ORIGINAL

VERNER · LIIPFERT
BERNHARD · McPHERSON AND HAND
CHARTERED

901 - 15TH STREET, N.W.
WASHINGTON, D.C. 20005-2301
(202) 371-6000
FAX: (202) 371-6279

EX PARTE OR LATE FILED

RECEIVED
FEB 10 2000
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

February 10, 2000

To Contact Writer:
(202) 371-6326
drs@verner.com

Ms. Magalie Roman Salas, Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

Re: ET Docket No. 99-261

Dear Ms. Salas:

On February 9, 2000, Leo Fitzsimon, Otto Pulkkinen, Damien Higgins, Pat Betik and Dennis Johnson, all of Nokia Telecommunications Inc. (Nokia); Peter Hadinger of TRW; Chris Harvey of MET Labs; and the undersigned met with the following Office of Engineering and Technology staff: Julius Knapp, Tom Derenge, Karen Rackley, Tom Mooring, David Kirschner, and Rodney Conway. The purpose of the meeting was to address issues raised in the above-referenced rulemaking.

During the meeting Nokia addressed the operations of its MetroHopper Radio and reiterated points made in its Comments and Reply Comments in this proceeding that address unlicensed use of the 57-59 GHz band. A copy of the presentation and other information distributed at the meeting is attached for the record.

Pursuant to § 1.1206 of the Commission's rules, an original and one copy of this letter and attachments are being filed in the above-referenced proceeding. A copy of this letter also is being sent separately to each staff person.

0+1

Please direct any questions regarding this matter to the undersigned. Thank you.

Sincerely,

David R. Siddall
Counsel to Nokia Inc.

enclosures
DRS/pjt

cc: Julius Knapp
Tom Derenge
Karen Rackley
Tom Mooring
David Kirschner
Rodney Conway

The High Density Fixed Service allocation in the 58 GHz band

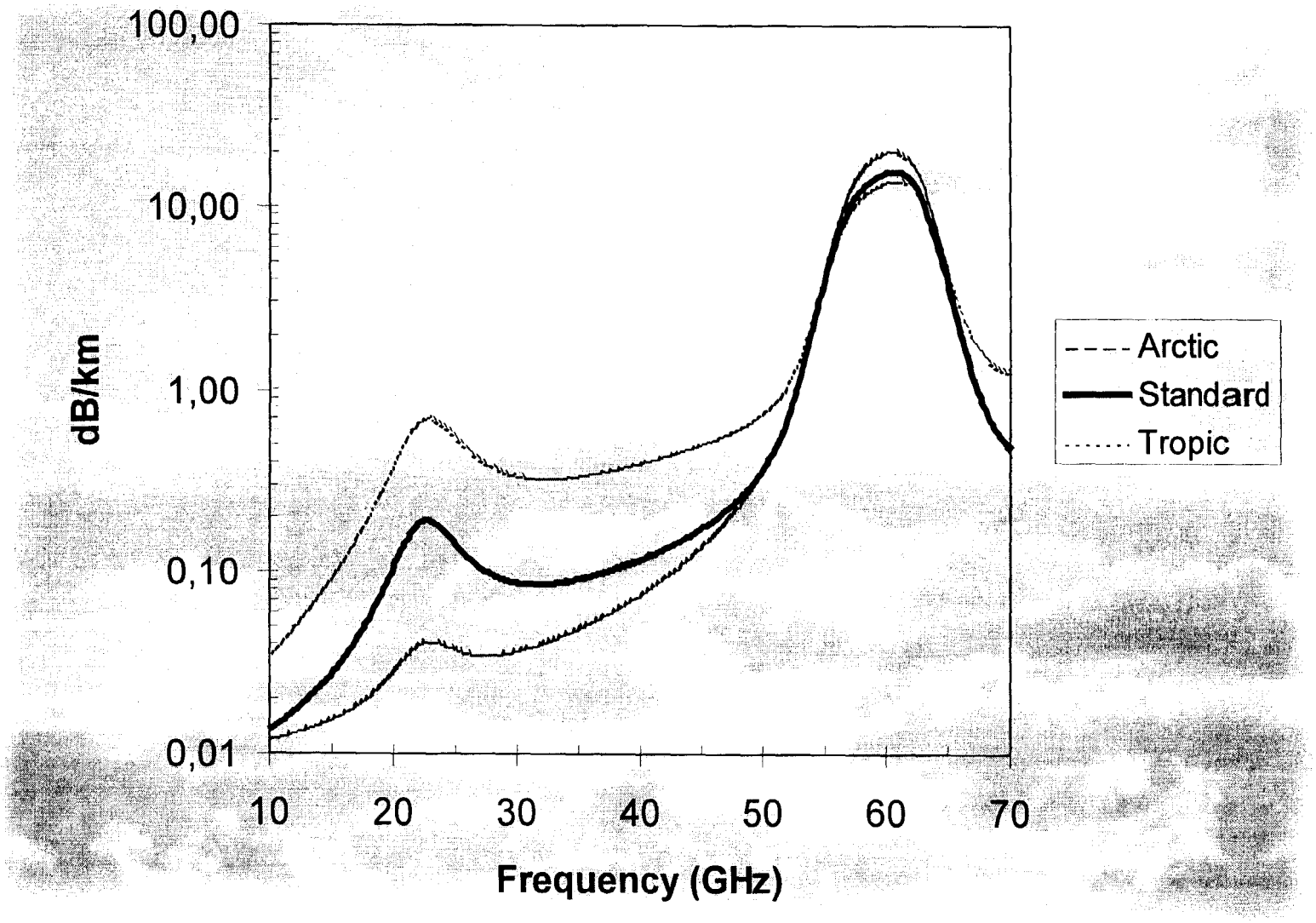
NOKIA

Agenda

- Characteristics of 58 GHz
  - Additional oxygen absorption peak around 60 GHz
- Why 58 GHz suits well for mobile operators?
  - Feasibility in the metropolitan environment
  - Reasons to open 58 GHz band
- How many links could share the 58 GHz band?
- Current regulatory situation
- How to open the 58 GHz band?

