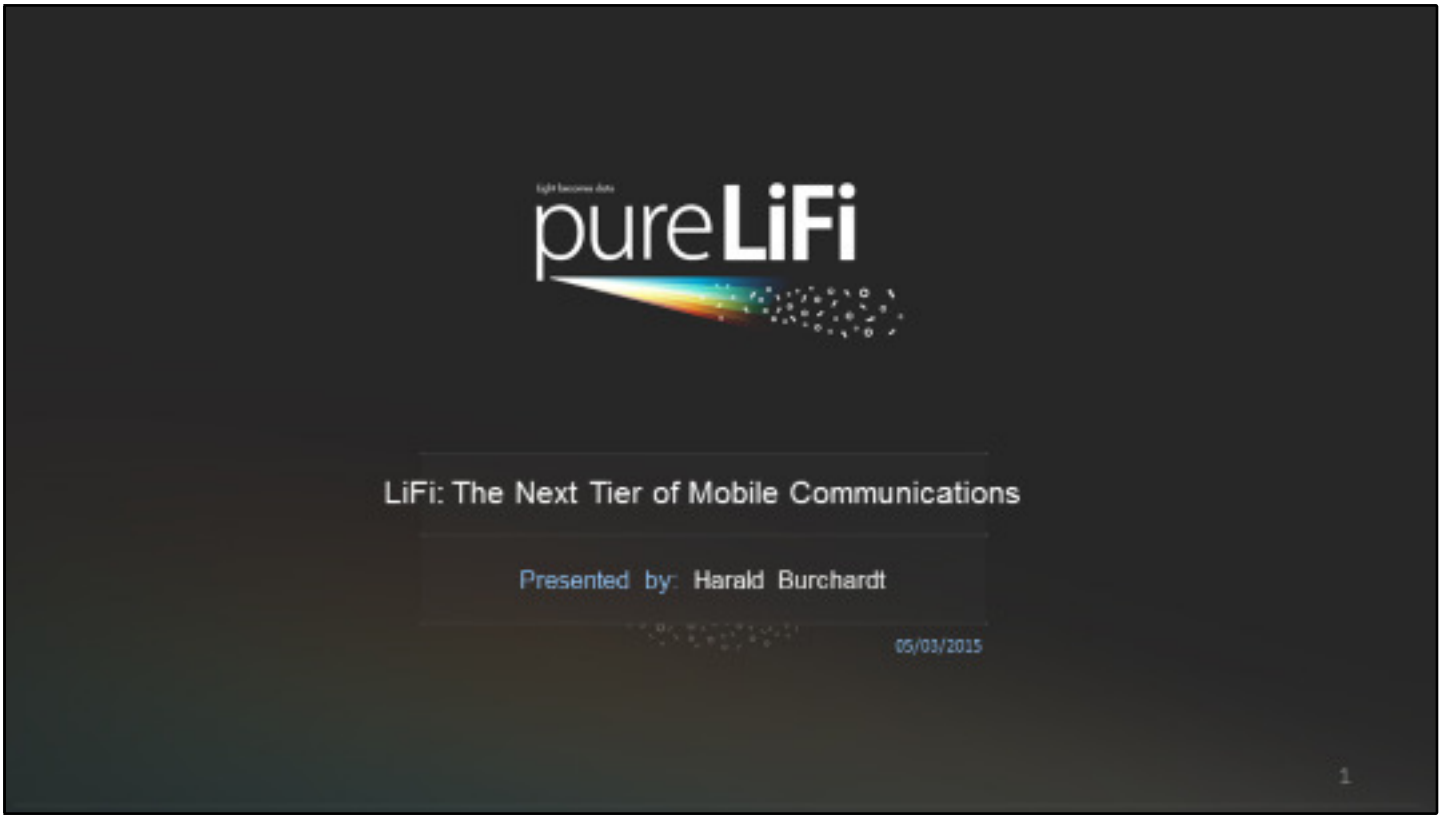
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LiFi: The Next Tier of Mobile Communications
Presented by: Harald Burchardt
05/03/2015
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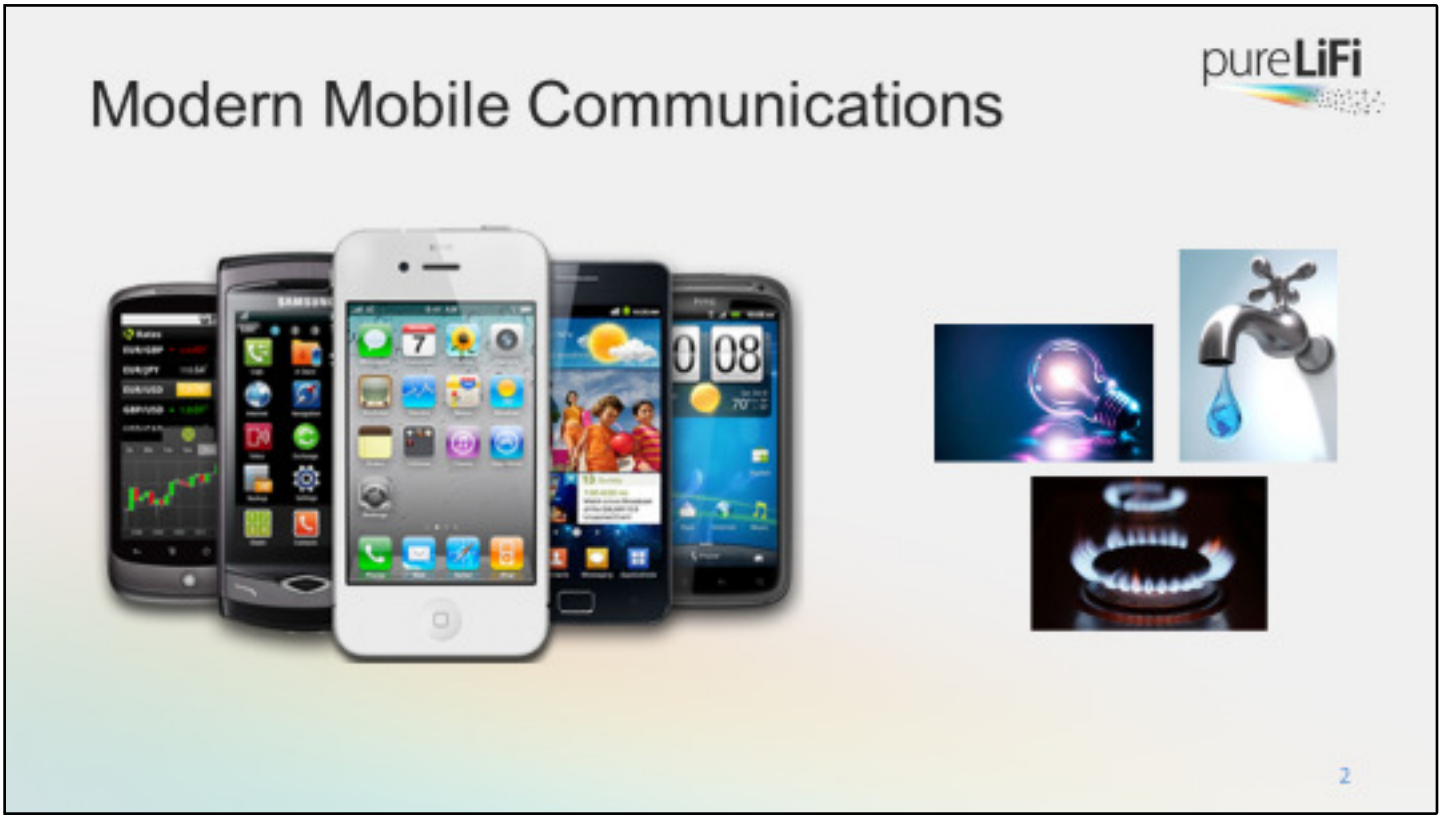

