

TRIDESETO MEDNARODNO POSVETOVANJE
THIRTIETH INTERNATIONAL SYMPOSIUM

RAZSVETLJAVA 2022
LIGHTING ENGINEERING 2022
20. in 21. oktober 2022, Terme Dobrna



Terme Dobrna
20 – 21 October 2022

Road lighting as the backbone of smart city networks

Opportunities and questions

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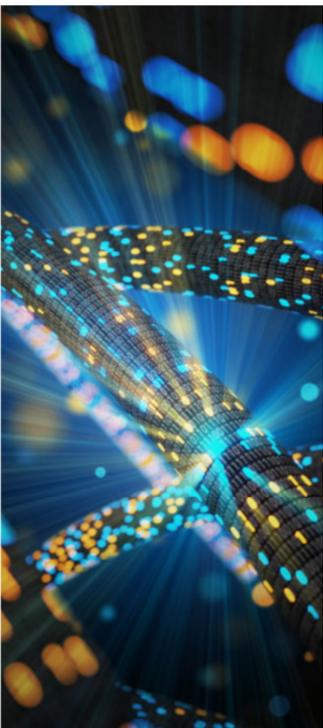


TUNGSRAM

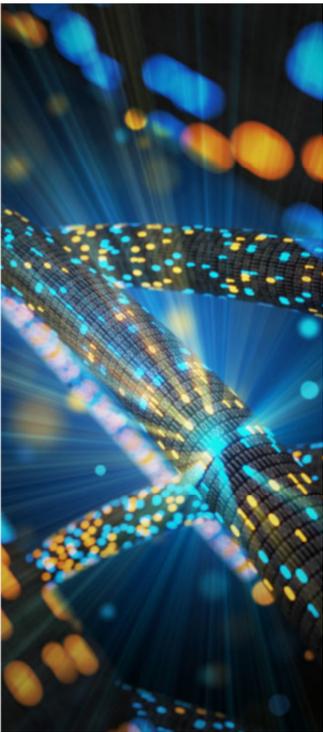


Abstract

Questions



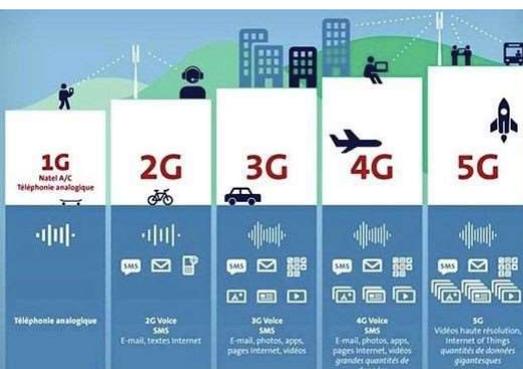
1. How can 5G and streetlighting influence each other?
2. Is there a real need for this?
3. What is the reality?
4. Vision – Opportunities – Threats



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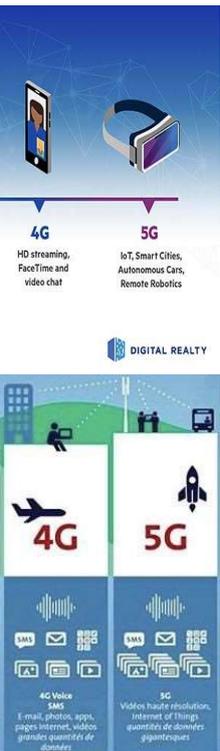
5G

Short history by user experience



- 1G: analogue voice
- 2G: Digital voice, SMS, text e-mail
- 3G: applications + Internet + photos + videos = **smart phone**
- 4G: HD streaming, video chat
- 5G: IOT, autonomous car, industry 4.0, remote robotics, **Smart city**

Comparison of main technical parameters



Parameters	4G	5G
Speed, Mbs	20-30	100-200
Device density/km ²	2,000	1,000,000
Latency, ms	100	1
Readiness, %	99,25%	99,999%
Coverage, m	1,000 – (5,000)	30-(50)