NOKIA

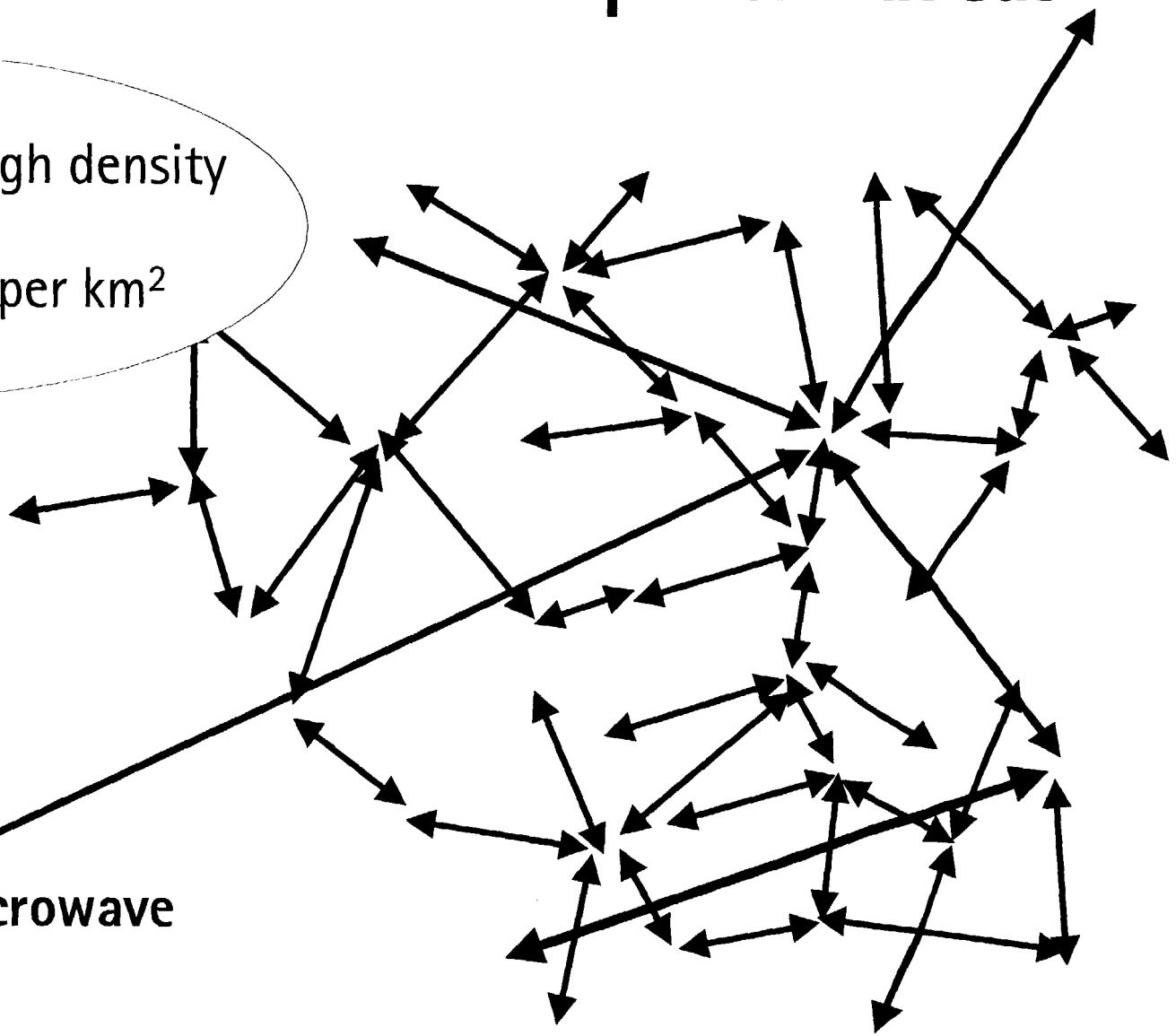
Atmospheric Attenuation



NOKIA

High density access for metropolitan areas

- 58 GHz enables high density access networks
- Hundreds of links per km^2

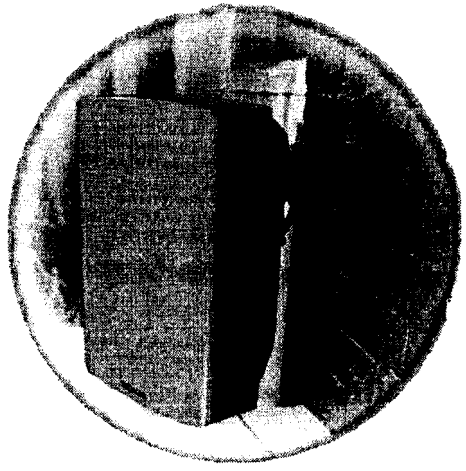


High Density Fixed System 58GHz

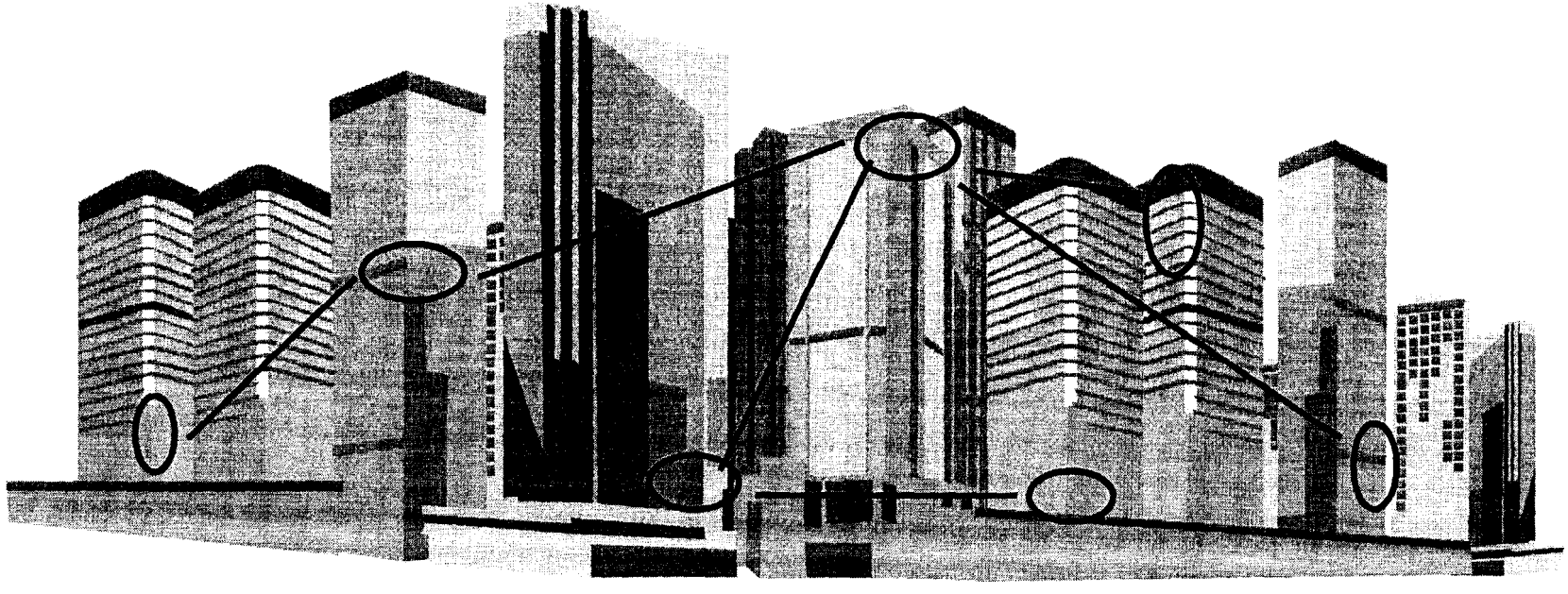
Traditional microwave

