cichon, "Investigations in a new developed urban propagation model," *COST 231 TD(94)135*, Darmstadt, Germany, September 1994
- [107] J. Deygout, "Multiple knife-edge diffraction of microwaves," *IEEE Trans. on Antennas and Propagation*, vol. 14, no. 4, pp 480-489, 1966
- [108] CCIR, vol. V Report 567-4, "Propagation data and prediction methods for the terrestrial land mobile service using the frequency range 30 MHz to 3 GHz"
- [109] T. Kürner, D. J. Cichon: "Comments on TD (93) 6: Comparison between different path loss prediction models", *COST 231 TD(93)81*, Grimstad, Norway, May 1993
- [110] M. Perucca, "Small cells characterization using 3-D database and Deygout diffraction approach," *COST 231 TD(94)54*, Prague, Czech Republic, April 1994

[40]Section 4-5 Prop....pdf Show all downloads...

To Do:

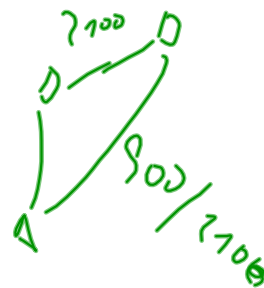
- a) control algorithms
 - (h ~ 100m)
 - manual control points
- (A) test cases
- (C) b) sensitivity analysis
 - 2/3 cases
- A applicability
 - (1) Free space
 - "up into the sky"
 - "focussed link"
 - (2) flat ant. height > building height
 

The diagram shows two vertical lines representing buildings. At the top of each building is a circle representing an antenna. A horizontal line with an arrow at the end connects the two antennas, labeled 'radio link'.
- (B)
- (3) Cost 237-WI: Walfish-Ihigami
 - "typical Bergen"

① Cost 231 VI is implemented

- realistic assumptions for environment & distance between building
- finnsendoren. no + ghl sider. no/hart
One operator Google maps

① 900 link
- 2100 link



} Comparison:
handover numbers

②

Browser tabs: Josef's calen, UNIK4700, cwi.unik.no, CNET outdo, W Radio propa, finnsenderen, WebVPN - U, Micro-cellul, IEEE Xplore

Address bar: finnsenderen.no/finnsender

Logo: pt Post-og teletilsynet Norwegian Post and Telecommunications Authority

Navigation: NPT.NO OM TJENESTEN ORDBOK OM STRÅLING KONTAKTINFORMASJON HJELP

Left sidebar:

- Finnsenderen
- Trådløse mikrofoner
- Strålingskalkulator
- Hordaland
- Bergen
- Adresse
- Postnr
- Søk
- Nullstill alt
- Bergen (Kommune)
- Vis sendere i kart
- Tegnforklaring
- Radio- og TV
- Mobil
- Vis alle
- Radio og TV
- Mobil

Main map area:

- Map of Bergen with various colored markers (red, green, blue) and handwritten labels (e.g., 900, 2100, MN, Th, Te).
- Scale bar: 120 m
- Map controls: Tips en venn, Kart, Foto, Hybrid, Panorér, Zoom
- Legend: FM-RADIO (1), GSM (36), LTE (15), UMTS (22)
- Footer: Besøksadresse: Nygård 1, Lillesand • Postadresse: Postboks 93, 4791 Lillesand • Tlf.: 22 82 46 00 • Faks.: 22 82 46 40 • firmapost@npt.no

Handwritten notes on the right:

- 900 + 2100
- 2100 only