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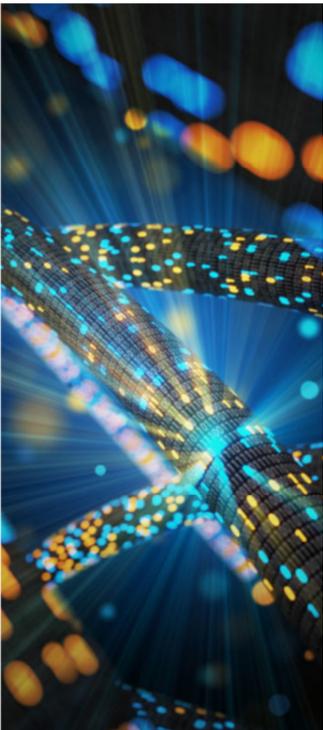
Location of endpoints in streetlighting

Evaluation for 5G and its users



- The density of endpoints of streetlighting (**20-50m**) are slightly higher those required for full 5G coverage (**50-80m**). This is the best fit possible.
- **The endpoints are where people and cars**, where high speed and density data transmission is necessary.
- The road surface is **near 2D** and cars also moving in 2D, as well as sensors are located in 2D, but the endpoints of streetlighting could **extend it for 3D**, they can add an additional dimension and endless possibilities.

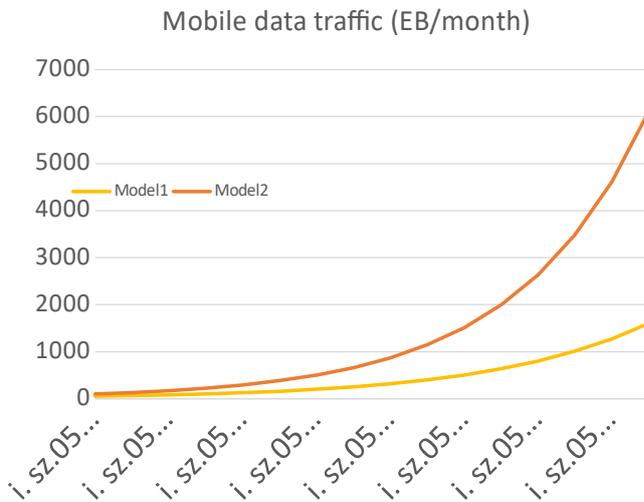
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Location of endpoints in streetlighting

Evaluation for 5G and its users



- Metaverse
- Autonomous cars
- Industry 4.0
- ...

Multiple-byte units				
Decimal		Binary		
Value	Metric	Value	IEC	Legacy
1000	kB kilobyte	1024	KiB kibibyte	KB kilobyte
1000 ²	MB megabyte	1024 ²	MiB mebibyte	MB megabyte
1000 ³	GB gigabyte	1024 ³	GiB gibibyte	GB gigabyte
1000 ⁴	TB terabyte	1024 ⁴	TiB tebibyte	TB terabyte
1000 ⁵	PB petabyte	1024 ⁵	PiB pebibyte	–
1000 ⁶	EB exabyte	1024 ⁶	EiB exbibyte	–
1000 ⁷	ZB zettabyte	1024 ⁷	ZiB zebibyte	–
1000 ⁸	YB yottabyte	1024 ⁸	YiB yobibyte	–

Orders of magnitude of data

Top five applications in 2030



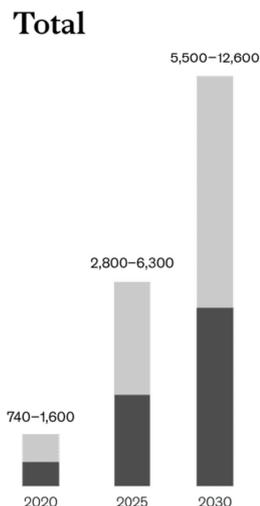
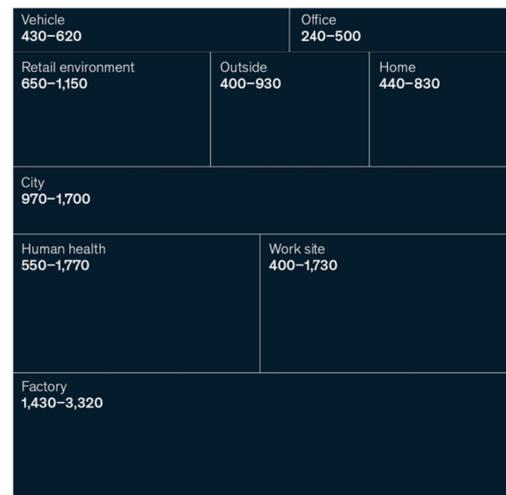
- Smart meter
- Industrial
 - Robotics
 - Automation
 - Digital twins
- Router/CPE
 - FWA
 - private networks
- Automotive
 - Connected
 - Autonomous mobility
- POS