NOKIA

58 GHz for metropolitan access

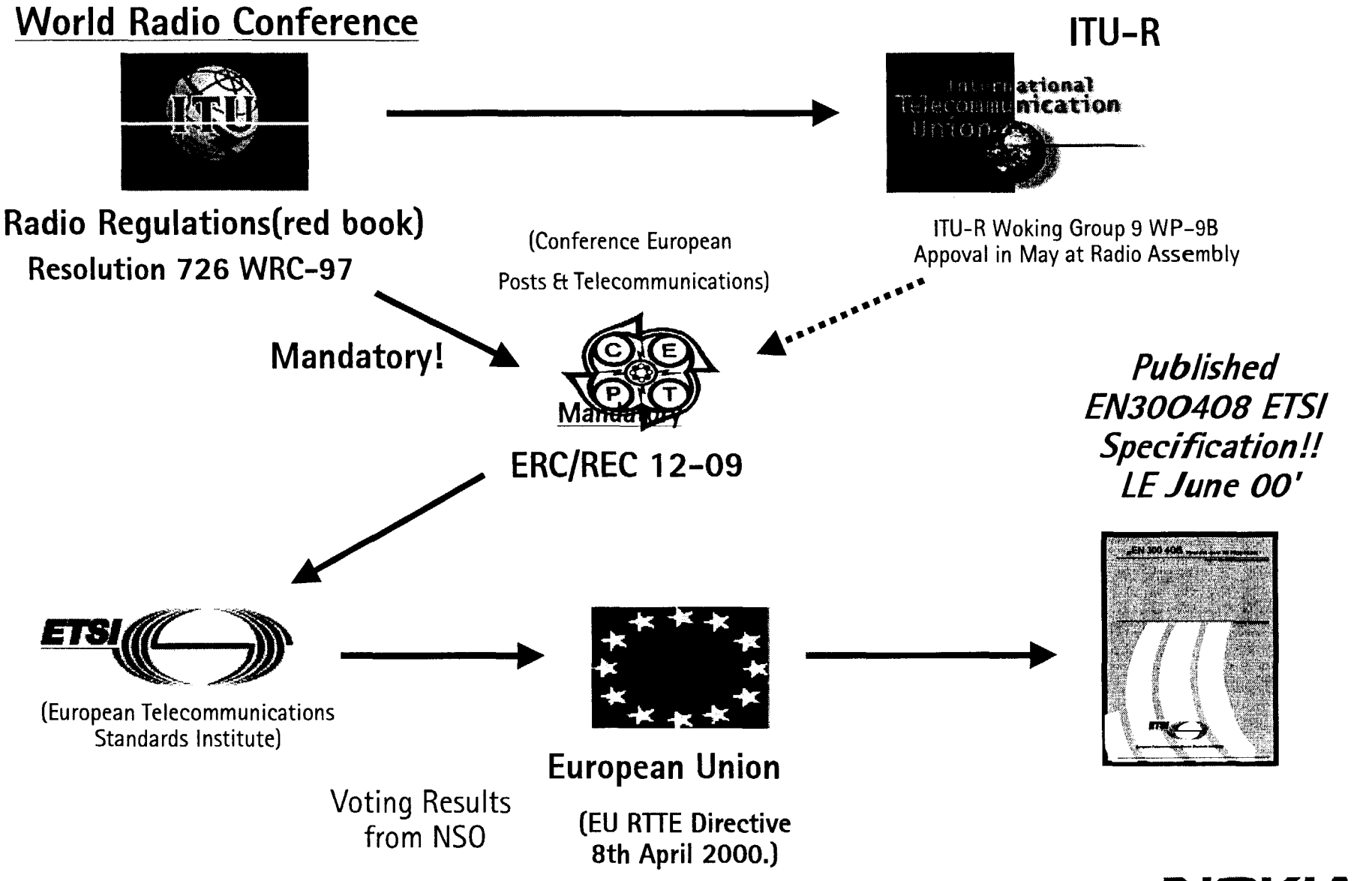


- CEPT: 58 GHz does not need coordinated frequency planning, ETSI has prepared the standard for this application
- Smooth implementation from end user point
- Very low output power
- The most spectrum efficient band for 500m distances



