

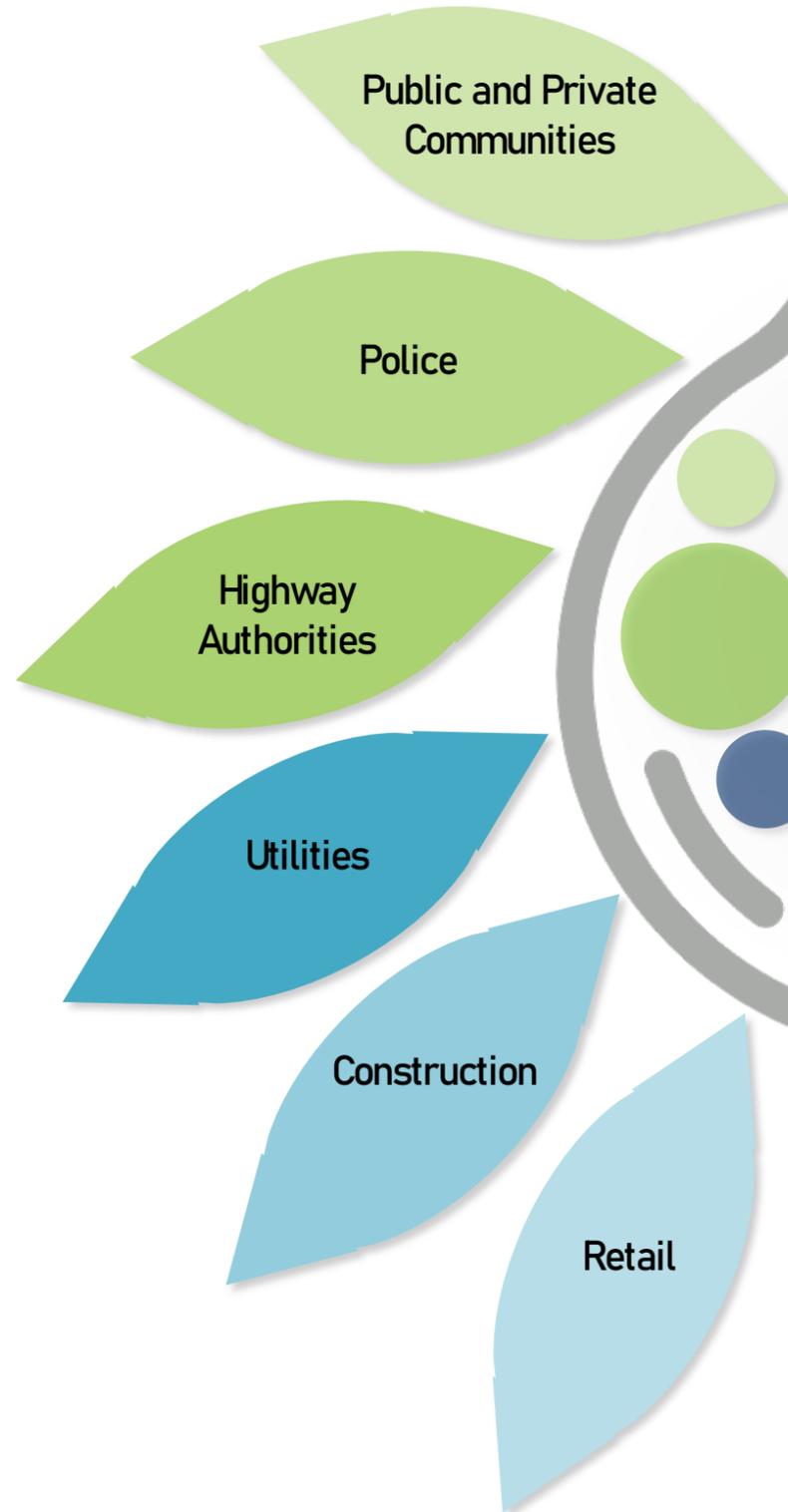


Lighting the Way

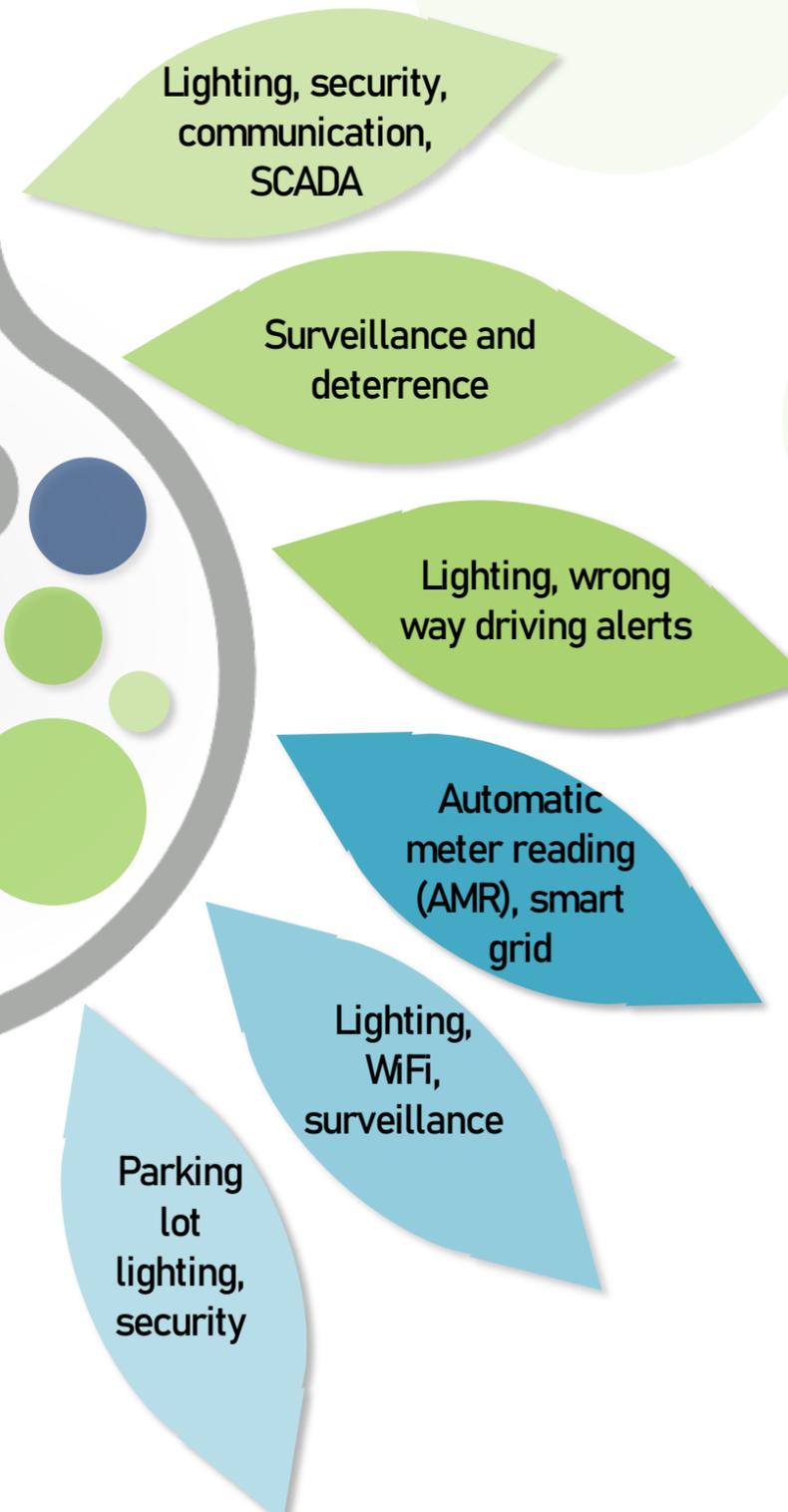
November, 3rd 2020

Applications

Customers



Applications



Apollo Communication Options

Using street lights as ubiquitous universal technology platform



Light Control

