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February 6, 2002

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By Hand

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems
ET Docket No. 98-153
***Ex Parte* Communication**

Dear Mr. Caton:

Pursuant to Section 1.1206(b) of the Commission's rules, I am writing on behalf of the Short Range Automotive Radar Frequency Allocation group ("SARA"), an association of automotive and automobile component manufacturers, to notify you of *ex parte* meetings that occurred at the Commission on February 5, 2002 in connection with the above-referenced proceeding. The meetings were held to address the use of 24 GHz ultra-wideband ("UWB") radar systems designed to enhance road safety. The attached materials were distributed and served as the basis for discussion.

Those participating in the meetings included Commissioner Kevin Martin and Monica Desai, Legal Advisor to Commissioner Martin, Paul Margie, Legal Advisor to Commissioner Copps, Julius Knapp, Deputy Chief, Office of Engineering Technology ("OET"), Timothy McBride, Vice President, Washington Affairs, DaimlerChrysler Corporation, Mark Esherick, Director, Legislative Affairs, Information Technology and Telecommunications, Siemens Corporation, Jake Jones and Volker Schmid, DaimlerChrysler, Daniel Selke, Mercedes-Benz USA, Jeffrey Krauss, Consultant to MA/Com and Ari Fitzgerald, Counsel to SARA.

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An original and one copy of this letter is submitted for inclusion in the proceeding record.

Respectfully submitted,

Ari Q. Fitzgerald
Counsel for SARA

Enclosures
cc (w/enc.): Commissioner Kevin Martin
Ms. Monica Desai
Mr. Paul Margie
Mr. Julius Knapp

Short Range Automotive Radar Frequency Allocation Group

24 GHz Short Range Radar for Automotive Applications

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February 5, 2002

SARA GROUP

- ACRONYM: Short Range Automotive Radar Frequency Allocation

- CHARTER:
  - Coordinate Regulatory Requirements for SARA Members
  - Agree on a Common Set of Spectrum Parameters
  - Create Radio Standards to enable Certification
  - Perform or contribute to Compatibility Studies
  - Worldwide harmonization

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- MEMBERS: & Liaisons
  - Major Car Manufacturers *(Passenger and Truck)*
  - Leading Radio Frequency System, Component Manufacturers
  - Organizations such as ACEA, CLEPA, VDA *(European & Global Auto and Auto Component Mfrs)*

Audi, BMW, DaimlerChrysler, Fiat, Ford, Jaguar, Opel / GM, Porsche, PSA Peugeot Citroën, Renault, Saab, Seat, Volkswagen, Volvo, A.D.C., Bosch, Delphi, InnoSent, Megamos, Siemens VDO, TRW, Tyco Electronics, Valeo, Visteon.

24 GHz Short Range Radar

SARA

SARA Active Members

DAIMLERCHRYSLER, BMW, FIAT, VW, JAGUAR, PSA PEUGEOT CITROËN, RENAULT, Audi, tyco Electronics, M/A-COM, BOSCH, Visteon, DELPHI Automotive Systems, Valeo, SIEMENS VDO Automotive, A.D.C. Automotive Distance Control Systems GmbH

SARA Supporting Members

Ford, SAAB, SEAT, OPEL, SKODA, VOLVO, megamos, TRW, InnoSent, MAN

Audi, BMW, DaimlerChrysler, Fiat, Ford, Jaguar, Opel / GM, Porsche, PSA Peugeot Citroën, Renault, Saab, Seat, Volkswagen, Volvo, A.D.C., Bosch, Delphi, InnoSent, Megamos, Siemens VDO, TRW, Tyco Electronics, Valeo, Visteon.

24 GHz Short Range Radar

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Traffic scenarios

- [redacted] and pile-ups [redacted]ways
- [redacted]nd collisions [redacted]se city traffic
- [redacted]ing lot collisions

Need for accident prevention

"A death from vehicle crashes every 13 min. (injury every 14 sec.)
41,200 motor vehicle deaths per year."
(National Safety Council, *Injury Facts,* 1999)