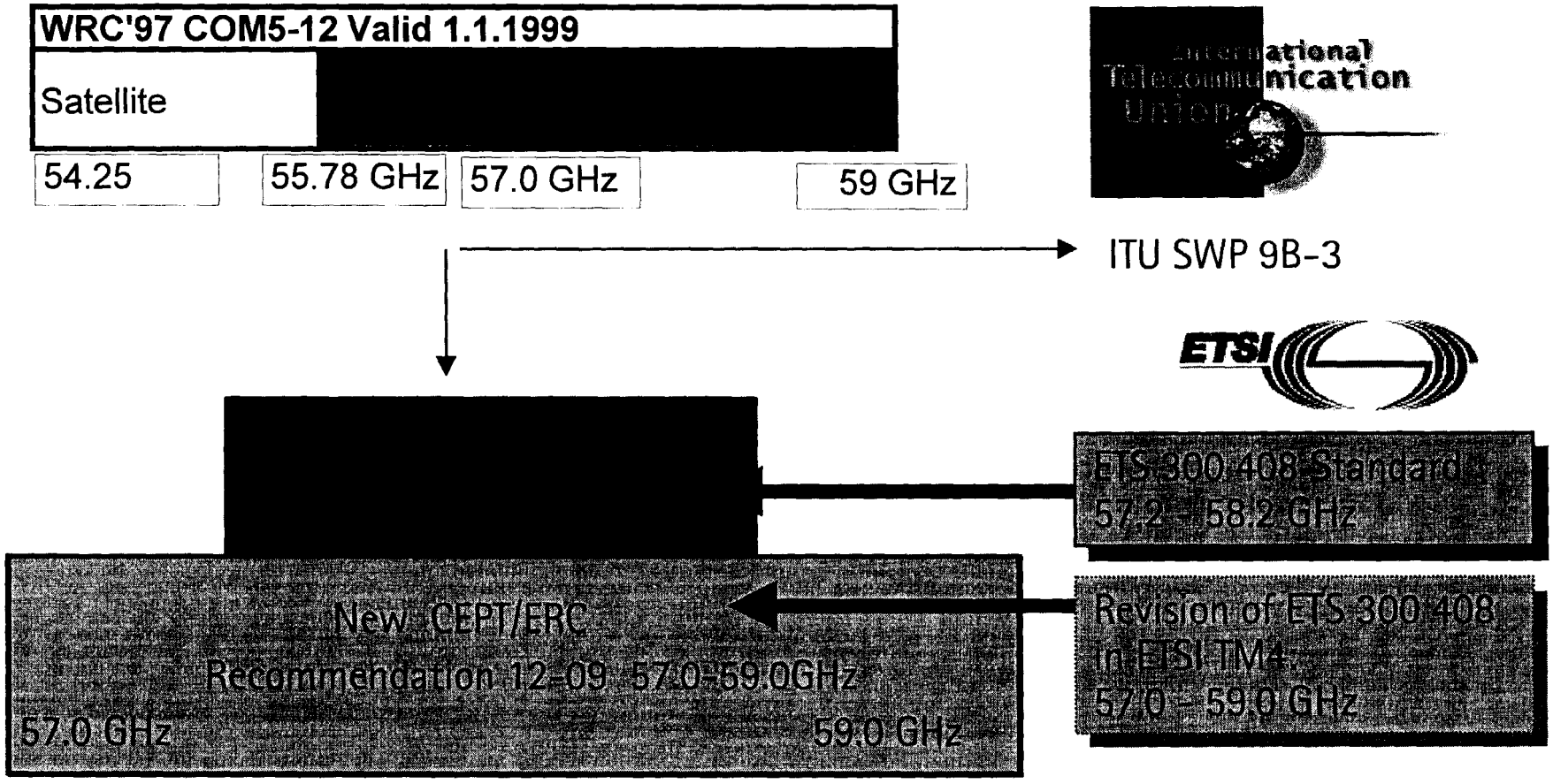
NOKIA

Process for Recommendations and Standards 58GHz Band - Europe



NOKIA

Recommendations and standards for the 58 GHz band



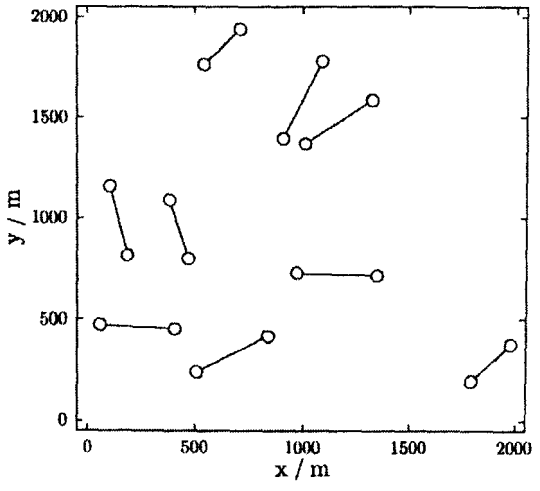
NOKIA

Guidelines for human exposure of radiofrequency electromagnetic fields

- United Nations, World Health Organization, WHO Health physics, Vol 54, No 1, p.115-123
- Limit is 10W/m^2 for uncontrolled exposure
- Nokia's 58 GHz radio-relay (PTx only ~6mW) fulfills safety recommendations made by
  - Institute of Electrical and Electronics Engineering, USA
  - Federal Communications Commission, USA
  - Commission of the European Communities
  - European Committee for Electrotechnical Standardization
  - International Commission on Non-Ionizing Radiation Protection
  - International Radiation Protection Association

NOKIA

How many links could share the 58 GHz band?