- 150/220/450/900MHz direct ISM/LMR
- WiFi/Bluetooth



Cameras

- Ethernet
- Fiber
- WiFi
- LTE
- DVR/LTE



Gateway

- Ethernet/fiber
- WiFi



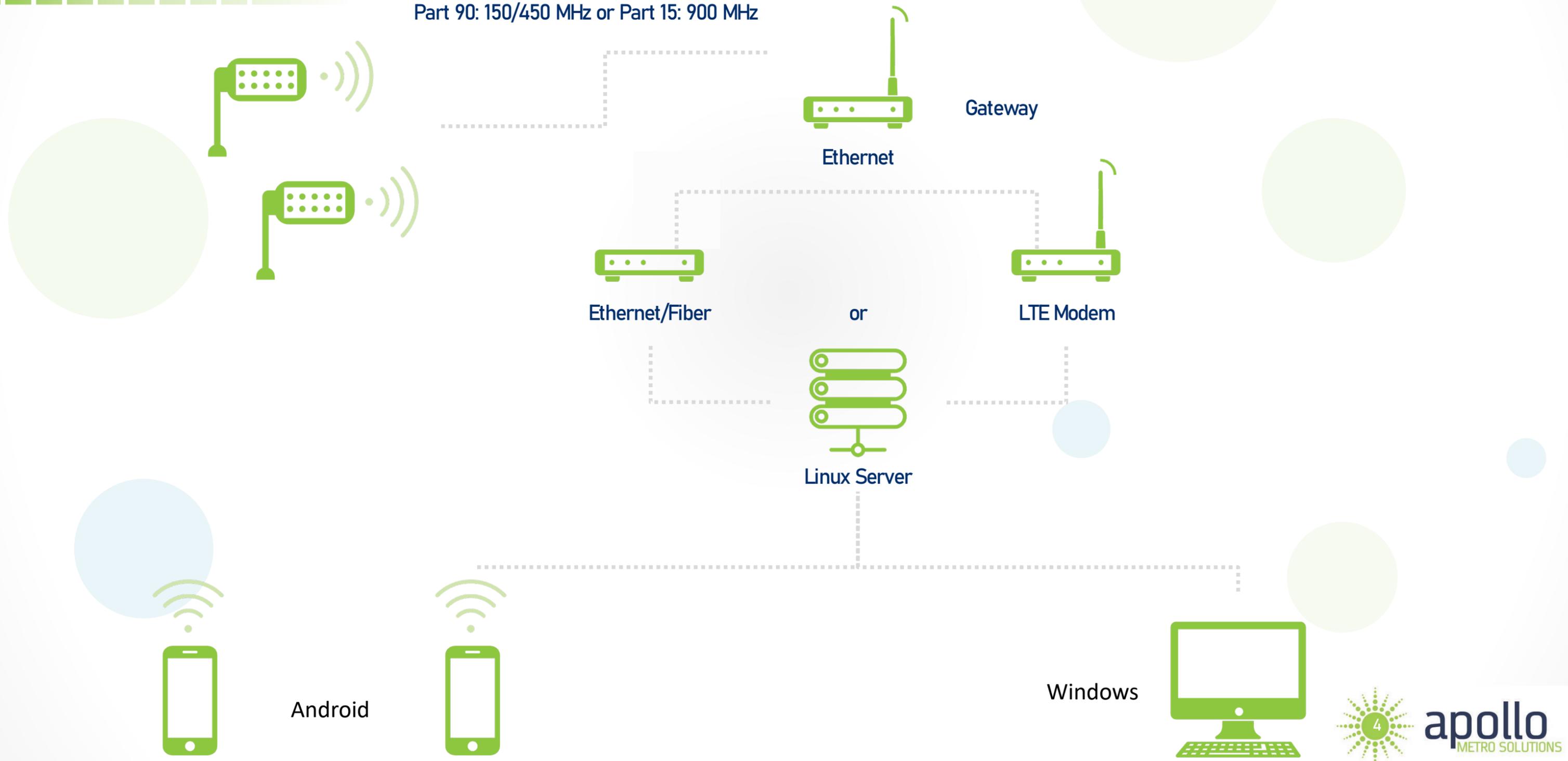
Software

- Gateway dashboard
- Lighting server Dashboard (Browser/Android app)
- Radio configuration (Windows/Android App)