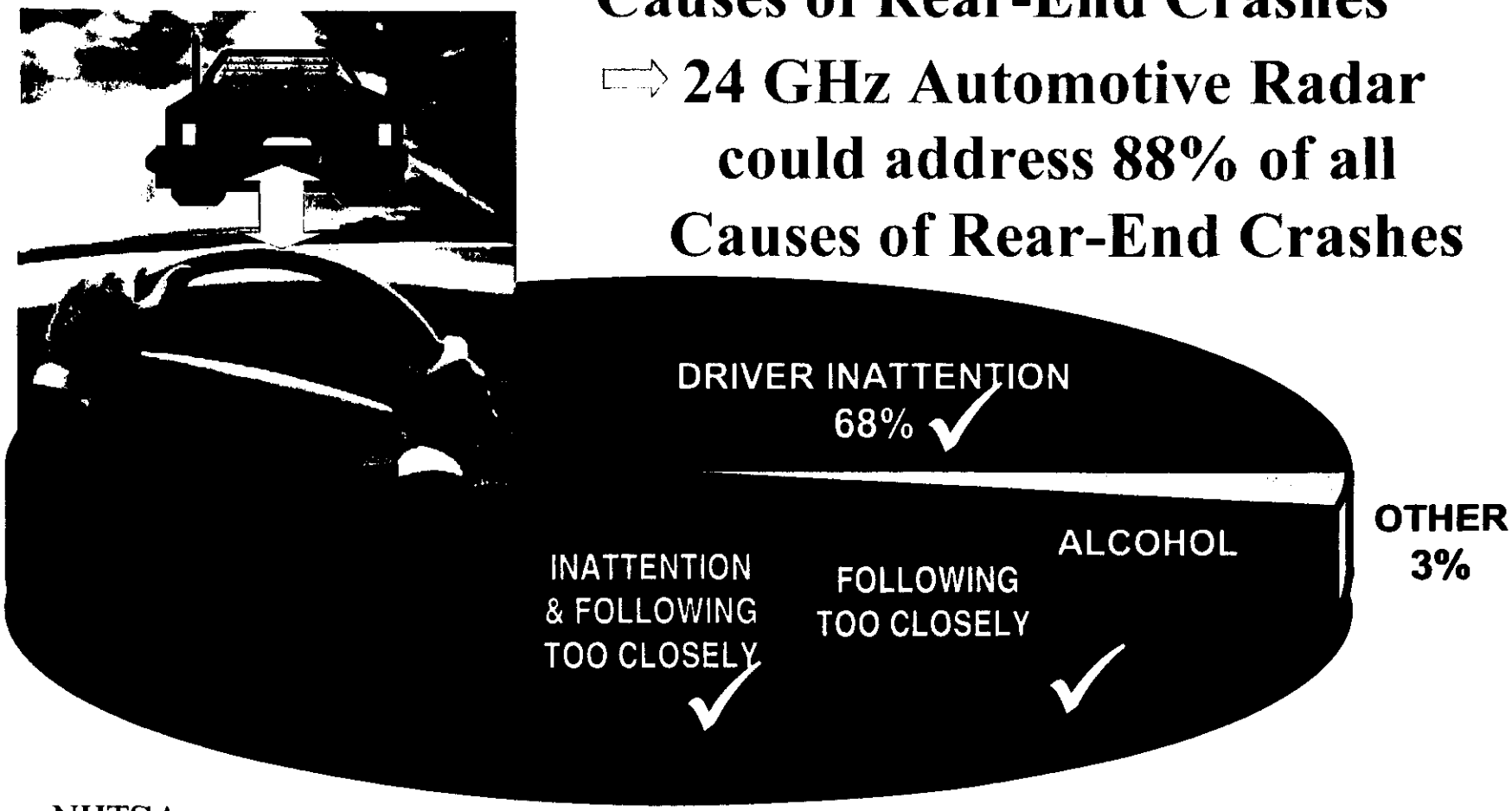
Statement of U.S.A. National Transportation Safety Board Public Meeting - 1 May 2001:

"Develop and implement... a program to inform the public... on the benefits, use, and effectiveness of CWS and ACC!"

(CWS = collision warning system ; ACC = adaptive cruise control)

Causes of Rear-End Crashes

⇨ 24 GHz Automotive Radar could address 88% of all Causes of Rear-End Crashes



Source: NHTSA

24 GHz Short Range Radar

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- The UWB proceeding record does not contain any documented suggestion that 24 GHz UWB operations will cause interference to any service.

- Specifically, 24 GHz UWB operations will not cause harmful interference to radio astronomy or Earth Exploration Satellite Services, two passive services that have allocations at 23.6-24.0 GHz.

- Being able to operate in the 24 GHz band at -41 dBm is critical to the viability and reliability of the SRR devices. If the car and car parts manufacturers that are developing these devices are not allowed to operate according to those parameters, the life-saving devices will never find their way into the marketplace.

24 GHz Short Range Radar

SARA

- Mass market component parts are not available for higher frequency bands. Therefore, it would not be viable from a financial perspective to develop SRRs that operate in the higher bands.

- There is nothing in international footnote S5.340 or US footnote US246 (the footnote implementing S5.340 in the US) that prohibits the FCC from allowing UWB devices to operate in a manner that causes intentional emissions into the 23.6-24.0 GHz band (in fact, US246 does not even apply to Part 15 devices).

- The regulatory process for securing approval to operate 24 GHz UWB is well on its way in Europe, and we have every reason to believe that it will be successful.

- It is time to resolve this proceeding in a manner that allows the operation of 24 GHz SRRs.