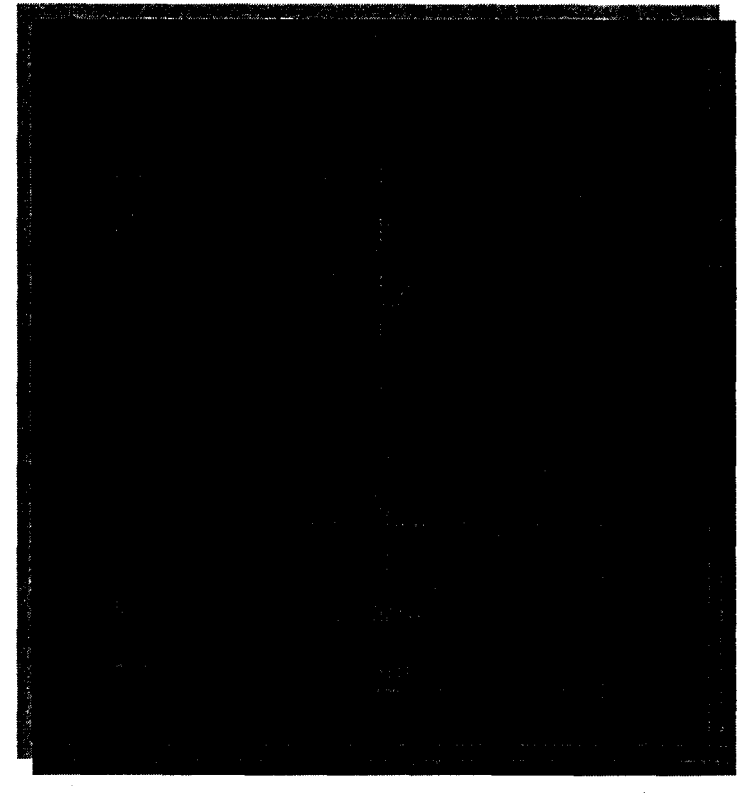


- Computer simulation assumptions
  - S/I ratio 20dB
  - Only in two dimension, no building blocks
  - Probability for need to change the channel 0.1
  - Hop length 500 meters
  - ETS 300 408 antenna requirements
- Results:
  - 20 hops/km^2 per channel
  - 57.2-58.2 GHz, 10 channels $\Rightarrow$ 200 links/km^2

NOKIA

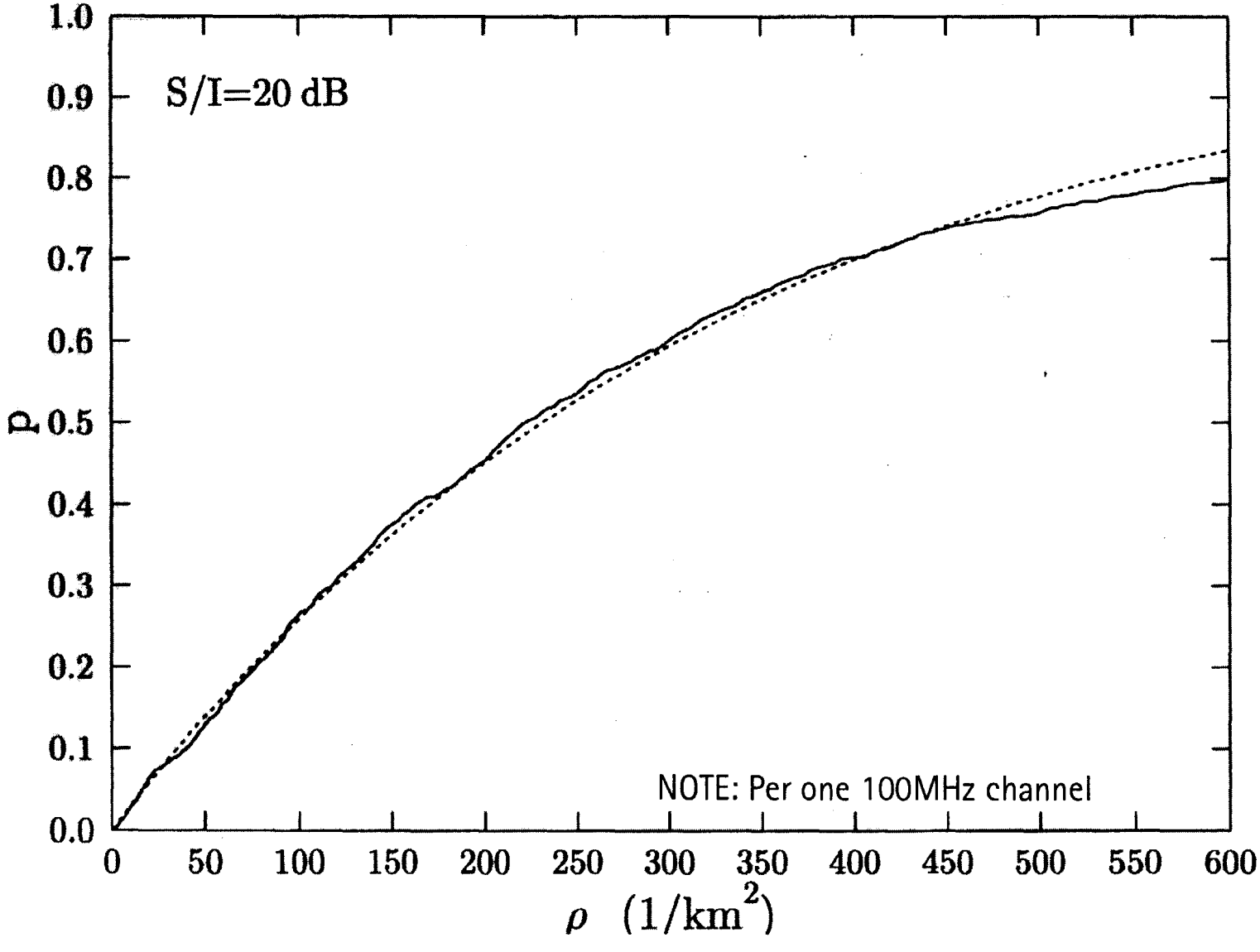
Simple etiquette to increase the spectrum efficiency

- Simple idea to measure the interference
- Identifies existing transmission e.g. noise
  - Creates a simple policy for the 58 GHz allocation: "First-came, first-served"
- Automatic or manual only during installation or commissioning
  - Not to be confused with dynamic frequency hopping