- Video dashboard



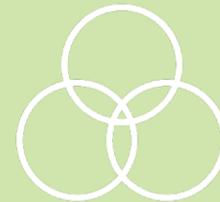
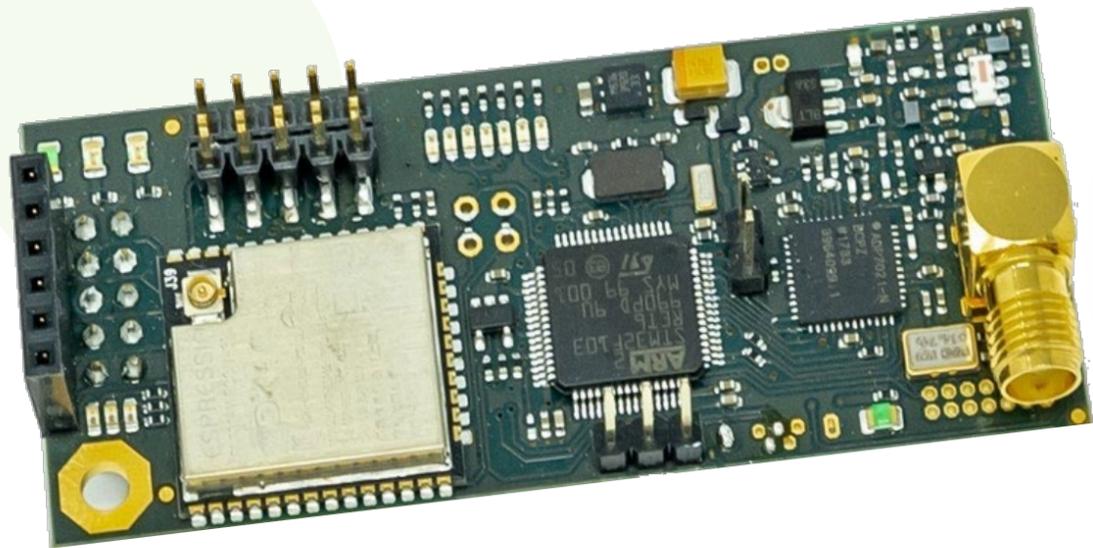
Using Street Lights as Ubiquitous Universal Technology Platform

Part 90: 150/450 MHz or Part 15: 900 MHz



Light Control

The Apollo lights contain a microcontroller which controls the LED driver, reads LED temperature, voltage and current and distributes power to the LED boards.



It also controls 3 color LEDs on the LED board which show the status of the light and the radio, visible under the installed light. This board is called the triple power board.