Presentation of the
Short Range Automotive Radar Frequency Allocation Group:

24 GHz Short Range Radar for Automotive Applications

before the

National Telecommunications and Information Administration
Office of Spectrum Management

February 1, 2002

OUTLINE

- Traffic safety benefits
- Compatibility of SRR with Radio Astronomy Services
- Compatibility of SRR with Earth Exploration Satellite Services
- Relocation of SRR center frequency is not feasible

24 GHz Short Range Radar

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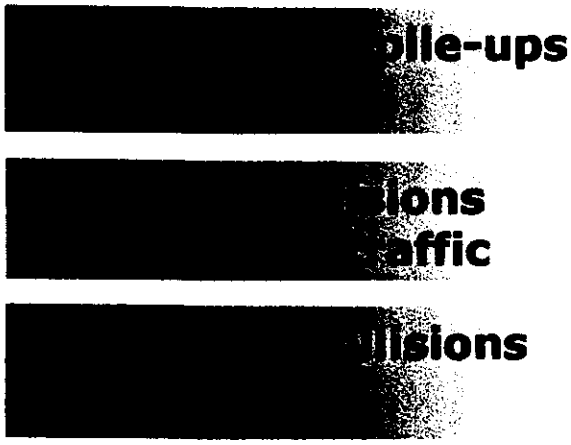
Traffic scenarios



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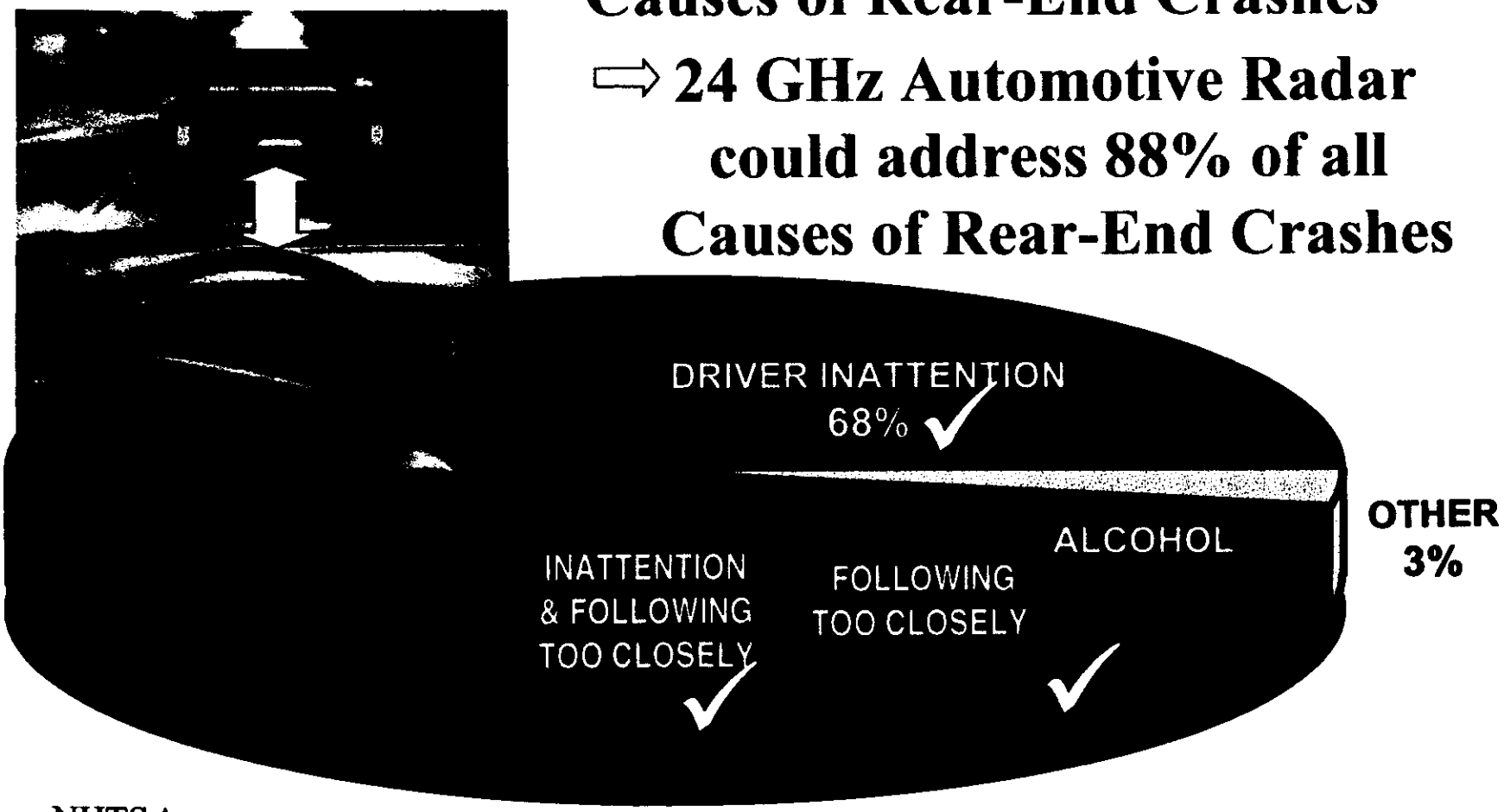
(C.W.S. = collision warning system; A.C.C. = adaptive cruise control)