IOT Economic potential in 2030: 5,500-12,600 Mrd USD

Concentrated to 9 applications

The Internet of Things' large and growing economic-value potential is concentrated in nine settings where the technology is deployed.

Estimated 2030 economic value of Internet of Things adoption, by setting, \$ billion



- Vehicle
- Office
- Retail
- Outdoor
- Cities
- Healthcare
- Worksite
- Factory

Lighting is present each and every applications

Note: Segment sizes based on high-end estimates. Figures may not sum to listed totals, because of rounding.

Why should lighting industry miss this opportunity?



IOT Economic potential in 2030:

9,050 Mrd USD*

*McKinsey mean value

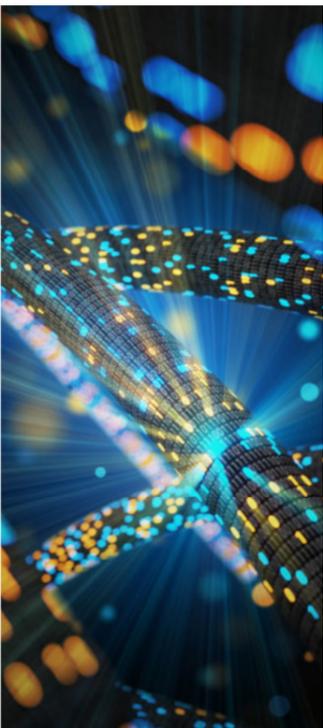
Global Lighting Economic potential in 2027:

163 Mrd USD*

*BaU based on 118 Mrd USD base in 2019

Why should lighting industry miss this opportunity?

Question3



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Streetlighting

- 400 M lighting endpoints
- Potential data node or sensor



Indoor lighting

- 20 Mrd lighting endpoints (=socket)
- Potential data node or sensor

Lack of 7/24 access



Streetlighting

- Vast majority of endpoints still not receive 7/24 power supply
- Although, the need other functionality than lighting raised a decade ago, very little improvement made.
- This is not a technical but financial issue. Nobody is ready to pay the investment and the increased running cost
- How long will it remain like this?

Indoor lighting

- There is (at least) one socket per room at the middle of ceiling, there is always wall switch cutting the power supply
- Luckily, the investment is not huge to reach the socket with continuous power supply, it is still not standard even for new properties.



Protection only at the endpoint is enough?



State-of-art surge protection of street lighting luminaires

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DEHN + SÖHNE GmbH+Co.KG Magyarországi Képviselet
Óbudai Egyetem Kandó Kálmán Villamosmérnöki Kar
Villamosenergetikai Intézet – egyetemi adjunktus