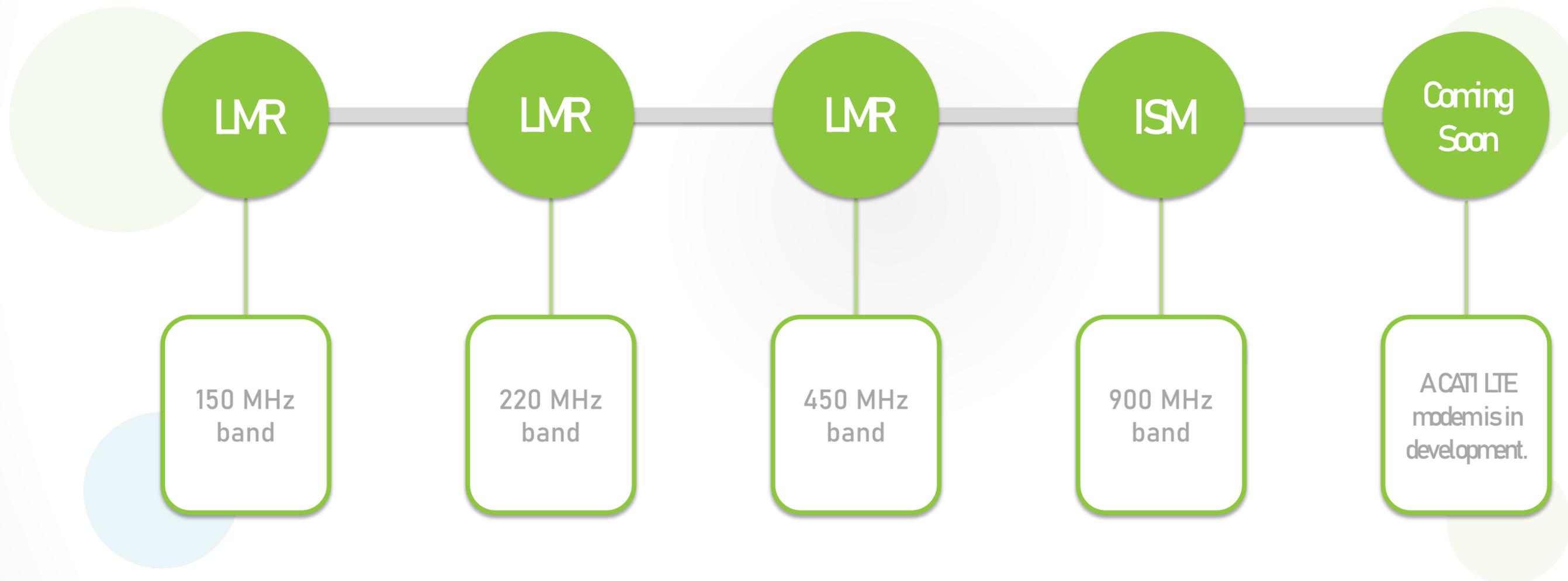


The triple power board can be powered by the aux power of the LED drive or by a separate 5W power supply, depending on the configuration.

The Apollo Metro radio module is plugged into the triple power board which controls all functions of the street light.

