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Submission Title: [Considerations for getting a delicate VLC Application Summary]

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Abstract: [This document presents the considerations for getting a delicate VLC application summary.]

Purpose: [To provide the considerations for a well defined VLC application summary]

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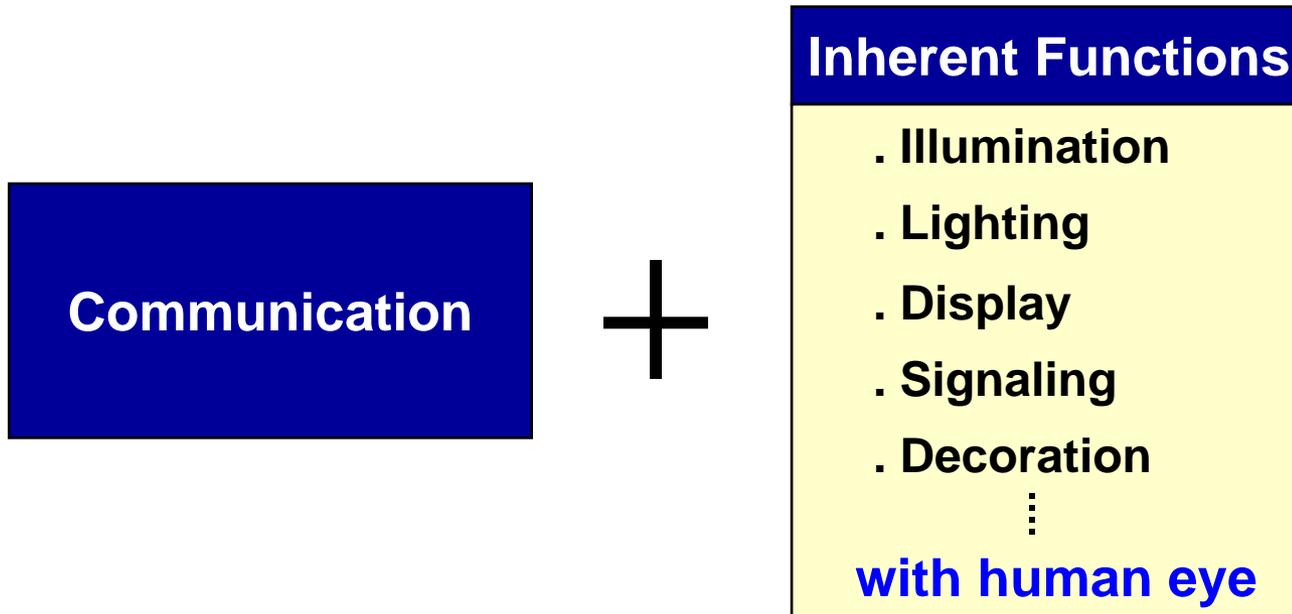
Considerations for getting a delicate VLC Application Summary

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Outline

- ❑ ***Characteristics of VLC***
- ❑ ***What we get through VLC application summary and How we get a delicate application summary***
- ❑ ***Classification of VLC applications***
- ❑ ***Some issues to discuss more in detail***
 - ***Mobile device and mobility in VLC***
 - ***Incoherent use of application model, data type, and device-to-device configurations***
 - ***VLC light source intensity : Concept and units***
- ❑ ***Conclusion***