- In today's modern world, mobile communications has become a basic utility, similar to water, electricity and gas; practically essential to our everyday lives
- Mobile phones have become personal computers, greatly accelerating the adoption of mobile devices even further
- With every person now owning a mobile, tablet, laptop, data has become a valuable resource for everyone. And the IoT will continue this progression further…

Capacity/Demand Increase

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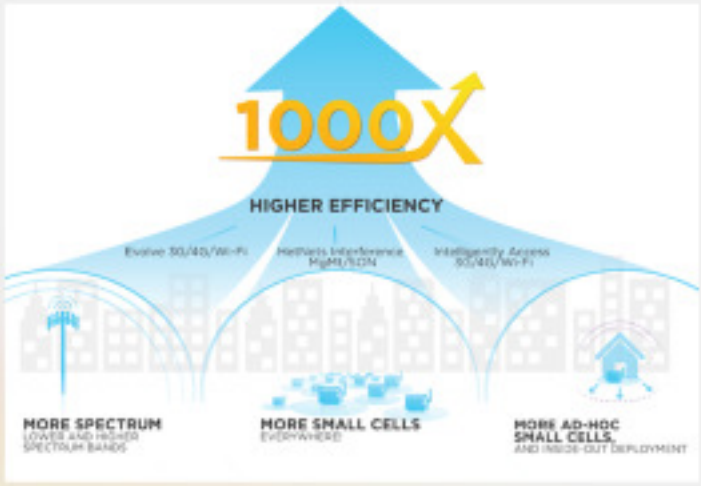