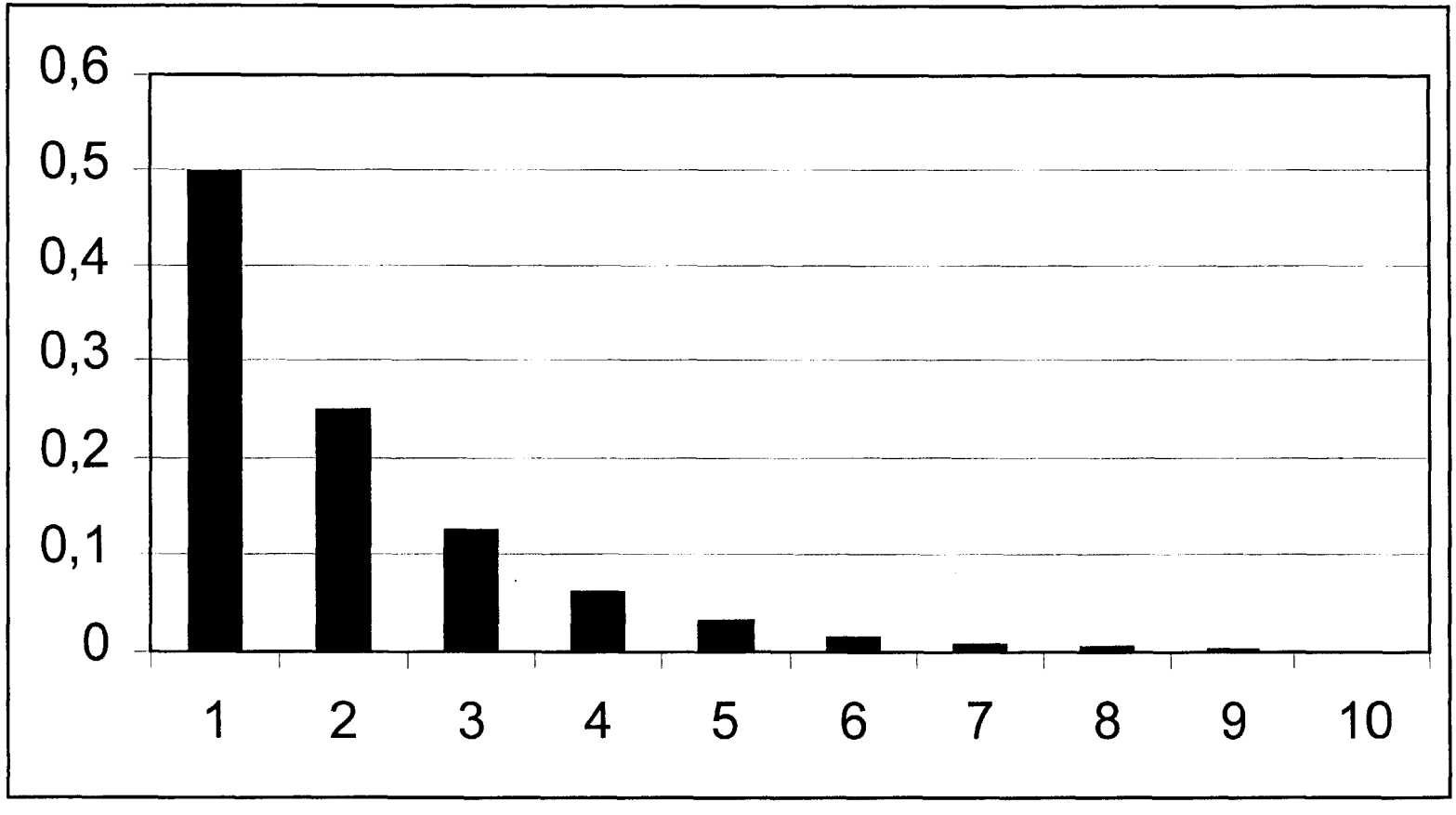
NOKIA

Spectrum efficiency in the 58 GHz band



NOKIA

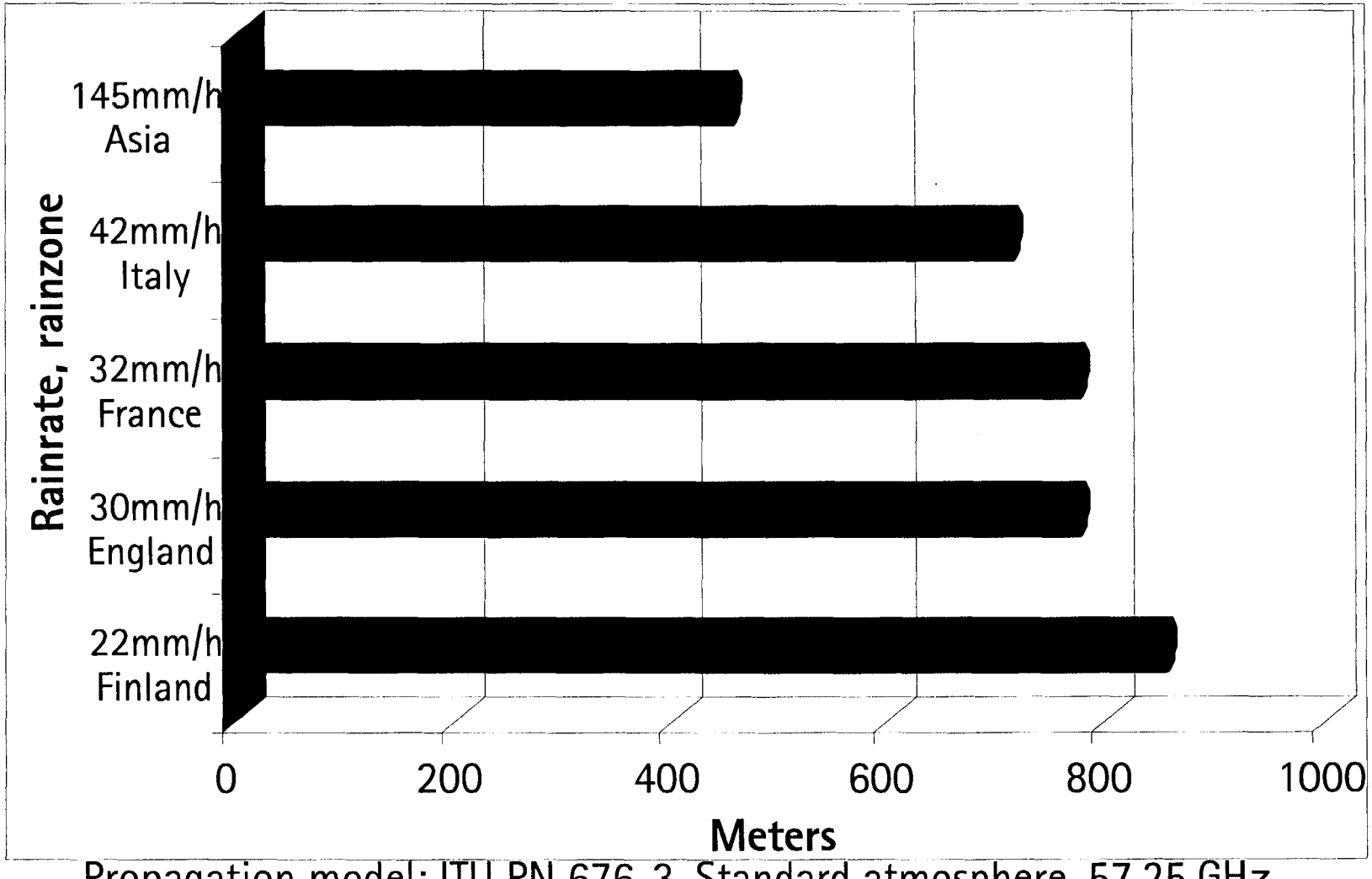
Spectrum efficiency with the Channel Selection Procedure