Distinct Characteristics of VLC

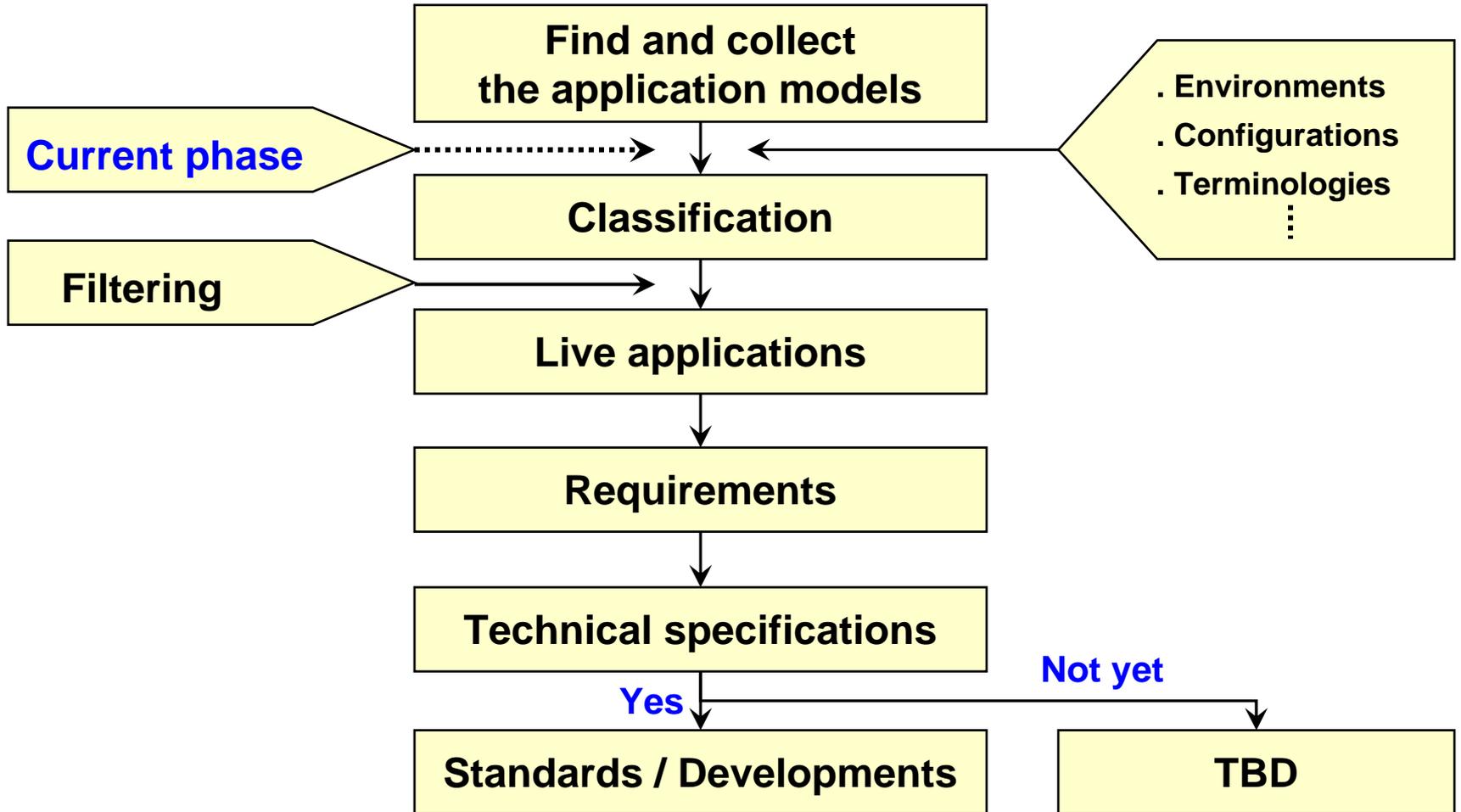


- We can do only communication through VLC in narrow scope, however, we have been much interested in getting simultaneously both of **communication and a part of inherent functions of light sources.**

Purpose of VLC Application Summary

- The purpose that we summarize VLC applications is to make the technical standards for the useful, available and user friendly VLC applications.**
- We need to collect and classify many imaginable applications before we extract the useful, available, and user friendly applications among many applications.**