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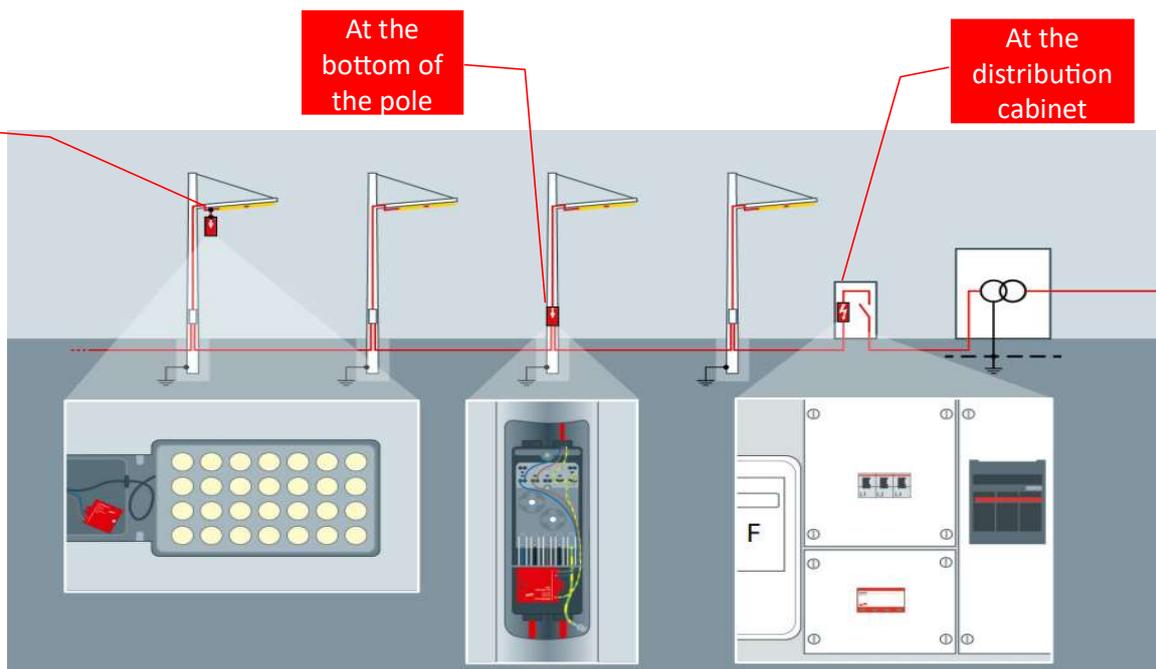
Streetlighting

- The outdoor network is exposed and sensitive to voltage surges. LED luminaires are more sensitive as any other lighting technology before.
- The best solution is the protection distributed along the key points on the network, it is not possible to solve it with protection exclusively at the end-point.
- However, stakeholders force to solve it by luminaire manufacturer, only, the operators have not spent a cent on it.
- Why is the protection so important for expanding smart city applications on streetlighting network?
- The potential devices to be installed on streetlighting network, like 5G transmitters, sensor, CCTV cameras are very sensitive to high voltage surges.
- They have significant investment cost and significant labor cost for replacement. Outage of those application is critical to the functionality of smart cities.
- If the network itself not protected properly against high voltage surges, the investors will be reluctant to use them as backbone of their applications.

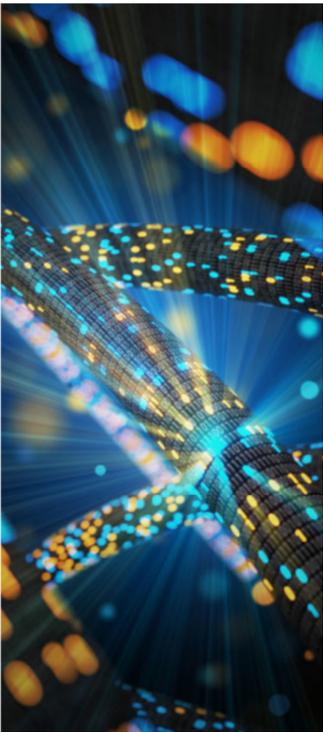
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State-of-art surge protection of street lighting network