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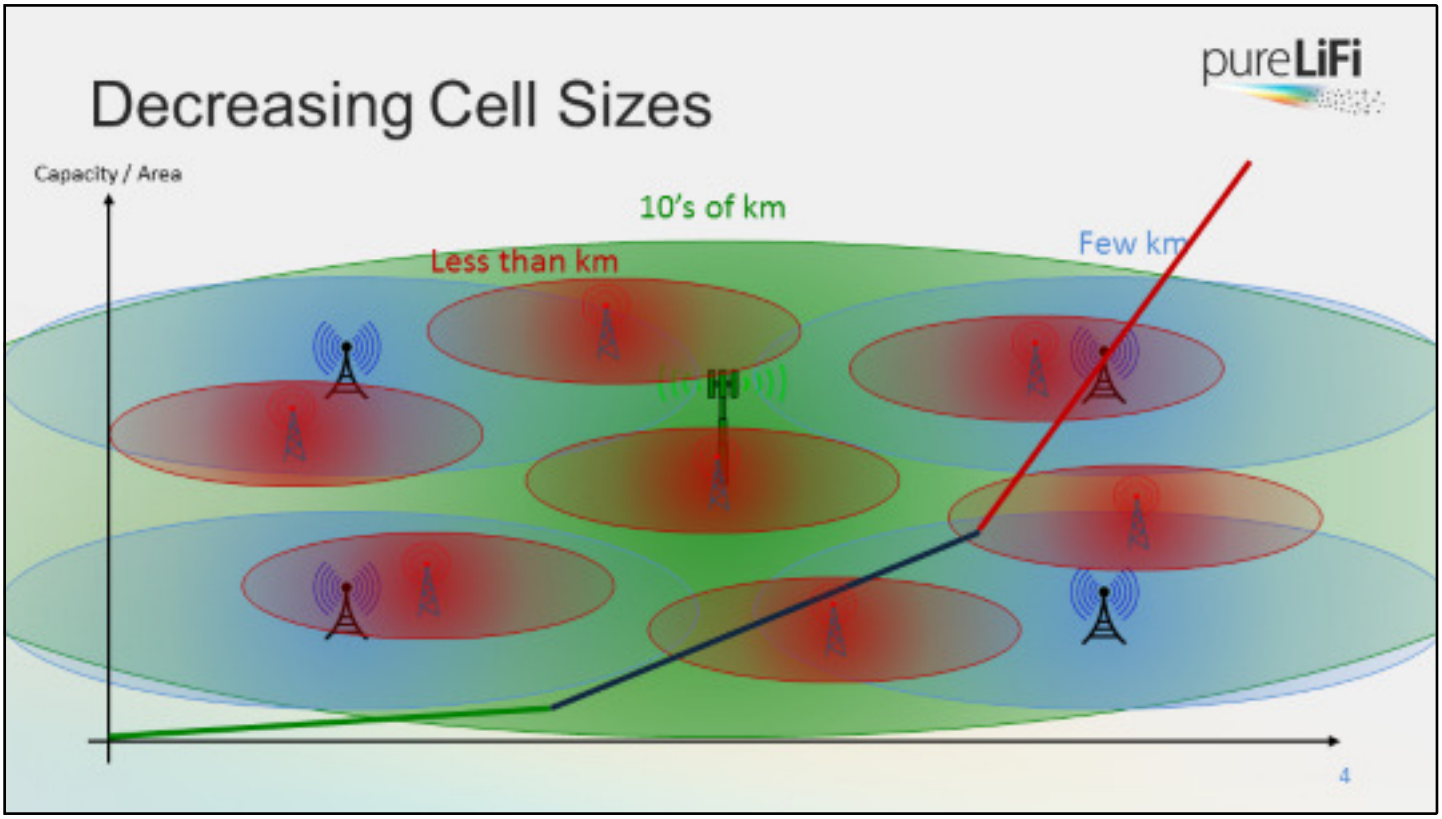
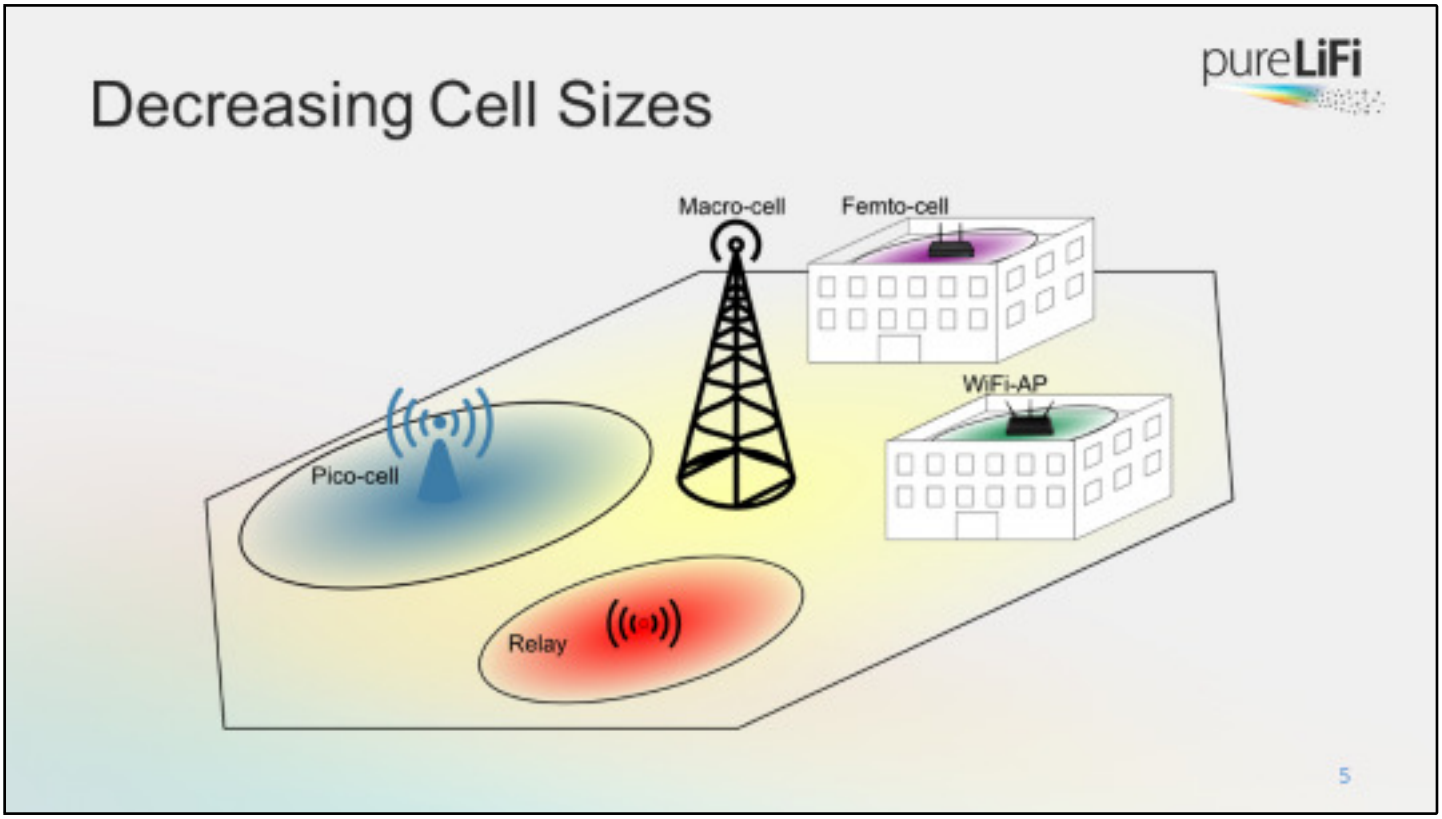
- The vast increase in connectivity results in exponential growth in wireless demand. It is predicted the global mobile traffic will reach 16 Exabytes per month by 2018, over 10x that of 5 years before
- In order to meet this demand, the target for communication systems in 2020 is 1000x capacity at 1000x energy efficiency, which is to be achieved through the denser and denser reuse of smaller cells