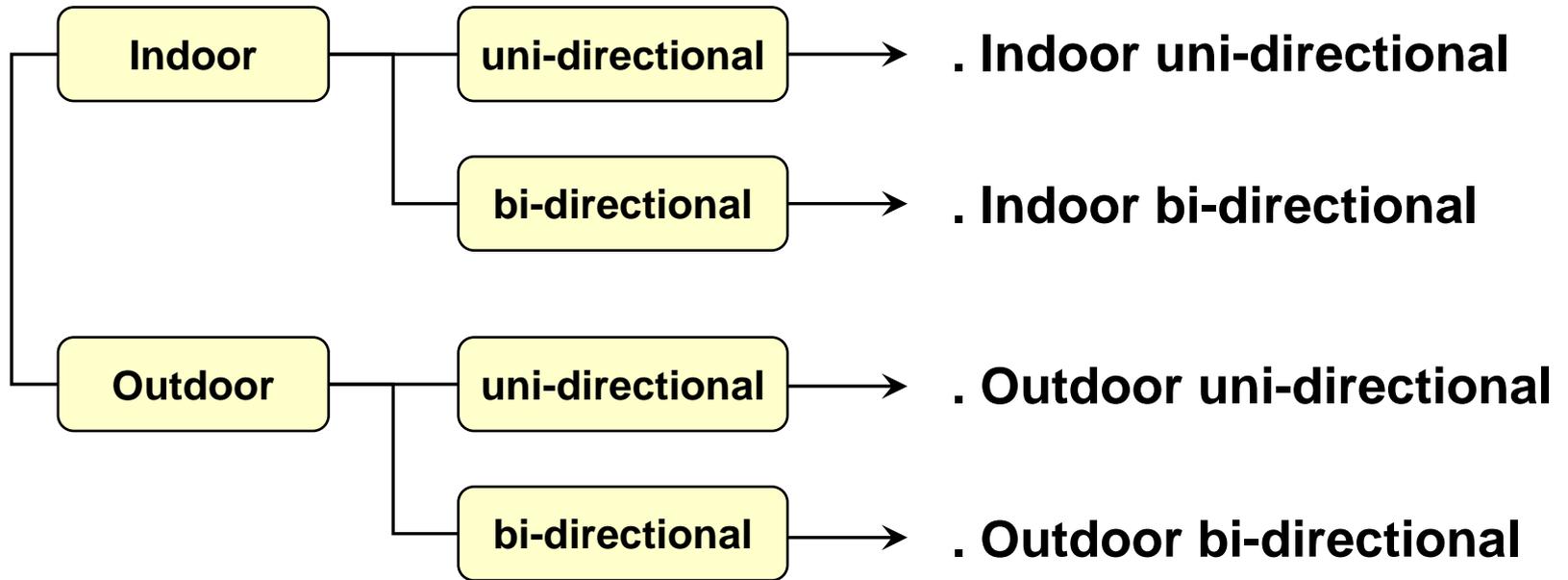
Strategy to get Our Destination



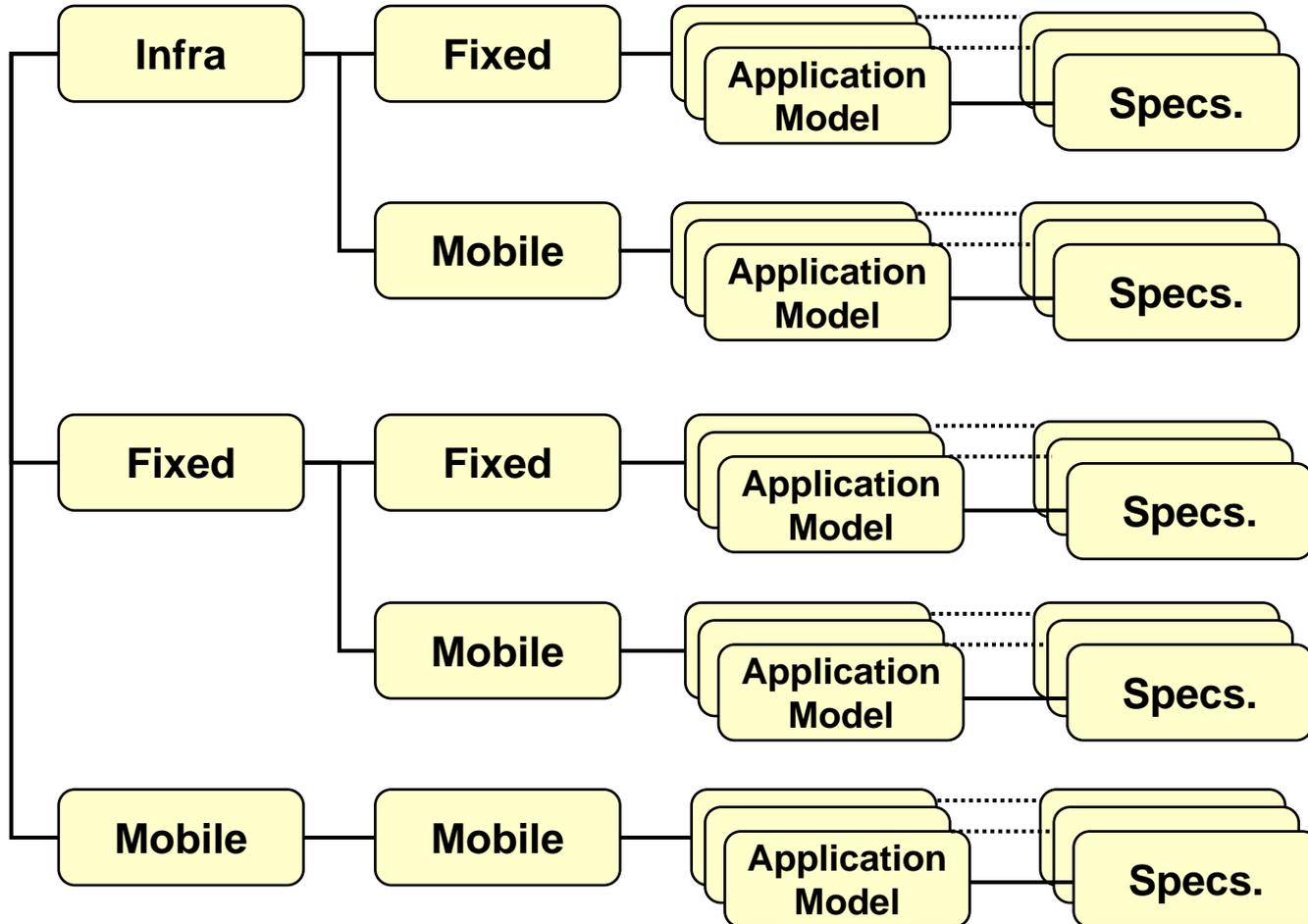
Grouping of Many Factors in VLC Application Summary

Environments	Configurations	Service Model	Specifications
<ul style="list-style-type: none"> . Indoor . Outdoor . Underwater 	<ul style="list-style-type: none"> . Unidirectional . Bidirectional . Infra . Fixed . Mobile . Vehicle . Symmetrical . Asymmetrical 	<ul style="list-style-type: none"> . Broadcast . Indoor navigation . Sign ITS . Aircraft intra-cabin . File transfer . E-commerce . E-content vending ⋮ 	<ul style="list-style-type: none"> . Data type . Data rate (UL/DL) . Distance . Source intensity . Channel type . Beam width ⋮