Concept: luminaire ≠ network



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Ownership

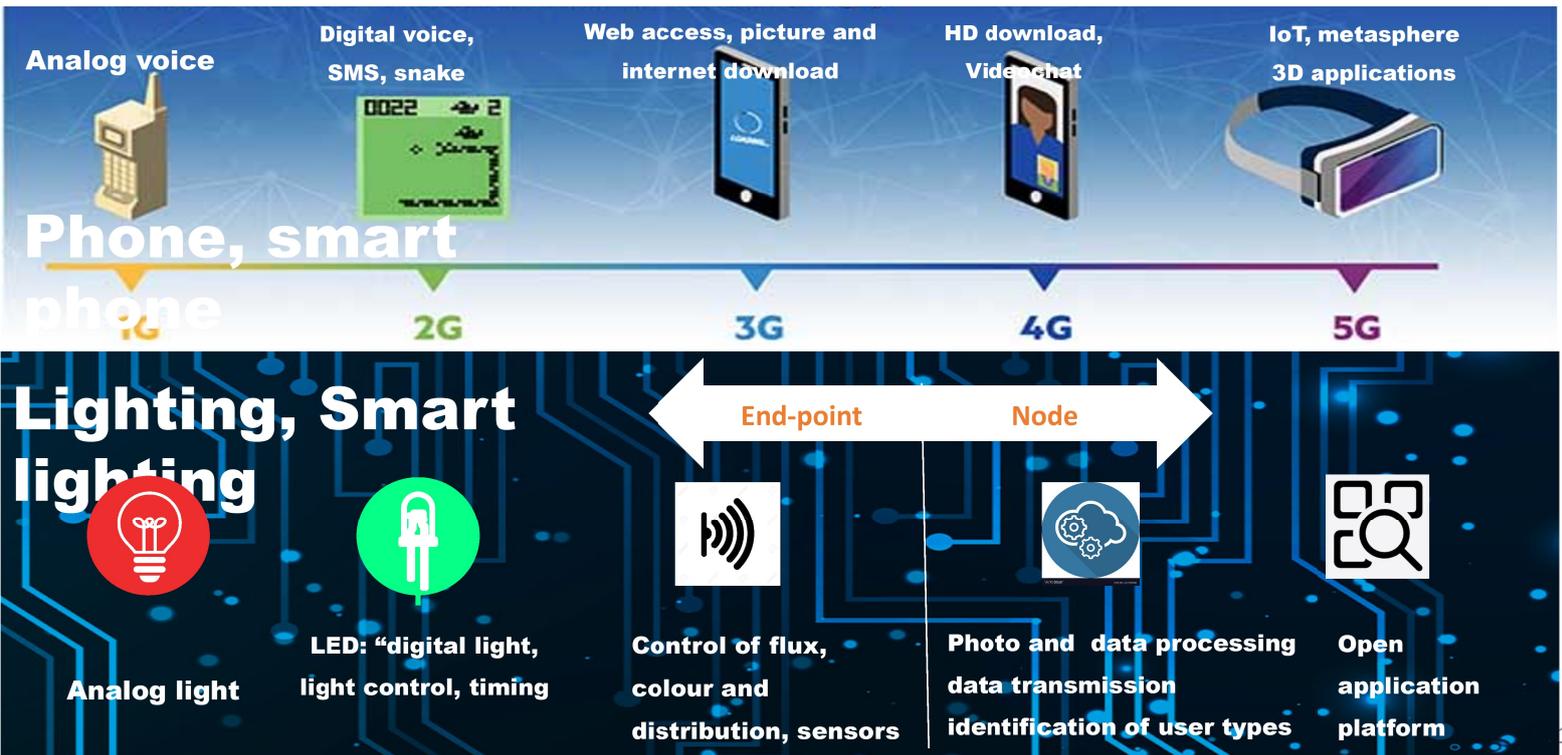
Multiply stake-holders -> single stake-holder or consortium



Streetlighting

- The stake-holder structure is different by country, by city, by street, sometimes there is even different stake-holders structure whit-in the same column.
- If we want quick implementation of smart city function on streetlighting network, the stake-holder structure must be uniform. Otherwise, the business plans are different, with different Return-On-Investment and distract investors.
- The investor will look for other exiting networks or they will build an additional network along the streets which will look awkward and definitely cost more in investment and maintenance.

Redefinition of Smart Lighting



LEDs

How LEDs can serve Smart Lighting



Yesterday

- Higher efficacy

Today

- Life centric lighting

Tomorrow

- Data transfer by modulated light, LiFi

Data transfer by modulated light



Advantages

- Much higher bandwidth than WiFi
- Short latency compared WiFi
- Natural data protection, closed doors, closed curtains
- More energy efficient than WiFi
- Multiplex options
- Integrated devices
- Redundancy

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Summary



- The interaction between lighting networks and smart cities and smart homes is evident
 - The real question is: Whether the lighting network is going to be an endpoint or the backbone and facilitator in terms of both technology and business model?
 - At this moment, it slowed down or even blocked by several issues
- The current lighting network must be transformed to open, safe and secure network and be the host of smart applications.
 - One of the driving force could be the extensive use of LiFi.
 - There is a need for additional business models beyond energy-saving.

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Thank you for your attention and consideration



SLOVENSKO DRUŠTVO ZA RAZSVETLJAVO / SDR
LIGHTING ENGINEERING SOCIETY OF SLOVENIA