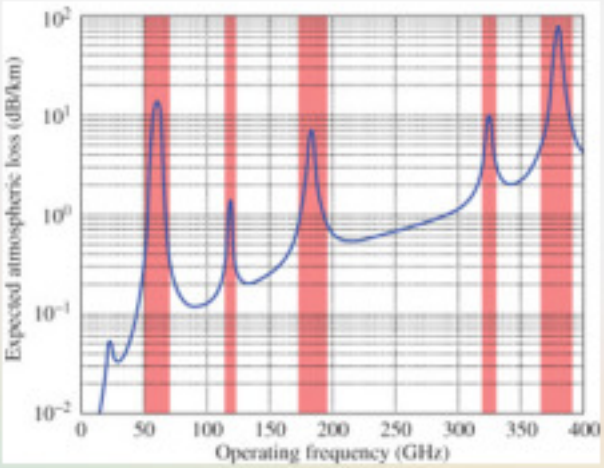
- This has already been the trend for network capacity improvement over the past two decades, where GSM cells covered up to 10's km, 3G cells a few km, and 4G cells can be as small as a few 100 m in densely populated areas

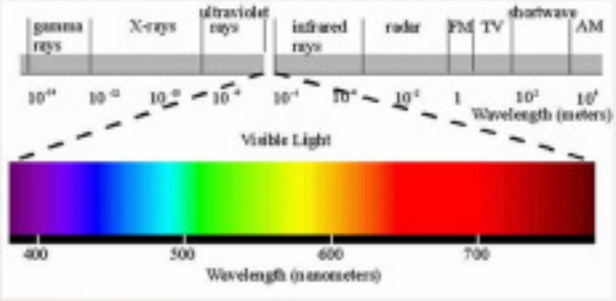
- With each iteration, the network capacity per area has been dramatically increased



- But even this development was not enough. In recent networks, even smaller smells such as pico-cells and relays, covering 100's of meters, femto-cells and Wi Fi APs for indoor coverage have been deployed for even denser reuse.
- But how do we go EVEN SMALLER?