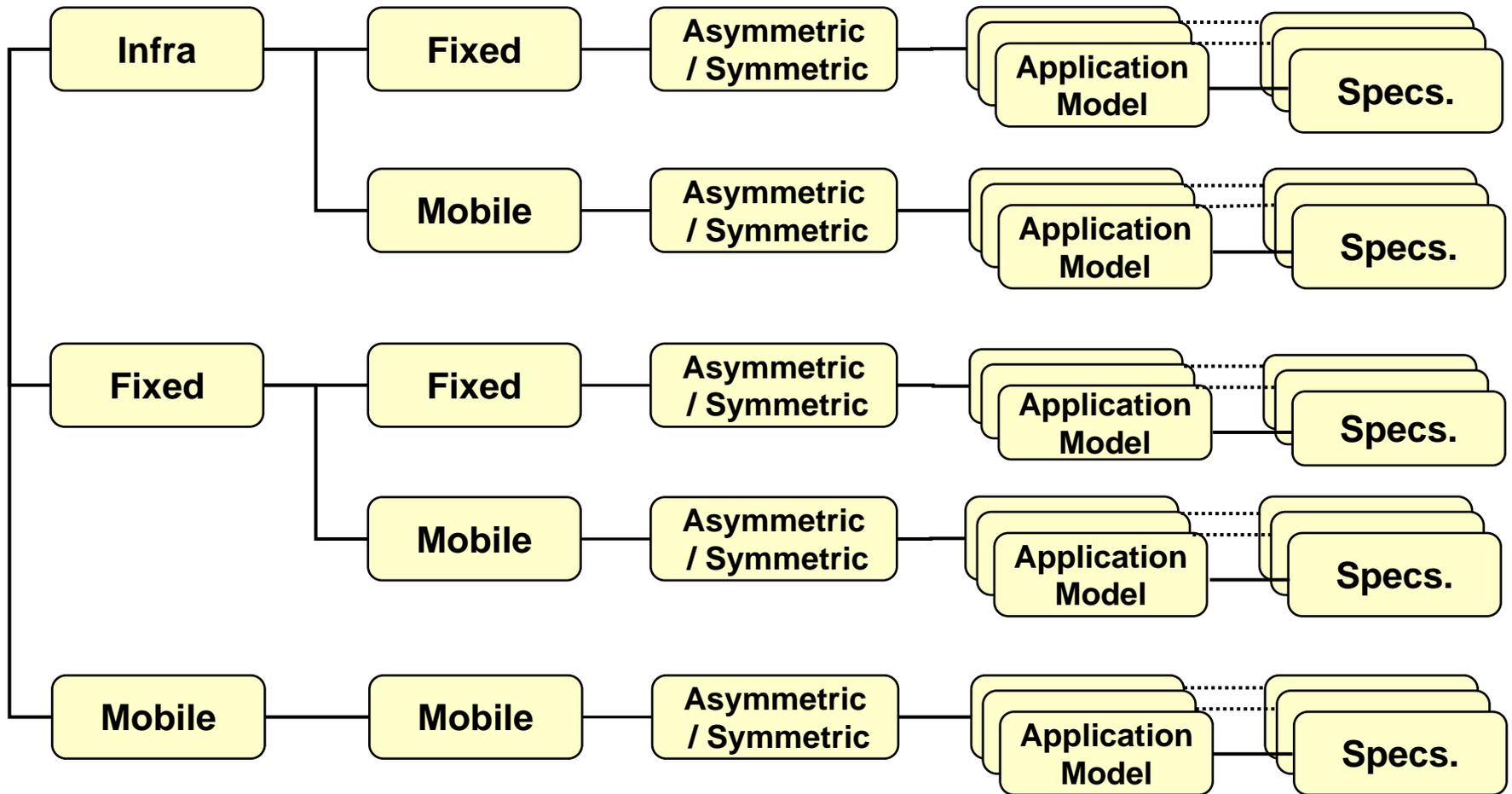
Main Groups of VLC Applications



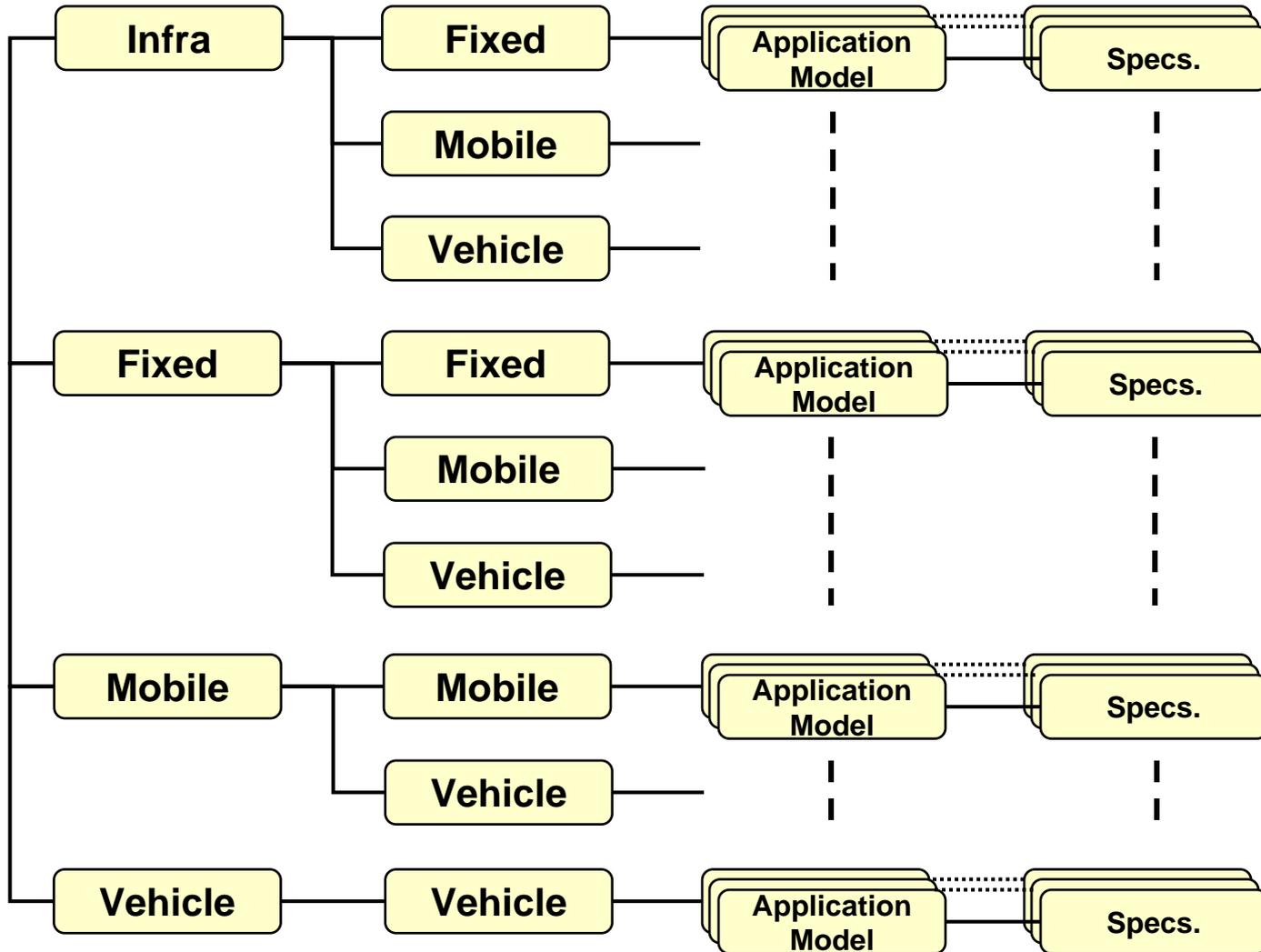
Indoor uni-directional



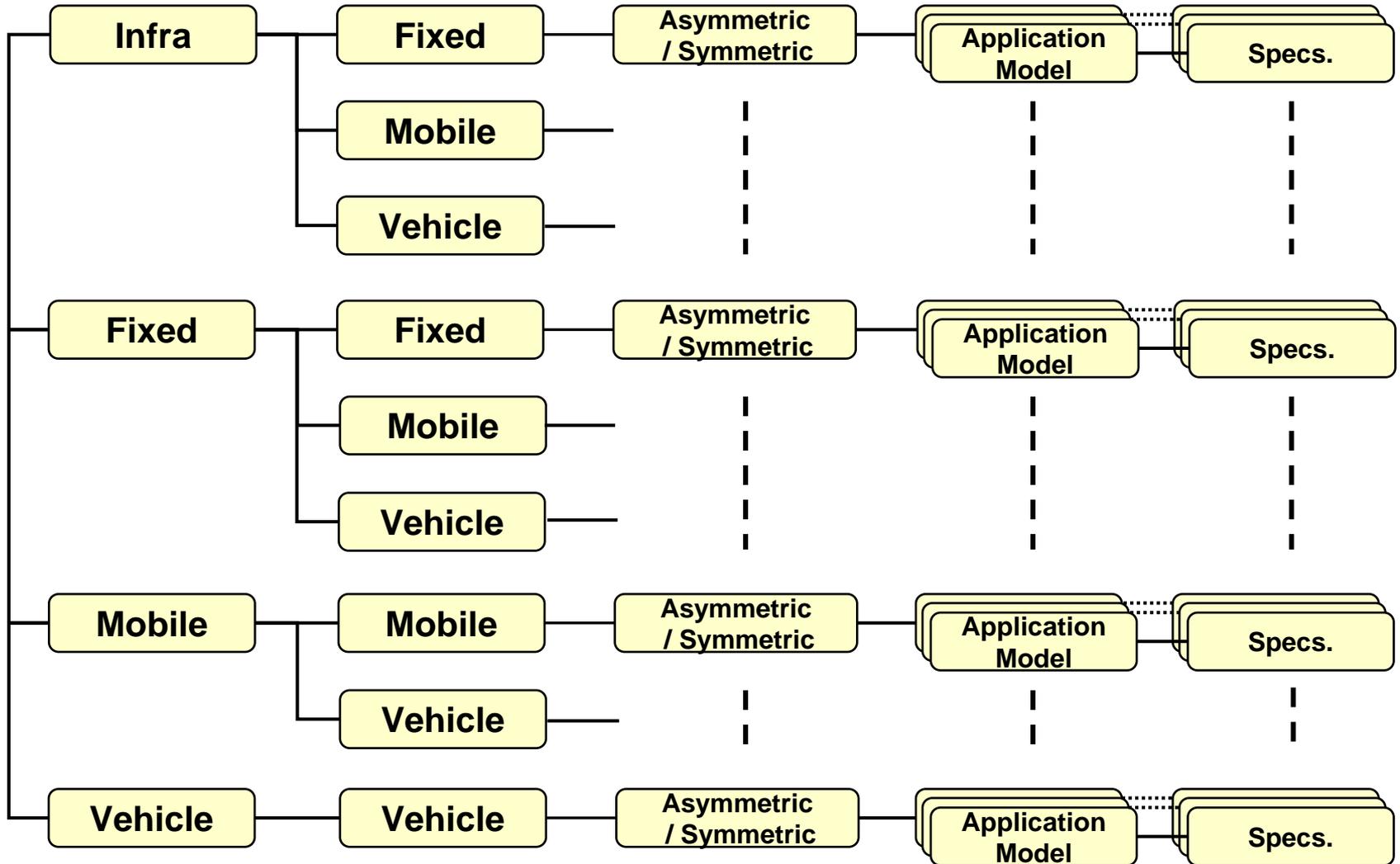
Indoor bi-directional



Outdoor uni-directional



Outdoor bi-directional



Some Issues to Discuss more in detail

□ *Definitions*

- . uni-directional or bi-directional depending on **data flowing directivity**.
- . Mobile device : A VLC device that moves (has **mobility**) and ~ .
- . Asymmetric / Symmetric : undefined state