Causes of Rear-End Crashes

⇨ 24 GHz Automotive Radar could address 88% of all Causes of Rear-End Crashes

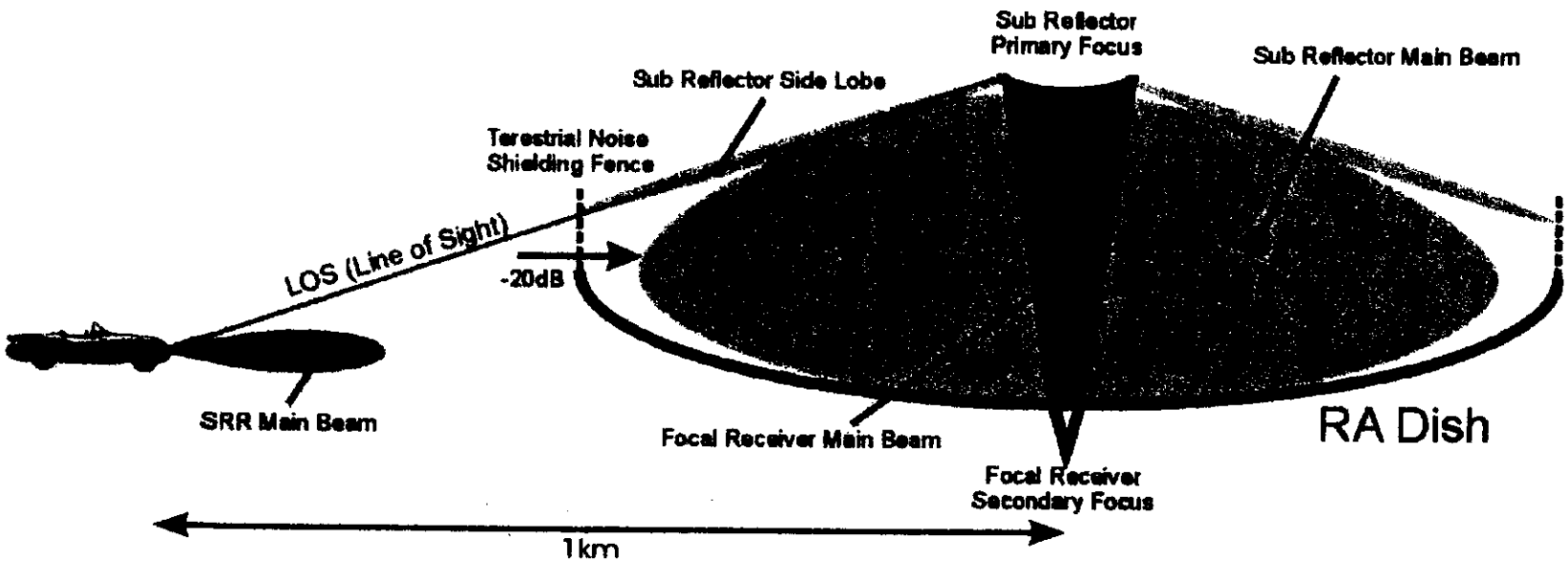


Source: NHTSA

Compatibility of 24 GHz SRR with Radio Astronomy

- FCC Policy: Acceptance of 1km separation distance
- ITU-Limit with respect to RA769-1 recommends -251dBm/Hz
  - such a best case sensitivity can only be achieved under the following conditions:
    - all fluctuations of terrestrial and atmospheric noise are eliminated via calibration
    - the dish elevation is more than 30° to avoid influences from ground (MIT Haystack site)
    - the water vapor content of the atmosphere is nearly zero (only achievable on dry, cold winter nights)
- The realistic sensitivity depends on the dish elevation and varies from -248dBm/Hz to -203dBm/Hz

Single Entry Interference Scenario with Radio Astronomy



Shielding fences around the RA observatory provide further attenuation of 20dB.