New Spectra





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- Traditionally, we have focused on the low-attenuation portion of the spectrum. But recently, we've seen the research and roll-out of higher frequency RF technologies, such as 60 GHz, 250 GHz (or mmWave) and higher. Their higher attenuation further reduces cell sizes

- Why not go to even higher frequencies? The visible light spectrum is 10,000x (350 THz, 50 million 20 MHz channels) larger than the allocated radio spectrum, and the high frequencies significantly increase attenuation

- Is it worth mentioning that optical filters are advancing enabling us to use ever smaller "bits" of the light spectrum, ie., 480-490 nm with one filter then 500-510nm etc.....???

Lighting Coverage Area

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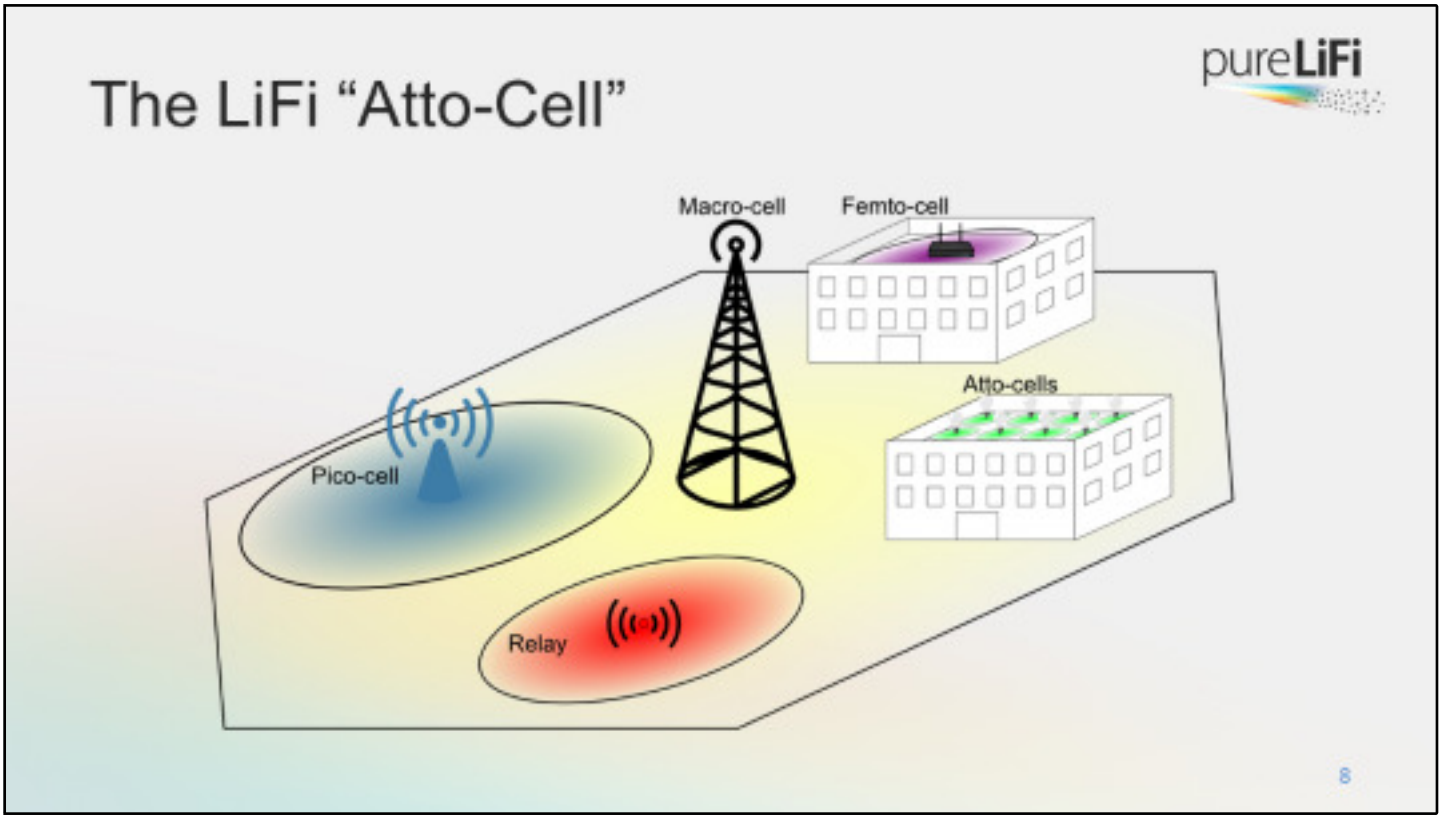