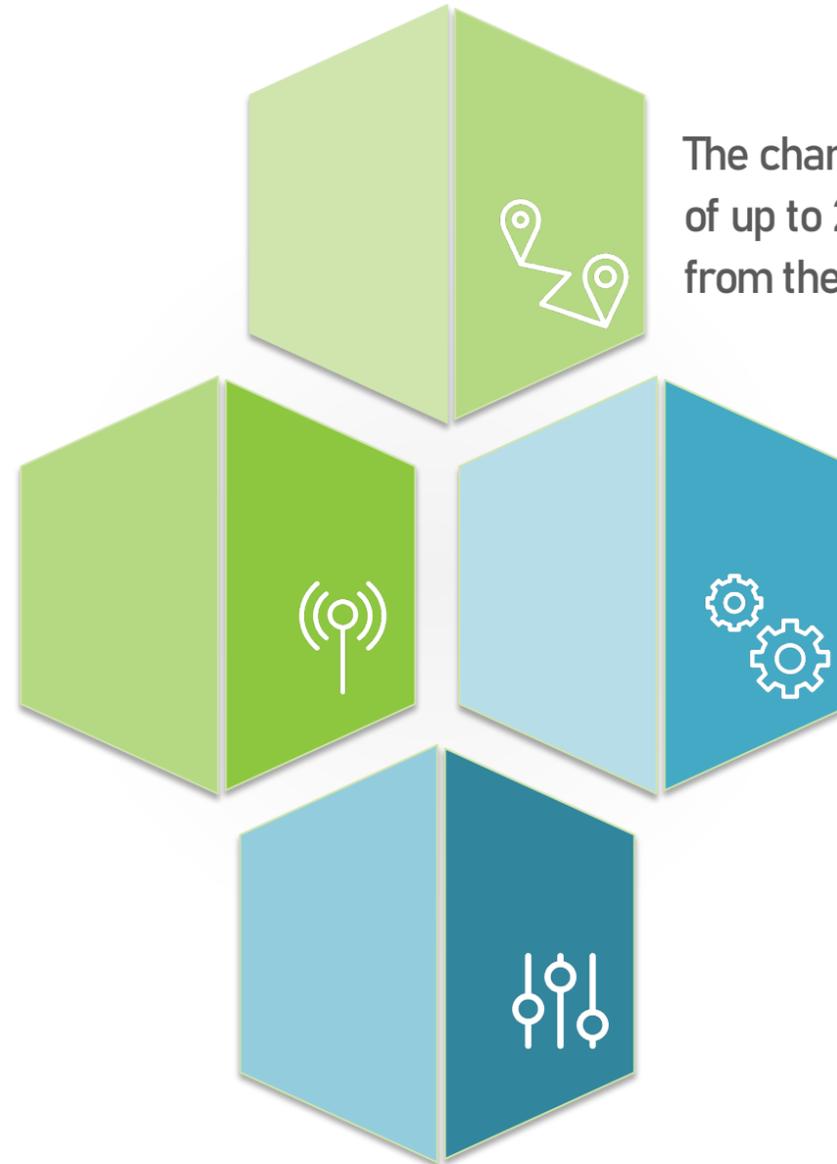
Light Control: Apollo Radio Module

There are 4 versions of the radio module available:



Light Control: Apollo Radio Module Cont'd.

The radio board has an optional serial interface as well as an optional Ethernet interface to communicate with other devices in or around the light. It also has a 2.4 GHz Radio which can be configured as a WiFi access point, a WiFi client or as a bluetooth radio.



The channels can be 6.25 or 12.5 kHz wide, with an output power of up to 2W RF out. This allows a control range of over 10 miles from the control Gateway to the light.

This 2.4 GHz module is used for the initial setup of the light and the radio in the field, using an Android tablet. There are many parameters which can be set. The setup screen has a simplified standard mode and a password protected expert mode.

The radio can also be switched into a digital LMR radio mode, supporting several modes, such as P25 or DMR. The radio connects via Ethernet or WiFi to a central reflector system which in turn connects to the existing base station repeaters of the network.

Gateway



The Apollo Metro Server **collects data from the Gateway**, using an MQTT based protocol. It is running on an Ubuntu server and can be **accessed from Windows and mobile Android devices**.

The Apollo Server uses an **SQL data base** which collects **all collected data**, it also holds a **reference table** which logically links the luminaire addresses to circuit and pole numbers as well as longitude and latitude for a graphical representation of the information collected.

Server

The Apollo Metro Gateway is the interface between the Apollo Metro Radios in the street lights and the central control server.

One Gateway can handle over 1000 lights. With an output power with up to 25W it controls devices up to 20 miles away.



The Gateway has a broadcast mode. In this mode, commands (such as dimming at midnight) can be sent to all lights or group of light simultaneously.

The radio connects either to an Ethernet or Fiber to the central control server or, alternatively through a VPN via a cellular LTE modem.



The other mode is the polling mode, which is used to check on each light sequentially, collecting values such as power, voltage, temperature. Each light is checked multiple times per night.



Multiple Gateways can share one antenna, using duplexers. Typical extended dipole antennas with 4 dipoles are recommended.

