Make Internet-enabled, energy-efficient lighting networks a reality

This complete hardware/software solution enables IP connectivity, where every light bulb has its own IP address, so you can create advanced lighting systems that are easily controlled by IP-enabled devices like smartphones, tablets, and PCs.

**Key features**

- Flexible, cost-effective software solution
- IP-enabled smart lighting system with JenNet-IP software stack
- Future-proof development with “Over-Network-Download” capability
- Supports standalone network operation with simple, secure commissioning using a remote
- (Ultra-)low standby power when lamp is off
- Multiple control options

By bringing together wireless IP connectivity, energy-efficient lighting, and low-power standby operation, NXP’s GreenChip smart lighting solution makes the lighting network system of the future a reality today.

The GreenChip smart lighting solution comprises the GreenChip iCFL or the GreenChip iSSL module reference designs providing a low-cost, wireless solution for smart lighting networks that use CFL and SSL lamps respectively. The module enables high-efficiency luminary operation with ultra-low standby power (down to 50 mW). The hardware components are complemented by NXP’s JenNet-IP software stack, which provides true IP connectivity. Every light bulb has its own IP address, so the system can be controlled by smartphones, tablets, PCs, and other IP-enabled devices.

GreenChip smart lighting offers new ways to control lights and manage energy consumption as well as new usage models, making the Internet-enabled, energy-efficient lighting network now a reality – not only for consumers in the home but also for commercial applications. This provides clear proof-of-concept for the “Internet of Things” – a world in which every home appliance can be monitored and controlled via an IP address.

GreenChip smart lighting solutions are complete and flexible solutions that consist of high-performance chipsets featuring highly efficient and dimmable smart lamp drivers such as the UBA2027 and the SSL21081. It also includes the TEA1721, an ultra-low power standby supply controller with a no-load capability of just 10 mW, and the JNS14x, which integrates a low-power RF transceiver compatible with the IEEE 802.15.4 standard with a 32-bit microcontroller that has receive currents as low as 17.5 mA.
The chipset is combined with the robust JenNet-IP network protocol stack, which offers small code size and supports a truly cost-effective design. The solution is complemented by a full set of reference designs and related Bill-Of-Materials (BOM) covering a wide range of applications. Other software stacks, including ZigBee, are available as options.

The GreenChip smart lighting solution allows for multiple control options including RF remote controls and battery-powered switches for use in a standalone network. The very low-power performance of the JN514x enables battery lifetimes exceeding 10 years from a coin cell, and supports the use of battery-less, energy-harvesting switches.

Beyond these more conventional control options, the JenNet-IP SW stack allows the system to be controlled by smartphones, tablets, or PCs. This functionality is enabled via low-cost gateways, providing control either via the Internet or the Local Area Network (LAN). This makes GreenChip iCFL and GreenChip iSSL solutions for everyone from consumers in the home to professional users working with Building Management System (BMS) applications.

GreenChip (iSSL and iCFL) smart lighting solutions

- (Ultra-)low standby power when lamp off
  - ~ 50 mW with JenNet-IP SW stack & low power option
  - ~ 150 mW with Zigbee SW stack
- Low cost option with linear instead of buck supply
- Low BOM cost (ICs, external components, PCBs)
  - Lowest cost with JenNet-based software stack and linear supply
  - ~ 20% cost adder for Zigbee software stack due to larger memory footprint RF chip
- Flexible solution due to full range of NXP lighting drivers, AC/DC converters, and high-performance, IEEE 802.15.4 single-chip transceivers and MCUs
  - UBA207x CFL-family, SSL21xx SSL-family, UBA201x TL-family, both standalone controllers as with integrated power FET
  - 100/120 and 230 V solutions
  - Various power ranges (5 to 150 W)
  - Isolated and non-isolated (flyback and buck topologies)
  - Deep dimmable down to 2% by RF remote control, switch, or IP device
  - Triac tolerant and on-off control by triac
  - JN5142 for JenNet(-IP) and JN5148 for ZigBee SW stacks
- Multiple control options
  - Battery-powered switches and RF remote control with >10 years battery lifetime
  - Dual-boot option for remote (e.g. running both RF4CE and JenNet/ZigBee protocols)
  - Battery-less energy harvesting switches
  - PCs, tablets, smartphones, etc. via gateway
- Supported software stacks and size (excluding application)
  - JenNet-IP and application-specific options ~ 96 kB
  - JenNet standard ~ 50 kB
  - ZigBee Home Automation ~ 128 kB
  - ZigBee Green Power ~ 10 kB
### Low-cost and low-power solutions