24 GHz Short Range Radar

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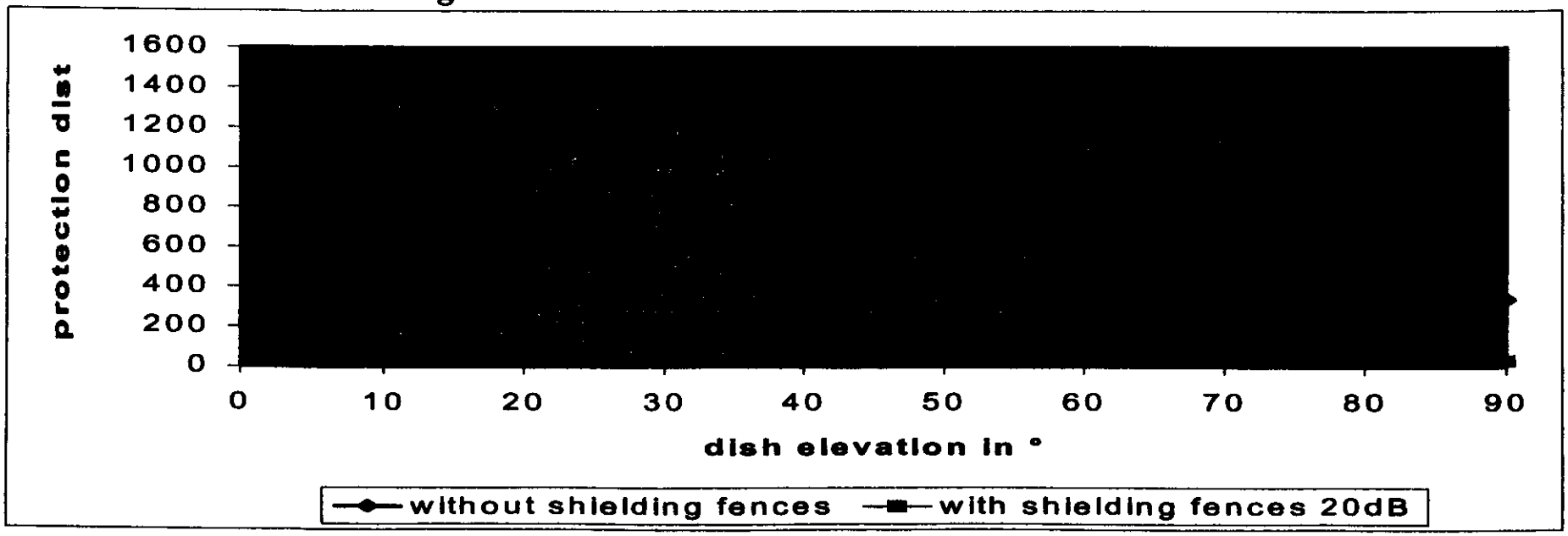
Dish angle	L_atm_dB Atmos. Loss in dB 0.16dB/km (7.5mm^2 H2O)	T_terr in K (supressed due to shielding fence vs. Spillover)	T_sys in K	max. PSD_Tx in dBm/Hz w.o. shielding	PSD Sensitivity in dBm/Hz 0.1kT_sys	mean Antenna sidelobe gain in dB (ITU-R SA.509-2 + F.1245-1)	max. PSD_Tx in dBm/Hz w.o. shielding	Remaining Margin w.r.t FCC part 15 UWB limit - 101.25dBm/Hz equivalent to 500µV/m at 3m w.o. shielding w.r.t 1km	Remaining Margin w.r.t FCC part 15 UWB limit - 101.25dBm/Hz equivalent to 500µV/m at 3m with shielding w.r.t 1km	Remaining Margin w.r.t FCC part 15 UWB limit - 101.25dBm/Hz equivalent to 500µV/m at 3m w.o. shielding w.r.t 1km	Remaining Margin w.r.t FCC part 15 UWB limit - 101.25dBm/Hz equivalent to 500µV/m at 3m with shielding w.r.t 1km	Minimum Protection distance in m w.o. shielding	Minimum Protection distance in m with shielding
90	0,8	0	107,7	-91,8	-247,8	-13,0	-91,8	9,45	29,45	9,45	29,45	337	34
85	0,8032	0	108,0	-91,8	-247,8	-13,0	-91,8	9,45	29,45	9,45	29,45	337	34
80	0,8112	0	108,6	-91,7	-247,7	-13,0	-91,7	9,55	29,55	9,55	29,55	333	33
75	0,8288	0	109,9	-91,7	-247,7	-13,0	-91,7	9,55	29,55	9,55	29,55	333	33
70	0,8512	0	111,6	-91,6	-247,6	-13,0	-91,6	9,65	29,65	9,65	29,65	329	33
65	0,8832	0	114,1	-91,5	-247,5	-13,0	-91,5	9,75	29,75	9,75	29,75	325	33
60	0,9232	0	117,2	-91,4	-247,4	-13,0	-91,4	9,85	29,85	9,85	29,85	322	32
55	0,976	0	121,3	-91,3	-247,3	-13,0	-91,3	9,95	29,95	9,95	29,95	318	32
50	1,0448	0	126,8	-91,1	-247,1	-13,0	-91,1	10,15	30,15	10,15	30,15	311	31
45	1,1312	0	133,7	-91,5	-246,8	-12,3	-91,5	9,78	29,78	9,78	29,78	324	32
40	1,2432	0	143,0	-92,5	-246,5	-11,1	-92,4	8,80	28,80	8,80	28,80	363	36
35	1,3936	0	155,8	-93,6	-246,2	-9,6	-93,6	7,65	27,65	7,65	27,65	414	41
30	1,5984	0	174,0	-94,8	-245,7	-7,9	-94,8	6,48	26,48	6,48	26,48	474	47
25	1,8896	0	201,3	-96,1	-245,1	-5,9	-96,2	5,10	25,10	5,10	25,10	556	56
20	2,3328	0	246,6	-97,7	-244,2	-3,5	-97,7	3,58	23,58	3,58	23,58	663	66
15	3,0736	10	343,5	-99,3	-242,7	-0,4	-99,3	1,95	16,95	1,95	16,95	799	142
10	4,5904	15	572,9	-101,5	-240,5	4,0	-101,5	-0,25	9,75	-0,25	9,75	1029	325
5	8,752	100	1927,7	-103,8	-235,3	11,5	-103,8	-2,58	2,42	-2,58	2,42	1345	756
2	10,4032	200	2995,7	-81,8	-203,3	21,5	-81,8	19,48	19,48	19,48	19,48	106	106