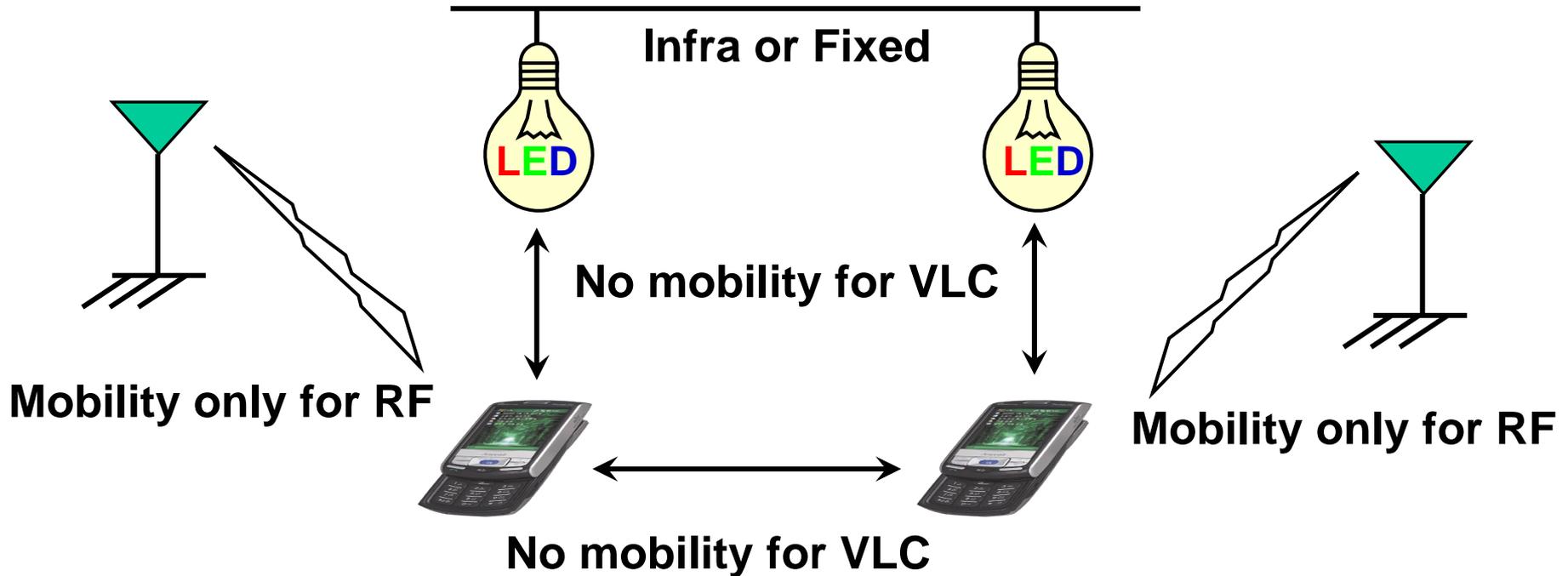
□ *Source Intensity Unit*

- *We need to distinguish and use separately the concepts on application(or service) model, data type, and device-to-device configuration.*

Definition of Mobile Device and Mobility

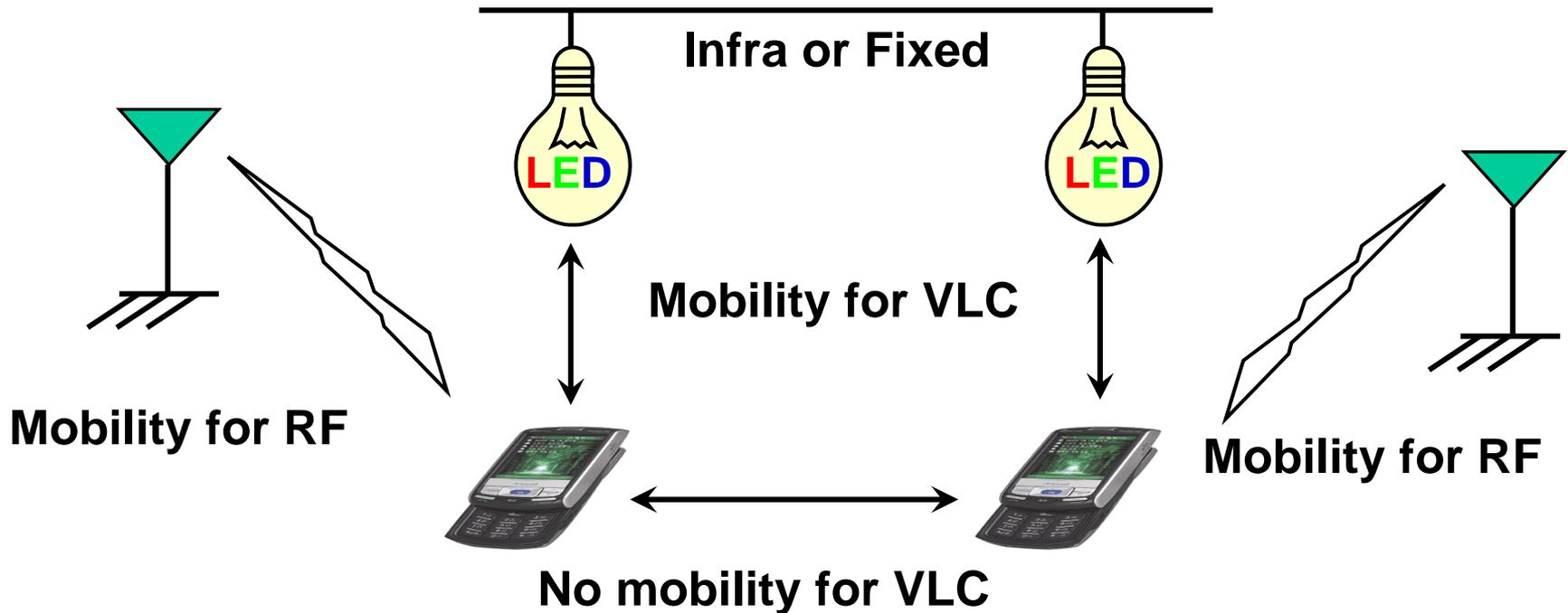
- ❑ Mobile device : A VLC device that moves (has **mobility**) and does not have logical connectivity to an information network.
- It is not clear whether we can do visible light communication with a VLC mobile device walking or running, or not - i.e. **a VLC mobile device with VLC functions has mobility for VLC or it has mobility only for another communication such as RF wireless without VLC mobility.**
- ❑ It is not clear whether ‘mobility’ means only ‘portability’ or not, and also ‘mobility’ can be accepted differently to us depending on ‘infra-to-mobile’, ‘fixed-to-mobile’ or cell hand-over function.