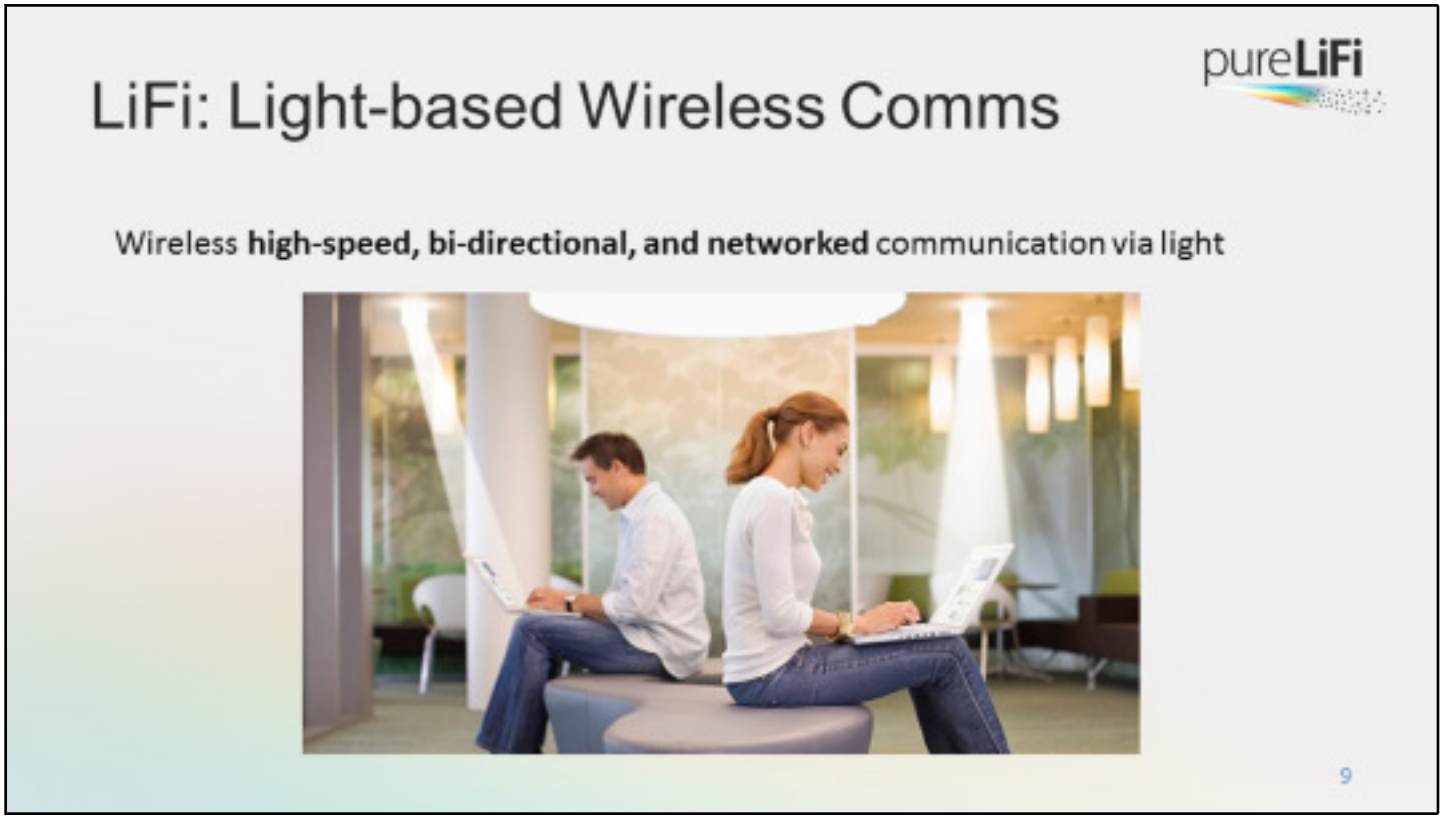
- An unconventional answer: Lights!
- The area covered by your average luminaire can be between 5 and 20 square meters, much smaller than a conventional RF cell!
- This is why so many lights are needed to cover a space with illumination, and they do not provide much area of overlap. Also, light does not provide additional interference to existing infrastructures! “Propagation loss is good!”
- So if you now consider the coverage area of a single light as a cell, you get the Atto-cell ->
- The fact that LEDs are electronic components, means that they can be used for information signalling.



- Therefore, we can use individual lights as access points, and create the Atto-Cell: capable of much denser reuse than before!
- This can provide, especially indoors but also outside, the additional spectrum density needed for future networks!