CONCLUSION: Compatibility of 24 GHz SRR to Radio Astronomy

- **For normal RA measurement conditions with an elevation of more than 10° over ground, the protection requirement of 1km is never exceeded.**
- **In the rare occasion of measurements of 5° elevation angle the worst case protection distance is 1350m without taking any shielding into account.**
- **With a fence shielding of 20dB the protection distance stays below the protection requirement even for an elevation angle as low as 5°.**



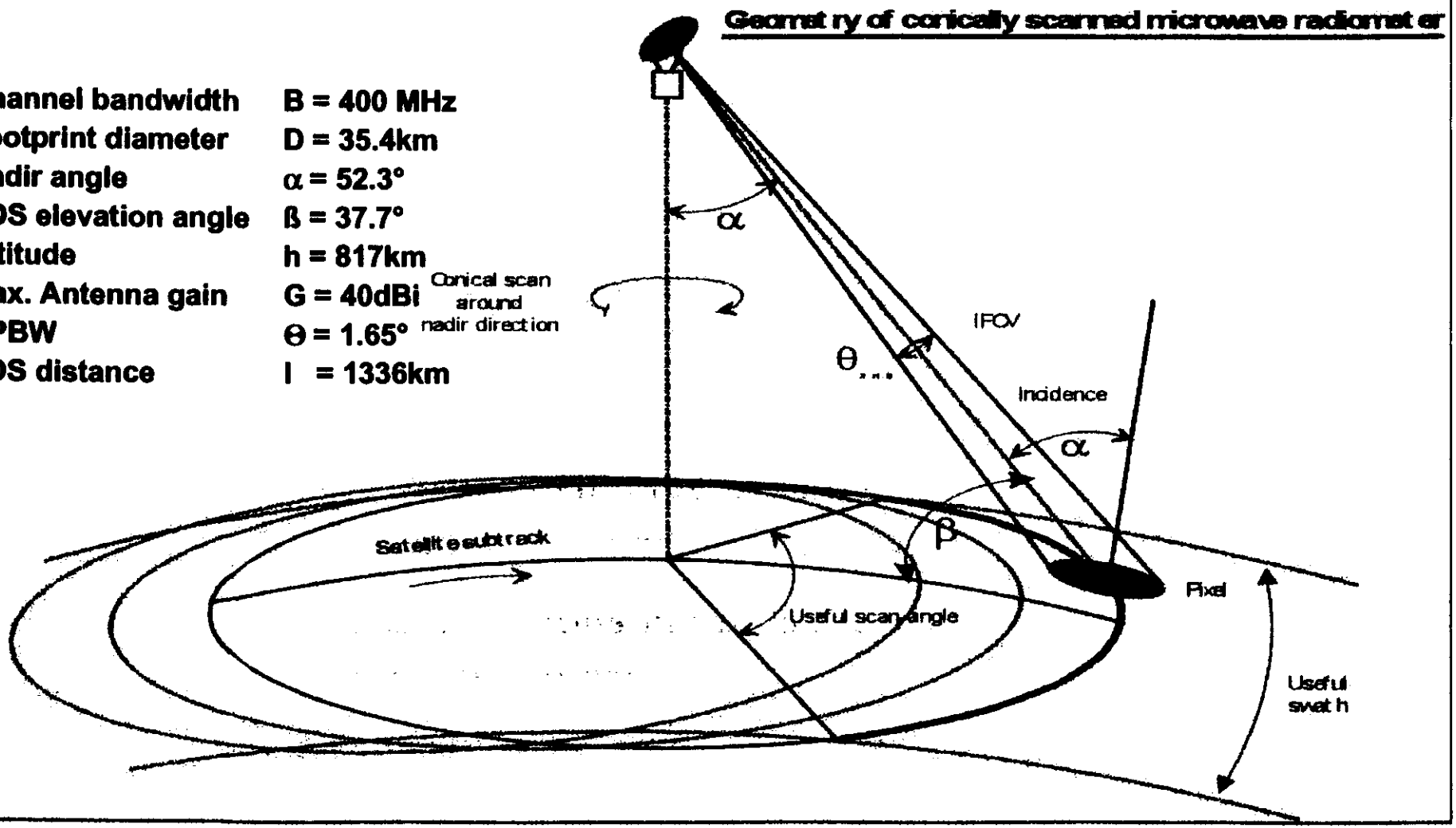
Compatibility of 24 GHz SRR to Earth Exploration Satellite Services

- Long term EESS threshold is -163dBW/100MHz ≡ -213dBm/Hz according to ITU-R SA.1029-1.
- SARA provides a calculation for the system "MEGHA-TROPIC". Other satellites with different gains and therefore different footprint sizes render similar results.
- Vehicle aggregation is considered via an area density based on two different models for crowded city highways as well as suburban areas.
- Peak traffic density situations in cities are not critical due to scattering and shielding effects by surrounding buildings.