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<tr>
<th>GENERAL</th>
<th>Low-Cost Solutions</th>
<th>Low Power Solutions</th>
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<tr>
<td>BOM cost electronics (Ics + external comp. + PCB)</td>
<td>Low, Small</td>
<td>Medium, +10-15% Medium, High, +20-30% Medium</td>
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<tr>
<td>Size</td>
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| HARDWARE | | |
| RF radio & MCU | JN5142 UBA2027 SSL2108 | JN5142 UBA2027 SSL2108 |
| Lamp driver CFL Lamp driver SSL | Linear supply | Buck converter e.g. TEA1721 |
| ACDC standby supply | | |

| NETWORK SOFTWARE | | |
| Network stack & Application Profile | JenNet-IP¹ 85 kB Star, Tree Yes Yes | JenNet-IP¹ 85 kB Star, Tree Yes No |
| Code size (stack only) | | | Zigbee Pro HA Zigbee SmartLight 128 kB Star, Tree, Mesh Yes No |
| Network Topologies | Star, Tree | Star, Tree, Mesh | |
| Network Self-healing Low Power routing option | Yes | No |
| Standby Power - 110 V - 220 V | <250 mW² | <50 mW² | <150 mW |
| | <450 mW² | <50 mW² | <150 mW |

¹ 6LoWPAN + JenNet
² Low Power routing option with 10% duty cycling

### iCFL Smart Lighting solution

**Dimmable CFL lamp driver UBA2027**
- Universal mains compatible
- Integrated bootstrap diode
- Triac dimmable, down to 1%
- Step dimming option
- Fast start-up adjustable down to 100 ms
- Boost function for faster light output run-up
- Longer lifetime with adjustable preheat, >15 k hours
- 5% higher energy efficiency
- Extensive protections
- SO16 package

**5 W low-power SMPS regulator with ultra-low-power standby TEA1721**
- No-load power consumption 10 mW
- Universal mains compatible
- Integrated 700 V powerFET
- High efficiency over full load range
- Primary sensing, eliminating need for opto-coupler
- Jitter for reduced EMI
- Minimizes audible noise
- Extensive protections
- SO7 package

### iSSL Smart Lighting solution

**15 W dimmable SSL2108 LED lamp driver**
- 100 to 120 V mains
- True constant-current source
- PWM dimmable
- Buck mode, efficiency >95%
- NTC temperature feedback
- No LED forward voltage required
- Low BOM cost and small size
- Extensive protections
- SO8 package

**IEEE 802.15.4 wireless microcontroller JN5142/48**
- 2.4 GHz IEEE 802.15.4 compliant
- Low operating power: 15/17.5 mA Tx/Rx
- Low sleep current: 0.1 µA deep sleep with IO-wake-up, 0.5 µA with timer running
- 98 dB link budget
- 128-bit AES encryption security processor
- Various MAC accelerator functions
- High-performance 32-bit, 32 MHz RISC CPU
- 128 kB ROM, 32/128 kB RAM
- Extensive set of peripherals, including I²C, SPI, UART, ADC, DAC, PWM, timers, GPIO
- Capacitive touch-sensing capability
- On-chip temperature sensor
- QFN40/56 package
JenNet wireless network protocol stack

This stack is used to manage the following: network formation, the execution of join and repair functions, and packet transmission between nodes.

- Based on IEEE 802.15.4 MAC and PHY and 6LoWPAN IPv6 IETF standard, backwards compatible with IPv4
- Highly robust, easily scalable, mesh-under star, tree, and linear network topology proven at over 500 nodes
- Gateway and non-gateway options for connecting to the internet (via low cost ethernet-15.4 IP-bridge) or standalone operation
- Automatic route formation and self-repair to prevent single-points-of-failure and network re-shaping functionality to reduce network ‘depth’ and latencies
- IP / ICMP / UDP Internet Protocol stack
- Easy-to-use MIB- and SNMP-model based SNAP application API tuned for extensible sensing/control
- Provides real end-to-end communication between nodes, eliminating all issues associated with intermediate expensive and power-hungry Home Automation gateways like increased latencies, security issues, limited feature visibility & expandability and state integrity
- Highly secure authentication & device joining and secure communication with 128-bit AES encryption, simple commissioning of standalone networks with a remote with reduced radio performance during key exchange
- Future proof with “Over-the-Network” download functionality for firmware updates
- Sleeping end-devices for extended battery life
- Co-existence with Bluetooth and Wi-Fi
- Low-power option for applications requiring low standby power
- Low cost of ownership: small memory footprint ~ 85 kB, low development cost, low complexity, license-free, compliance-free