- We call this “LiFi”, which provides the three essential components for mobile communications: high-speed, bidirectional and networked communications
- There is an important distinction to be made to standard visible light communication, which can be low-rate and unidirectional, and is generally limited for location-based services.
- pureLiFi believes that LiFi will be an essential part of future communication networks for a number of reasons, most importantly

LiFi: High-Density Reuse

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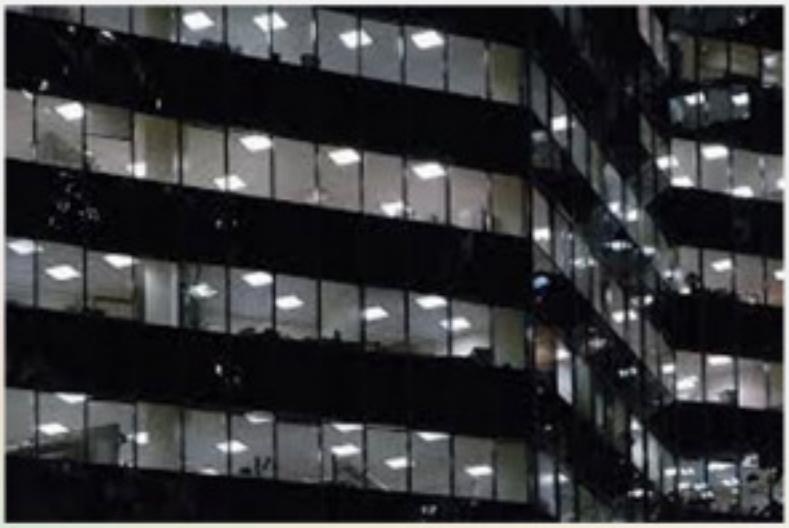

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- The already alluded to DATA DENSITY
- In the same area that a single femto-cell or WiFi AP covers, there may be (depending on the lighting system) over 100 lights to illuminate the space.
- If we can repeat the same bandwidth from a single light as we can from a RF AP, which our research shows we can, then we can create 100x the capacity in the same area, with a fairer distribution of resources.
- In fact, our research shows that up to 1000x capacity increase for indoor networks can be achieved by LiFi, helping to achieve the high targets set by the industry.

LiFi: Safe Wireless Comms

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- But there are other advantages to communication using light:
- The fact that light does not penetrate solid objects, such as walls, enables the wireless communication of data in secure areas, for defense applications, and maintains the privacy of data in enclosed spaces.
- In addition, light does not emit the same electromagnetic interference as radio frequency, and can therefore be used in areas such as petrochemical/power plants, O&G, healthcare and underwater communications

LiFi: Secure Wireless Comms

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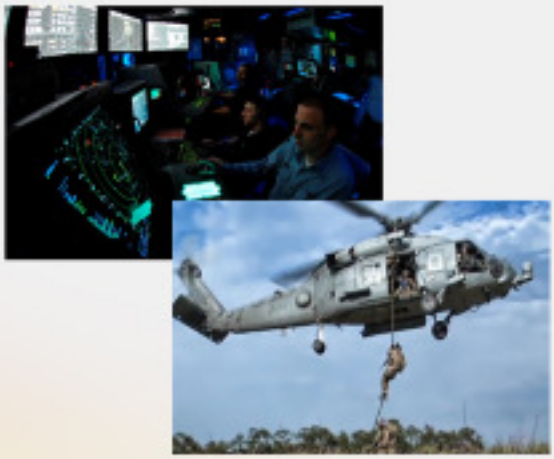

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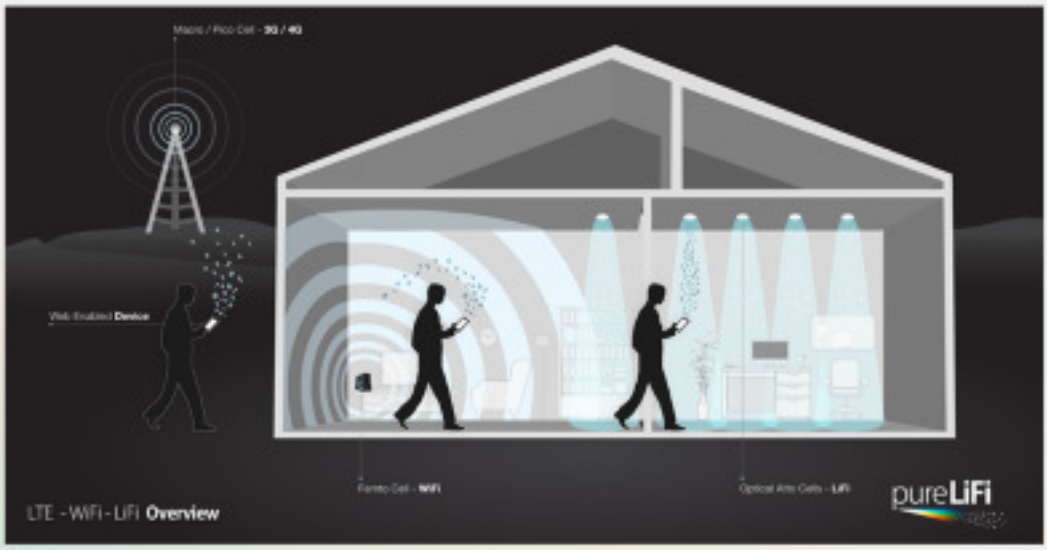
LiFi: Additional Communications Tier