Mobile Device and Mobility – Case (1)



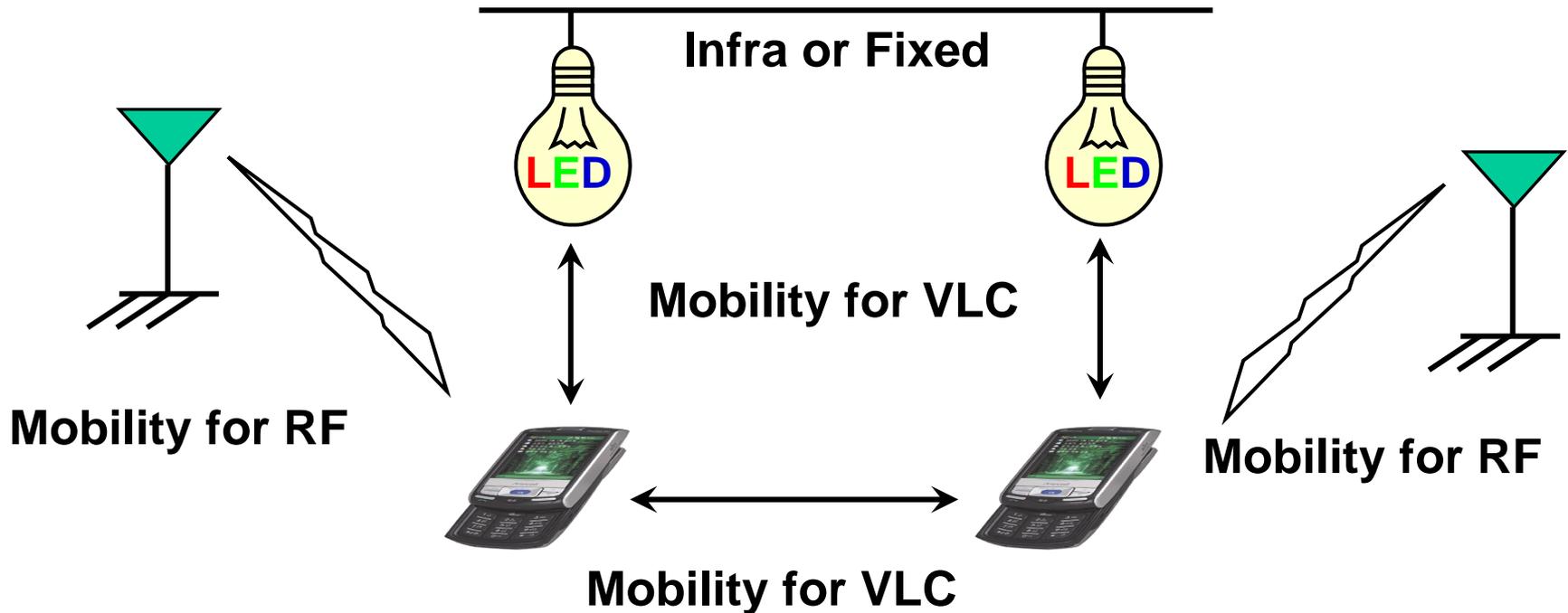
- If a portable device with VLC functions has mobility only for RF, we need to change ‘infra(or fixed)-to-mobile’ and ‘mobile-to-mobile’ into ‘infra(or fixed)-to-fixed’ and ‘fixed-to-fixed’, respectively.

Mobile Device and Mobility – Case (2)



- ❑ In this case, we can define ‘infra-to-mobile’ and ‘fixed-to-mobile’, but we need to discuss on where the boundary of ‘mobility’ is, i.e. whether ‘mobility’ includes the concept of cell hand-over or not.
- ❑ We need to change ‘mobile-to-mobile’ into ‘fixed-to-fixed’.

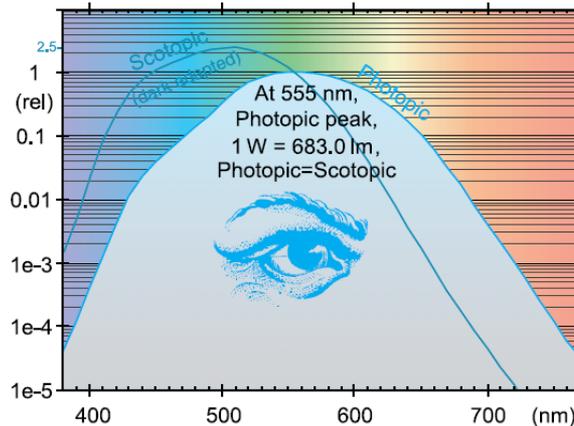
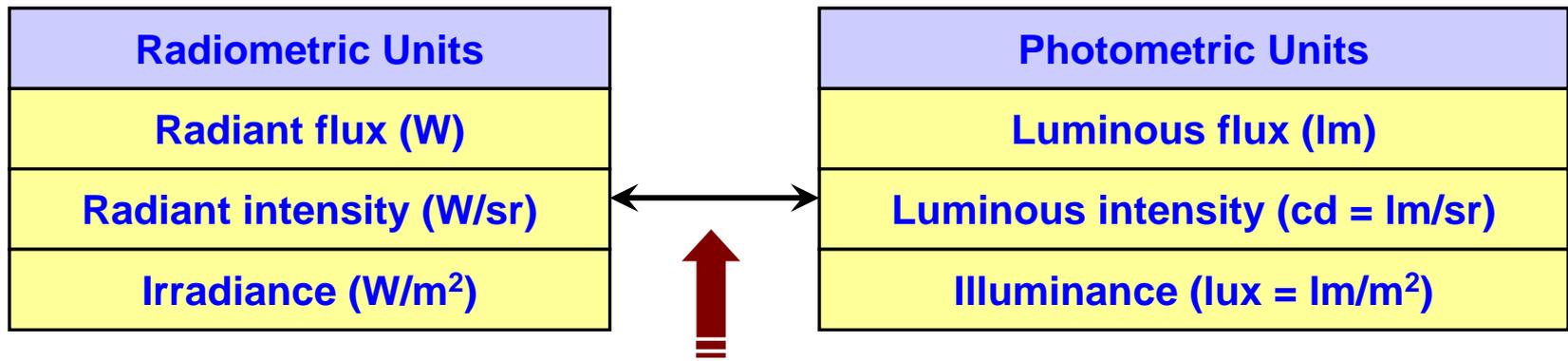
Mobile Device and Mobility – Case (3)



- In this case, first of all, we need to start from what the definition of ‘mobility’ in VLC is.