NOTE: 200 links per channel / km^2 $\Rightarrow$ **2.000 links / km^2**

NOKIA

Feasible distances for Nokia MetroHopper according to ITU PN 676-3.



Propagation model: ITU PN 676-3, Standard atmosphere, 57.25 GHz, 99.99% availability, interference ignored.

NOKIA

Conclusion

- 58 GHz provides fast, reliable, affordable transmission in the metropolitan areas
- Line-of-sight distances around 600 meters
- Does not require co-ordinated frequency planning
- High frequency reuse, spectrum efficient
- Alleviates congestion on traditional frequencies
- Low output power in the street canyons
- 100MHz bandwidth enables also high capacity solutions
- Allows operators flexibility and to synchronize rollouts

NOKIA

58 GHz Hop Lengths: A Case Study

- Assumptions:
  - ITU-R P. 530-7, ITU-R P. 676-3 and ITU-R 838 recommendations

Ptx (transmit power)	3 and 8 dBm
Antenna gains (both ends)	37 dBi
Total EIRP	40 and 45 dBm (= 10 and 15 dBW)
Rx, BER 10^-3 (threshold value)	-75 dBm
Atmospheric attenuation	~13 dB/km at 57.7 GHz

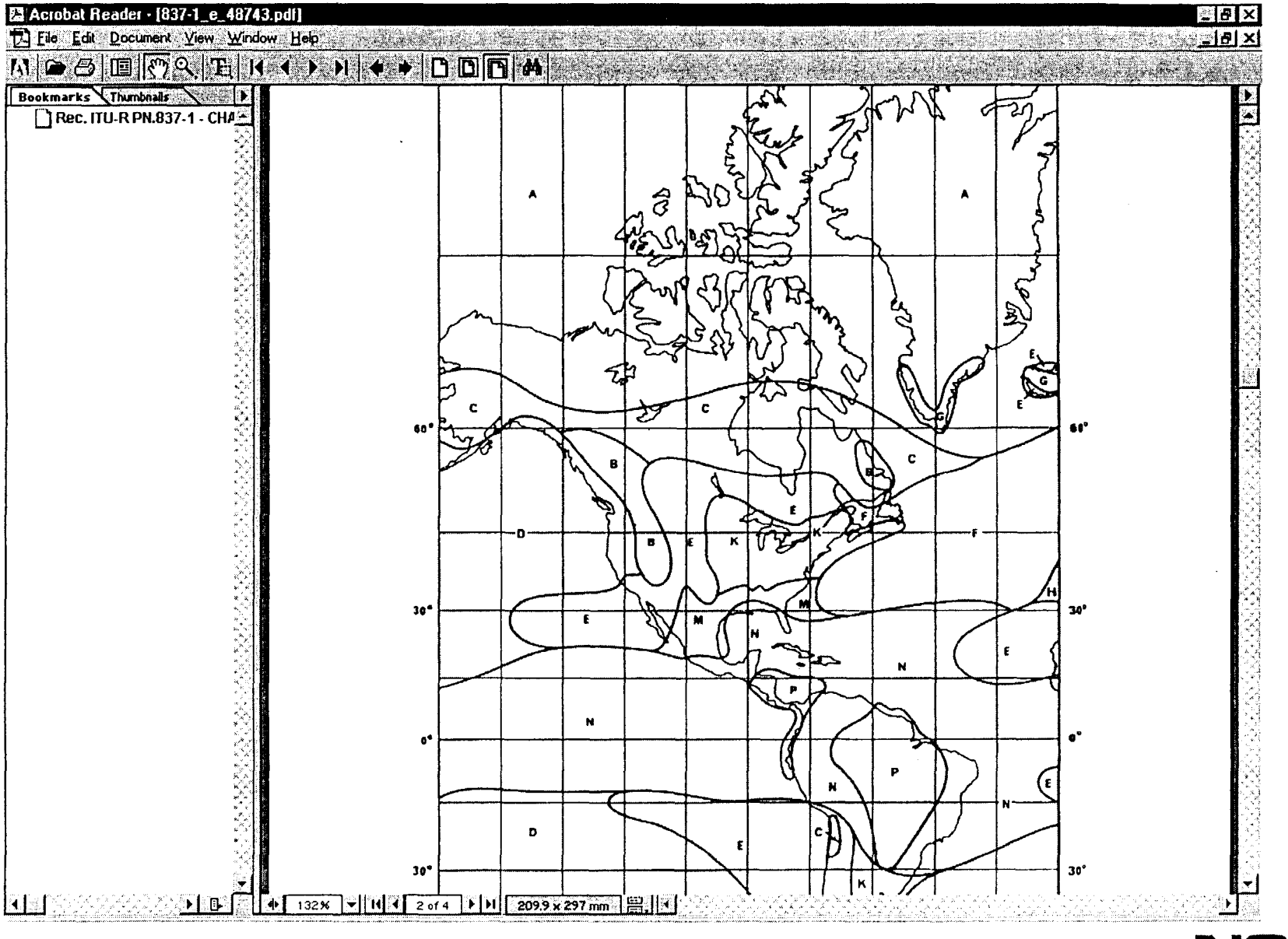
NOKIA

Rainfall Rates

Rain zone	Rainfall rate (R0.01, ITU-R PN 837-1)
E	22 mm/h
K	42 mm/h
M	63 mm/h
N	95 mm/h

NOKIA

Rain Zones in the U.S.