24 GHz Short Range Radar

SARA

Channel bandwidth	B = 400 MHz
Footprint diameter	D = 35.4km
Nadir angle	α = 52.3°
LOS elevation angle	ß = 37.7°
Altitude	h = 817km
Max. Antenna gain	G = 40dBi
HPBW	Θ = 1.65°
LOS distance	l = 1336km



Margin calculation of 24 GHz SRR vs. EESS

	Figure	Comment
EESS Limit	-213 dBm/Hz	w.r.t. ITU-R SA.1029-1
G rx mean	-(+38.5) dBi	mean Antenna Gain over HPBW, 40dBi-1.5dB
Propagation Loss	-(-182.5) dB	LOS $L_{los} = 20\log(4\pi l/\lambda)$, l = 1336km
Gating	-(-3) dB	50% calculation time within cycle w.o. Transmission
Relative elevation side lobe gain TX	-(-25.1) dB	w.r.t RPE of SRR specification $g_{tx} = -0.666*\beta$
Atmospheric Loss	- (-1.3) dB	0.16dB/km * 5km / cos (α)
SRR Transmitter PSD EIRP	-(-101.25 dBm/Hz)	w.r.t. FCC part 15 500µV/m at 3m
Margin	**+ 61,65 dB**	Equivalent to **1,462,177 sensors** in the entire footprint

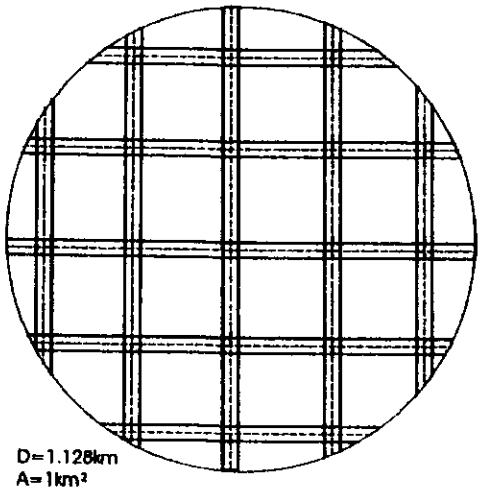
•With respect to the footprint diameter of 35.4km corresponding to an area of 984km^2 the margin of 61.65dB is equivalent to an SRR density of 1486 units/km^2.

•Assuming 4 active sensors on the car pointing in the same direction and a long term market acceptance rate of 40%, this translates into a maximum vehicle density of 929 cars/km^2.

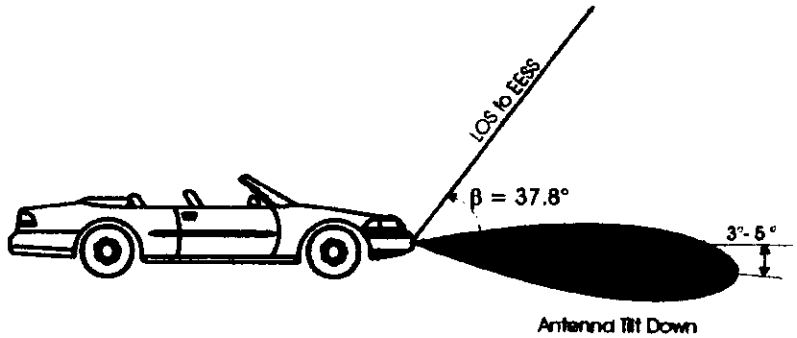
•With respect to a uniformly distributed car orientation over the azimuth and a half-power beamwidth of the sensor cluster in the order of 90° only a quarter of the sensors will be pointing in the direction of the satellite. This renders 6dB of additional margin translating into **3715 cars/km^2**.

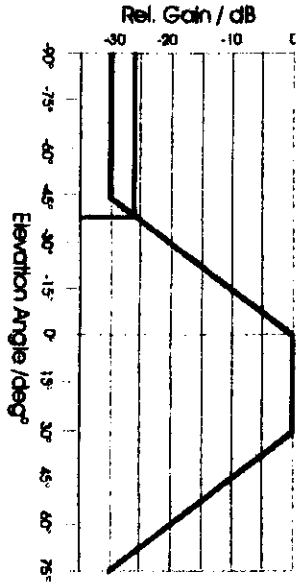
CONCLUSION: Compatibility of 24 GHz SRR to Earth Exploration Satellite Services

Rectangular street grid Scenario



Radiation Pattern Envelope





- Highway scenario: rectangular grid of highways with intersections every 3.5km with 8 lanes and 20m vehicle separation => 123 vehicles/km²
- Suburban city scenario: rectangular grid of streets with intersections every 250m with 2 lanes and 50m vehicle separation => 330 vehicles/km²
- With respect to the calculated maximum vehicle density of 3715 vehicles/km² a safety margin of 9dB remains even for a worst case superposition of both scenarios.

