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Wireless Access Methods and Physical Layer Specifications

Interferences between existing IR-Techniques and Present/Future Requirements to Avoid Them

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1. Avoidance of interferences between present products

In present IR-communication devices, no provision is made to avoid influence at devices of other manufacturers.
For my best knowledge, the first concept that explicitely allows the coexistence of different systems, is EXIRLAN.
As the amount of IR-communication applications grow rapidely, DKE/CENELEC/IEC have evaluated the opportunities to avoid those interferences [1]. The idea is, to label each IR emitting device showing certain characteristics, and thus to allow the user to take precautions from the beginning to avoid interferences.
The result of this proposal will be shown and discussed in this paper.

2. Classification Criteria

The IEC-proposal chooses 4 criteria to separate IR-transmission.

These criteria are:
1. IR-wave length
2. Kind of modulation
3. Duration of transmission
4. Power charasteristics

It suggests the following:

a) every IR-transmitter will be marked with a label defining the 4 criteria listed above.
b) a user can compose a mix of different applications not interferencing with each other, selecting the right products according the 4 criteria they are marked with.
THIS ASSUMPTION IS MEANINGSLESS DUE TO TECHNOLOGICAL FACTS; ECCEPT CRITERION 2, IF ELECTRICAL CHANNEL ASSIGNMENT IS STANDARDIZED.

The problem is, that those criteria for separation of IR-applications in 1 room are badly needed, but again, that criterion 1,3, and 4 do not meet the technical requirements of the users, though manufacters and organisations such as IRDA claim they did. Also criterion 2 does only help, if IR-data transmission will be standardized (if possible worldwide) with fixed modulation schemes and mandatory electrical channalization as proposed in the EXIRLAN-concept.

3. Discussion of the Classification Criteria

The following page shows Table 3 of [1]. Here are some comments to these criteria:

3.1. IR wave length

There are no optical separation techniques available today basing on the distinction of wavelengths at a cost, which makes any sense for the addressed applications, and there is nothing underway for at least the next 10 years to change this situation.
If this changes, say, after 15 years, this will give an additional flexibility to IR-communication, but it is not an item standardization can rely on. In addition, the 4 wavelength classes (as proposed) are not enough to give the required flexibility.

3.2. Modulation

The only way to separate IR-applications is by assigning electrical bands similar to the radio environment.
It is not sufficient to classify kind of modulation. Instead, electrical bands of the IR-modulation must be limited and standardized.

3.3. Duration of Transmission

A true time multiplex or time slot assignement between non-synchornized applications is impractical.
Of course (again, as an analogue to the transmission power of the radio world), a minimum transmission duration could be specified, that will not be considered by the standard. In practice, it will apperar as occasional noise, which in the most case just slows down the other system.

3.4. Power Characteristics

This criterion is a very dangerous one. It suggests, that it is possible, to separate IR-systems
a) by the output power of the transmitter and
b) by the beam angle of the transmitter.
Specifically the IRDA-association uses those arguments, i.e. they would not interfere in practice with other systems, as their operating distance is only 1 or 3 meters.
THAT IS AN ABSOLUTELY INVALID STATEMENT, because the operating range is a function not only of the transmitting power, but also of the sensitivity of a receiver.
Primitive and cheap receivers, like in the IRDA-concept or in consumer electronic products, will have a very low sensitivity and, therefore, need high power outputs from their associated transmitters.
Such a transmitter will interfere consequently with another (professional) application device over
a) a much larger distance than specified for its own operation
b) a much larger angle due to a) and reflections("bouncing").

4. Conclusion

The following page shows Table 4 of [1]. We strongly support to issue a committing rule to label all IR-transmitters (also lamps !!!) according to this document.
But, in addition, a standard has to be implemented, which guarantees IR-communication applications in the same room via electrical channalization - again, EXIRLAN is such an approach, which tries to compromise with all existing industrial options. We also suggest to IEEE802.11, to take into account these activities by IEC and, if necessary, to find a common concept soon.

5. References

[1] IEC document 84 (sec) 340 Draft IECxxx: Transmission using Infra-red radiation, Part 1: General, Nov 1993

Criterion 1 (IR level, wavelength)			
Class 1 700 nm to 800 nm	Class 2 800 nm to 900 nm	Class 3 900 nm to 1000 nm	Class 4 1000 nm to 1600 nm
Criterion 2 (electrical level, modulation)			
Class 1 Wide band modulation Base band	Class 2 Wide band modulation Carrier based	Class 3 Narrow band modulation Base band	Class 4 Narrow band modulation Carrier based
Criterion 3 (duration of transmission)			
Class K Short duration Low duty cycle		Class L Long duration Continuous operation	
Criterion 4 (power characteristic)			
Class A average power density greater than 100 mW/m^2 Narrow beam radiation	Class B Diffuse radiation	Class C average power density greater than 100 mW/m^2 Narrow beam radiation	Class D Diffuse radiation

Table 3: Classification criteria for IR transmissions

Clause	Characteristics	A	B
2.5.6	Channels used		X
4.1.1	IR wavelength		X
4.1.2	IR bandwidth (of the source)		X
4.1.3	Power output (of the source)		X
4.1.4	Radiant intensity (of the source)		R
4.1.5	Directivity (of the source)		R
4.1.6	Spurious IR emission (see also 5.2)		R
4.2.1	IR response (of the receiver)		R
4.2.2	IR bandwidth (of the receiver)		R
4.2.3	Input sensitivity for random incidence		X
4.2.4	Maximum sensitivity		R
4.2.5	Maximum signal-to-noise ratio		R
4.2.6	Directivity (of the receiver)		R
4.3.1	Signal bandwidth (of the modulation)		R
5.1	Maximum power density of the irradiation and any safety information consequently necessary		X
6.2/ Annex B	Classification code		X

A = data which shall be marked on the equipment
B = data which shall be included in the manufacturer's specification
X = mandatory
R = recommended

Table 4: Marking and contents of specifications

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