Intelligent road lighting
Bringing cities to life

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Urban population is growing by about 44 million people every year.

President Zuma: 63% of the country’s population is living in urban areas. This will increase to >70% by 2030.
Johannesburg ranks 7 of most polluted city according the economist.
2.8 billion people suffer the health risks, paltry energy services, and environmental damage due to fossil fuels.

The number of lung cancer patients has increased by 60 percent in the last ten years.
Energy demand is expected to double by 2030.
Lighting accounts for more than 19% of the world’s total electricity consumption.

With LED & Smart controls we can save up to 80%.
Within tight City Budget constraints
...and Green Targets
PHILIPS

Join the revolution to LED...NOW

... and save 60% of energy
Only 1% of installations have control systems to manage and regulate lighting usage.

Adding intelligent controls can achieve savings of between 70 and 80%.
# Intelligent lighting management systems

Moving from ‘dumb’ to ‘smart’ lighting networks

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Brings a world of Benefits

Safe energy:
• Reduced energy cost & CO2 footprint
• Reduced light pollution
• Accurate metering of the energy used
• Energy Demand schedules

Improve Safety:
• Real-time feedback/working Y/N?
• Real-time overrides
• Automated light level
  – traffic density/events/weather
Brings a world of Benefits

Keep Control

• Asset management of lighting infrastructure
• Optimize repair activity planning and reporting
• Automatic reporting of failures
How does it work...

- mesh network
- cabinet with:
  - segment controller
  - router/modem
- streetlighting with OLC’s
- managing and monitoring software
- RF
- WAN
Example: RF communication on High Tech Campus, Eindhoven

Segment Controller
Example: Average hopcount
CityTouch Live Demo
Project highlights: 190 projects in 27 countries

Our first installation
Prague, Czech Republic
- started end of 2010
- main street in a central shopping area

Our largest project
Croydon & Lewisham, London, UK
- project with 42,000 light points
- 25 years contract period

Our biggest proven savings
Salobre, Spain
- achieved energy savings of 72%
- annual savings of 29 tons CO2
• Additional energy Savings
• Increased safety
• Be in full Control
Why did Philips not select a wireless standard?

- Currently there is no wireless standard for telemanagement.
- Existing protocol solutions (incl. ZigBee) do not provide the required scalability for outdoor lighting. Max shown 100 – 200 nodes per segment controller → not designed for outdoor lighting.
- Therefore, Philips developed the StarSense Wireless protocol, allowing at least 10x more OLCs per segment controller.

![Diagram showing wireless standards comparison](image.png)

**Philips' choice** for robustness and scalability:

- **telemanagement application**
  - ZigBee
  - 802.15.4 2.4 GHz
  - other solutions

- **StarSense Application Protocol**
  - 802.15.4 sub-GHz
  - limited robustness
  - limited scalability

- **other solutions**
Why did Philips not choose 2.4 GHz?

Reason for Philips to go for sub-GHz wireless communications:

- Wireless transceivers operate under transmitter power limitations
- **Basic physics**: higher frequency = lower range
  → 3 times higher frequency, 3 times shorter range (2.4 GHz vs 0.8 GHz)
- Mesh networks get more robust with higher range of single hop
  - accidents
  - end of life / failure
  - fading
- Philips Research experiments show that at:
  - 868 MHz: 5 to 9 neighbors on one side
  - 2.4 GHz: 1 to 3 neighbors on one side → less robust
What is the risk for interference?

Reason for Philips to go for sub-GHz wireless communications for outdoor network:

• Wireless communications in open bands is prone to interference of other wireless systems
• 2.4 GHz: worldwide available and hence used by many products: WiFi, Bluetooth, ZigBee, etc.
• Interference has shown to have large impact on ZigBee
• Sub-GHz much less used → less impact of interference
Why has been chosen for a mesh network?

- Mesh networks use forwarding to create large network range
- This is used to create range and robustness
- Most optimal for city deployments
- Suitable for highways when correct choices are made:
  - communication range of nodes
  - interference robustness
  - scalability
  - security
How is the wireless communication secured?

- Wireless communication is easily accessible and hence several security threats exist
- Need to safeguard performance of the telemanagement system

Philips solution:

| Secure deployment and commissioning | To prevent the addition of malicious devices in the system. |
| Encryption of data | To prevent eavesdropping on the communications in the system |
| Authentication | To prevent unauthorized people and devices to control and disrupt the network |
| Secure software updates | To prevent hackers from uploading non-functional or adding malicious software |
What are the technical specifications?

- **Radio resolution:**
  - Standardized sub-GHz chipset (868/9xx/yyy) based on Philips NWK layer, MAC layer, 802.15.4 PHY and 802.15.4 compliant hardware

- **Temperature range components:** -40C/-30C to +55C/+75C

- **Security:** advanced encryption standard at 128-bit security level

- **Lifetime:** 80.000/110.000 hours with less than 10% failures

- **Accuracy integrated power meter:** >98%

- **System performance:**
  - < 10 sec for local override
  - < 30 sec for failure detection

- **System backup:** wireless OLC stores log information up to 5 days

- **Regulations:** RoHS, REACH, ENEC, and CE compliant
Pictures of the various components

OLC

Segment Controller

Antenna

Segment Controller

Dimensions (unit = mm)

52 mm

112.6 mm
Commissioning a system in 4 steps…
Commissioning procedure: STEP 1

• If available, upload Light Plan in Outdoor Configuration Assistant
  – For example:
    • Pole numbers/names
    • GPS coordinates
    • Lamp type
Commissioning procedure: STEP 2

• Every OLC has a unique identification, readable through a barcode

• Collect OLC information using the Outdoor Configuration Assistant:
  – GPS location
  – Scan barcode
  – Enter system information (lamp, driver, OLC)
Commissioning procedure: STEP 3

- Copy XML file from Outdoor Configuration Assistant to computer
- Start CityTouch and upload file
Commissioning procedure: STEP 4

- Create switch on, switch off and dimming schedules
- Assign dim schedules to specific days
... the wireless OLC functionalities

- Registration of burning hours
- Real energy consumption
- Lamp failure detection (DALI)
- System failure detection
- Switch power on/off
- Multi-level dim schedules
- Line voltage registration
- Time clock
- Stand-alone operating
- Delayed switching (avoid high inrush current)
… the wireless OLC

- Easy to integrate: small size, 20 mm
- Multiple interfaces: 1-10V and DALI
- Long lifetime: 80,000/110,000 hrs
- Long range communication (up to 300m/1000 ft)
- Scalable network: up to 4000 lightpoints
- Secure communication
- Integrated power metering: >98% accuracy
- Power switched by relay
- Reliable operation through mesh network
- Over-the-air software upgradeable
… the segment controller (kit)

- Mountable on DIN rail in cabinet in lightpole or on the ground
- Software pre-loaded
- Scalable network: up to 4000 lightpoints per segment controller
- Secure communication
- Connectivity to ethernet via modem for data transfer
... easy and fast commissioning

- Possibility to upload light plan customer (XML, CSV-files)
- Easy and fast on-site installation
  1. Bar code scanning of OLC
  2. GPS positioning of OLC
  3. Local refinement of position on street maps
- Full remote, automatic commissioning
  - Upload of lightpole positions
  - Default scheduling
  - Custom creation of schedules