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- And through such an ecosystem, LiFi will become part of the heterogeneous networks of the future, providing high-density high-speed data access, without interference to existing infrastructures.
- Handoffs between different technologies can follow similar processes as carrier-WiFi offloading, which due to the IP-based nature of modern networks becomes easier to manage
- The light network can be utilised to maintain the privacy of the network, an increasingly important attribute for future networks and the connected world

LiFi: Enlightened Communications

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pureLiFi: Our Company

*Li-1® Product

**Li-Flame Products

THE UNIVERSITY OF EDINBURGH

BOEING

ROLLS ROYCE

CISCO

Independence

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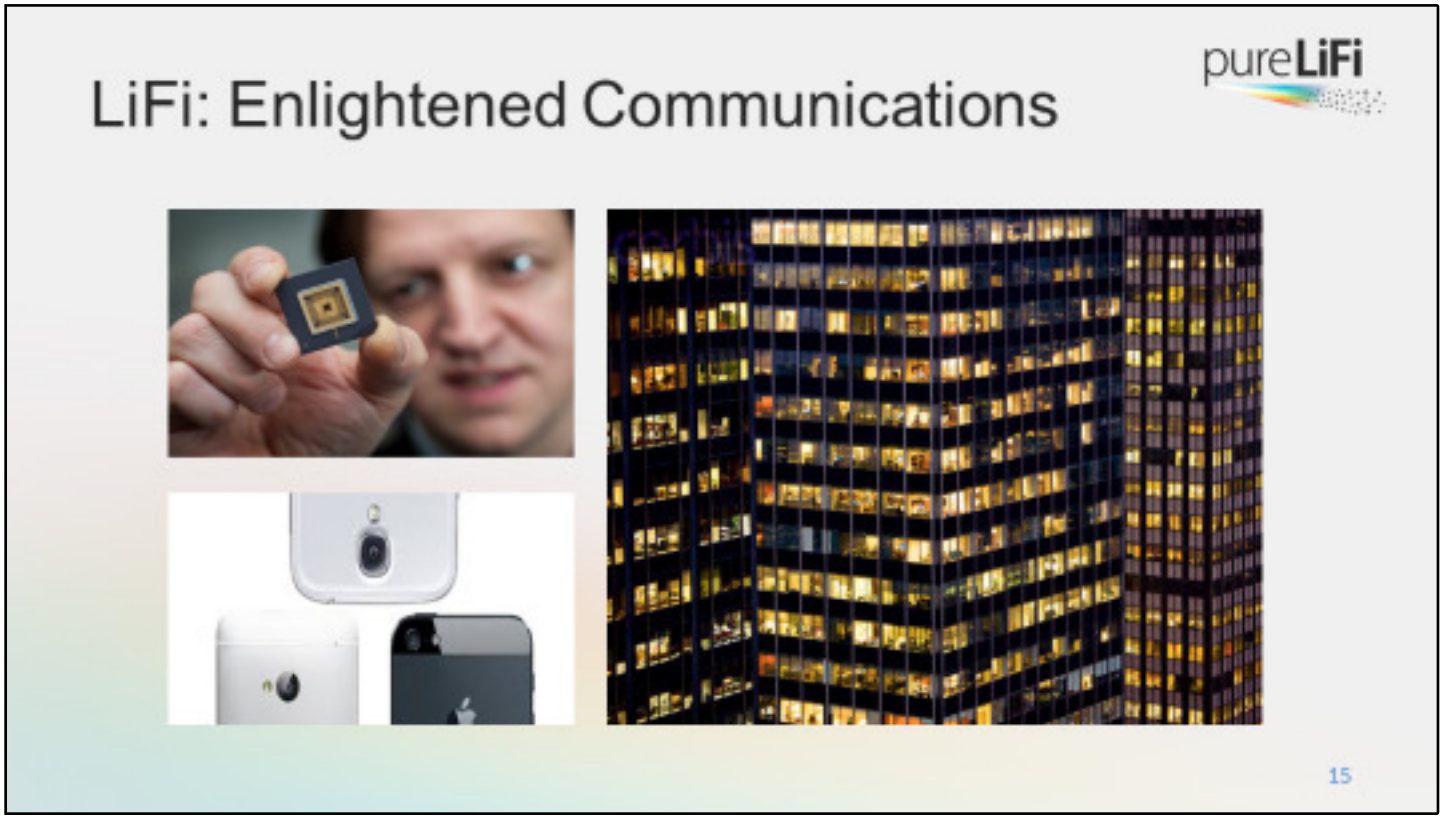

- Therefore, it is the goal of our company to develop LiFi modules, that can be integrated into every device, and every light, and make this technology as ubiquitous as its RF predecessors
    - ENLIGHTENING FUTURE COMMUNICATIONS

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Thank you for attending this presentation.

We now invite **questions** from our audience.

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