NOKIA

Calculation Results

	Ptx = 8 dBm	Ptx = 3 dBm	Ptx = 8 dBm	Ptx = 3 dBm	Ptx = 8 dBm	Ptx = 3 dBm
	E (22 mm/h)	E (22 mm/h)	K (42 mm/h)	K (42 mm/h)	M (63 mm/h)	M (63 mm/h)
99.99 %	1.31 km	1.12 km	1.11 km	0.95 km	0.96 km	0.83km
99.995 %	1.21 km	1.05 km	0.99 km	0.86 km	0.85 km	0.74 km
99.999%	1.00 km	0.86 km	0.77 km	0.67 km	0.63 km	0.56 km

	Ptx = 8 dBm	Ptx = 3 dBm
	N (95 mm/h)	N (95 mm/h)
99.99 %	0.82 km	0.71 km
99.995 %	0.71 km	0.62 km
99.999%	0.52 km	0.46 km

According to some research results, the ITU-R formulas give too optimistic results at frequencies > 38 GHz.

NOKIA

7. February 2000

Safety calculations concerning Nokia MetroHopper

7. February 2000

TABLE OF CONTENTS

1 Introduction 3
2 Technical performance of Nokia MetroHopper 3
3 Safety documents 4
4 Safety considerations 5
5 Power Density Calculations 6

Document History

Version	Modified / Approaved by	Notes	Date
0.2	Niklas Lybäck	Created	Monday, 7 December 1998
1.0	Damien Hiiggins	Modified	Tuesday, 19 October 1999
1.1	Damien Higgins	Modified	Friday, 22 October 1999

7. February 2000

1 INTRODUCTION

This calculates the electromagnetic field strength in relation to Nokia MetroHopper Radio.

2 TECHNICAL PERFORMANCE OF NOKIA METROHOPPER

Power levels

Tx power	5 dBm

Environment

ETS 300 385, EMC standard for digital fixed radiolinks and ancillary equipment		
Emissions	Radiated emission	EN 55022 Class B
	Conducted emission	EN 55022 0.15 - 0.5 MHz: 66 dBµV, average 0.5 - 30 MHz: 60 dBµV, average
Immunities	RF EM field	ENV 50140 80 - 1000 MHz, 3 V/m: no errors
	Electrostatic discharge	EN 60801-2 ±8 kV air discharge: no errors ±4 kV contact discharge: no errors
	Fast common mode transients	IEC 801-4 1 kV, no errors
	RF common mode	ENV 50141 0.15 - 80 MHz, 3 $V_{(rms)}$: no errors
	Surges	ENV 50142 1 kV, 10 Ω series resistance: no damage, self recovery
	Overvoltage tolerance of the indoor-outdoor cables and outdoor unit power input	4 kV, 8/8 µs rise time, 20 µs fall time (to half voltage)

Antenna type	Integrated flat panel antenna
Antenna gain	34 dB
Antenna radiation pattern ETS 300 408	
5°	< 19 dBi
15°	< 13 dBi
60°	< 3 dBi
100°	< 3 dBi
> 140°	< −5 dBi

The flat panel antenna of Nokia MetroHopper is an aperture antenna. These types of antennas are used in various applications e.g. such applications as satellite-earth stations and point-to-point radios. Generally, these types of antennas have parabolic surfaces, but the Nokia MetroHopper has a flat surface. The antenna of Nokia MetroHopper is characterized by its high gain which results in the transmission of power in a well-defined collimated beam with little angular divergence. Because of the highly directional nature of the aperture antenna, the likelihood of human exposure to radiation considerably reduced. The power densities existing at locations where people may be typically exposed are substantially less than on-axis densities.

This Nokia MetroHopper radio used in the telecommunication applications operates with a low power level due to very short distance required between the two Nokia MetroHopper Radios. The output power is limited to by the ETSI standard ETS 300 408(1996) and prEN300408(1999) to be 15 dBW EIRP and 10dBm. The unique oxygen absorption peak – 10-14dB/km that attenuates significantly the 60 GHz signals, additionally weakens the signal significantly in the air.

3 SAFETY DOCUMENTS

Following recommendations are based on the general document United Nations, World Health Organization, WHO Health physics, Vol 54, No 1, p.115-123. These documents describe the limit to be 10W/m2 for uncontrolled exposure.

- Institute of Electrical and Electronics Engineering, USA
- Federal Communications Commission, USA
- Commission of the European Communities
- European Committee for Electrotechnical Standardization
- International Commission on Non-Ionizing Radiation Protection
- International Radiation Protection Association

4 SAFETY CONSIDERATIONS

Based on the FCC Bulletin 65(edition 97-01) the Nokia Metrohopper complies with the recommendation of maximum exposure levels of 50W/m2 Occupational and 10W/m2 General Population where the calculated power density is always less than the the given limits.

Maximum power denisty directly
in front of an antenna (e.g. at antenna surface)
can be approximated by following equation

$$S_{surface} = \frac{4P}{A}, \textit{where} \qquad (1)^{1}$$

P is the power fed to the antenna,
A is the physical area of the aperture antenna

The maximum level field strength value can be found naturally at the surface on the antenna.

[1] Federal Communications Commission. Office of Engineering & Technology. Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. OET Bulletin 65. Edition 97-01. August 1997. Page 27. Formula 11.