Relocation of SRR center frequency is not feasible:

- SRR need to perform two types of measurements:
  - precise distance measurements (low power UWB emissions)
  - velocity Doppler measurements (narrowband CW according to existing Part 15)
- No alternate allocation of 100-200 MHz (10dBm EIRP) is available within 15-30 GHz
- Global allocation is necessary for economies of scale
- Discrete mass market components do not exist for frequencies higher than 24 GHz
- Alternative MMIC technology (GaAs) are cost prohibitive for SRR systems
- An additional delay of 3-5 years is inevitable for development (supplier and OEM)
- There is no high volume demand beyond 24 GHz in the telecom industry
- Traffic safety benefits are ready for deployment - and would be postponed in best case. Lives would be lost unnecessarily!

Power reduction is not feasible:

Reduction of power would cause the detection range to drop below critical thresholds:

- The rear-end collision functionality would be compromised
- Protection for pedestrians would be severely degraded

⇒ All potential benefits (Backup-Aid, rear-end collision mitigation, Parking Aid and Passenger protection etc.) would be jeopardized.

Limitation of vertical antenna characteristic

The vertical antenna pattern shall be limited according table 3 with respect to the maximum antenna gain. The vertical antenna angle is positioned on 0° for a vector direction parallel to ground and on –90° for a vector direction from top to ground. The antenna's co-polar elevation RPE (radiation pattern envelope) shall be measured within the azimuth plane of EIRP_max.

Limitation of vertical antenna pattern

Vertical antenna angle θ in °	spatial antenna gain
θ < -75° and θ > 45°	G_dBi_max –30 dB
-75° < θ < -30°	G_dBi_max + 0,666 × [dB/°](θ +30°)
-30° < θ < 0°	G_dBi_max
0° < θ < 45°	G_dBi_max – 0,666 × θ [dB/°]

The mounting height is limited to maximum 1,50 m (according to the draft EN 301 091-1, clauses 7.2.3.3 and 7.2.3.4).

SARA

November 27, 2001

The Honorable Michael Powell
Chairman
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: ET Docket 98-153: In the Matter of Revision of Part 15 of the FCC's Rules Regarding Ultra-Wideband Transmission Systems

Dear Chairman Powell:

We write you as members of the Short Range Automotive Radio Frequency Group ("SARA") [1/] to indicate SARA's strong support for your stated intention to issue rules in the very near future that will enable the deployment of ultra-wideband ("UWB") technology. UWB is a wireless technology that has the potential to foster innovative, beneficial and spectrally efficient automotive radar applications at 24 GHz. The automotive radar applications envisioned by SARA's members require intentional emissions into a spectrum band no wider than +/- 2.5 GHz around a center frequency of 24.125 GHz. Accordingly, these applications will occupy spectrum that is far removed from Global Positioning System ("GPS") spectrum, and, therefore, will pose no threat to GPS services. We expect SARA's automotive radar applications to enhance significantly the safety of America's roadways. Moreover, as participants in this more than three year old proceeding, we are confident that SARA's automotive radar systems can successfully be deployed at 24 GHz and work side by side existing services.

The automotive manufacturers organized in SARA plan to use this less expensive radar technology at 24 GHz to expand significantly upon the vehicle-based assistance systems that exist today. This technology will allow for the detection of persons and objects in front of, behind and in the "blind spot" of automobiles so that injuries from automobile collisions and near collisions can be reduced significantly. The radars will operate day and night, widely independent of weather conditions. The successful completion of the current UWB proceeding would allow us to make significant progress toward offering these ground-breaking safety services to the public.

[1/] SARA is made up of the following automobile manufacturers: *Audi, BMW, DaimlerChrysler, Fiat, Ford, General Motors, Jaguar, MAN, Opel, Porsche, PSA Peugeot Citroën, Renault, Saab, Seat, Skoda, Volkswagen and Volvo.* It also includes as members the following component manufacturers: *A.D.C., Bosch, Delphi Automotive Systems, Hella, InnoSent, Megamos, Siemens VDO, TRW, Tyco Electronics, Valeo and Visteon.*

Again, we urge the FCC to issue a report and order in this rulemaking expeditiously to allow us to get our 24 GHz automotive radar products into the marketplace as soon as possible. By doing so, the Commission will have again promoted a far-reaching, innovative wireless technology that provides significant public safety benefits.

Very truly yours,

AUDI

/s/ /s/

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cc: Commissioner Abernathy
Commissioner Copps
Commissioner Martin
Magalie Roman Salas