Characterizations of Visible Light

- The visible light can be characterized by radiometric or photometric unit.

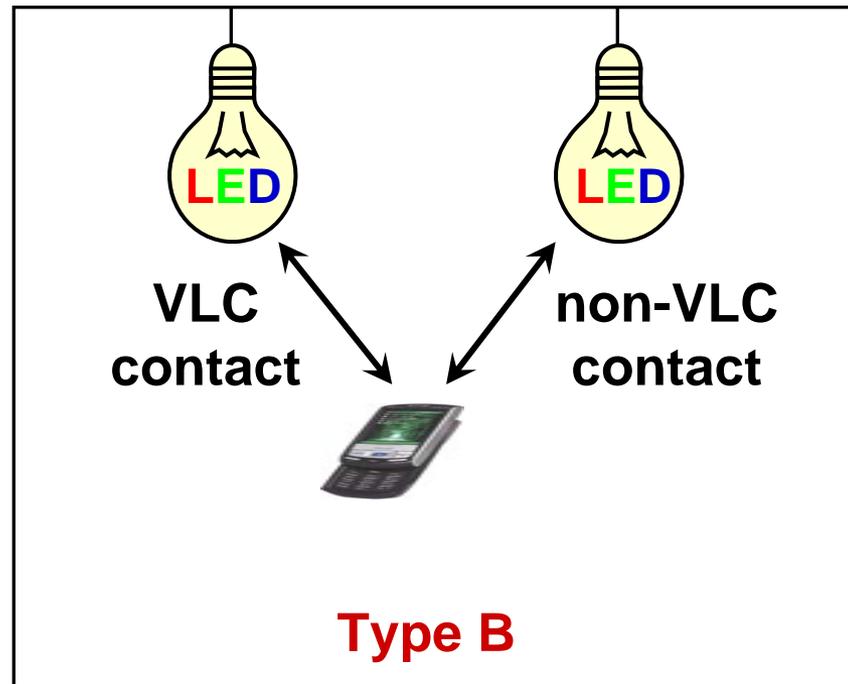
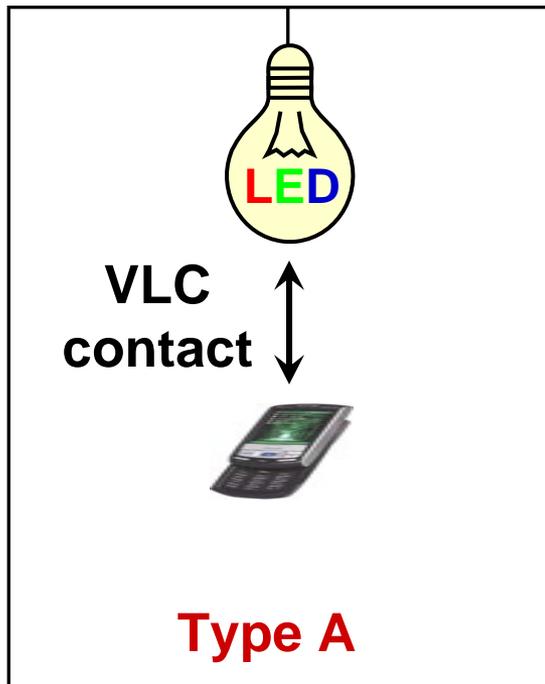


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Which one is more suitable for VLC Source Intensity, Photometry or Radiometry ?

- ❑ A photodetector for VLC has another sensitivity function different from human eye depending on wavelength.
- ❑ Most of communication engineers have been accustomed to characterize the source intensity or source power by radiometric unit, watt or dBm.
- ❑ It is desirable that we characterize a source intensity in VLC by both of photometric unit in point of human eye and radiometric unit in point of communication, respectively.

'lux' is suitable for a VLC source intensity, or not ?



Illuminance is unsuitable for a VLC source intensity

- ❑ The illuminance in type A relates to only a VLC light source, but the illuminance in type B relates not only a VLC light source but also non-VLC light source. Therefore we can not say that the illuminance in type B means the quantity relates directly to the intensity of a VLC light source.
- ❑ The illuminance at a point varies with the distance between a light source and a measurement point.
- ❑ Therefore, when we characterize the source intensity of a VLC light source by photometric unit, it is reasonable that we use luminous flux(lm) or luminance intensity(cd) not illuminance(lux).

Conclusion

- ❑ We may classify the main groups of VLC applications into indoor uni-directional and bi-directional and outdoor unidirectional and bi-directional.
- ❑ We need to start from what the definition of 'mobility' in VLC is clearly.
- ❑ The definition of asymmetric/symmetric in application matrix
- ❑ We need to distinguish separately the concepts about service (application) model, data type, and device-to-device configuration.
- ❑ We need to characterize the VLC source intensity by all of photometric and radiometric unit, respectively.
- ❑ We need to use luminous flux(lm) or luminance intensity(cd) not illuminance(lux) in characterization of the VLC source intensity by photometric unit.