Communication Options for Apollo Street Light Cameras

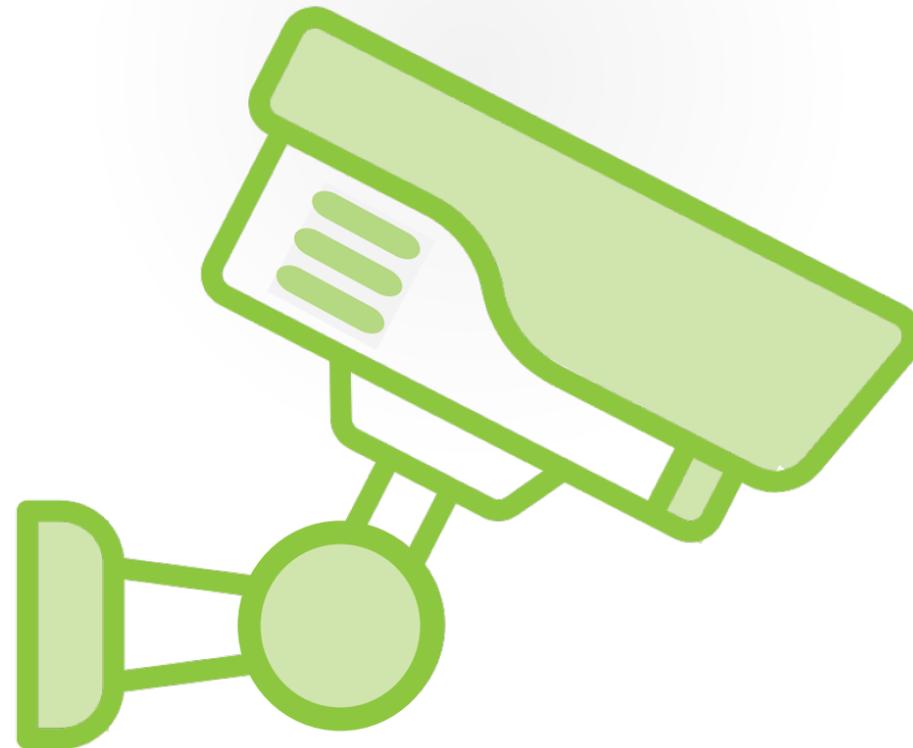
Apollo street light cameras have an Ethernet interface, which supports different video protocols mainly ONVIF and http. As the range of an Ethernet cable is limited to 300ft (100m), other media for backhauling have to be implemented, depending on the topology of the respective project. The following text discusses several options, which are by no means complete, but give an overview of the possibilities.

Ethernet

When the **street lights are within 300ft** of a building, or outdoor NEMA box, they can be **connected to an Ethernet switch which is then connected to a digital DVR**. This is the most simple solution and works very reliably on parking lots, when the Ethernet cable can be routed through an existing conduit.

Cable

When the **camera street lights are near a cable modem** (which can be installed outdoors in a NEMA box) the **Ethernet cables are connected to a VPN router mirrored by another VPN router on the central side**. Keep in mind, the uplink speed of the cable modem is relevant, not the downlink speed! A typical HD stream is 2 Mbit/s, a 4k stream about 4 Mbit/s. To have some reserve, 15MBit/s is a good number.



Wifi

When existing parking lot lights are replaced, it is often not possible to route Ethernet cable to the main building. In this case, the street light cameras can be connected via WiFi. **Apollo offers camera lights with Ubiquiti bullet radios**, which support both 2.4 GHz and 5 GHz bands, with protocols up to 802.11ac. **The street lights can directly connect to the WiFi** of the next building, which often exists, or to an outdoor Ubiquiti AP, which might be installed on the roof for better coverage.

Communication Options for Apollo Street Light Cameras

Apollo street light cameras have an Ethernet interface, which supports different video protocols mainly ONVIF and http. As the range of an Ethernet cable is limited to 300ft (100m), other media for backhauling have to be implemented, depending on the topology of the respective project. The following text discusses several options, which are by no means complete, but give an overview of the possibilities.

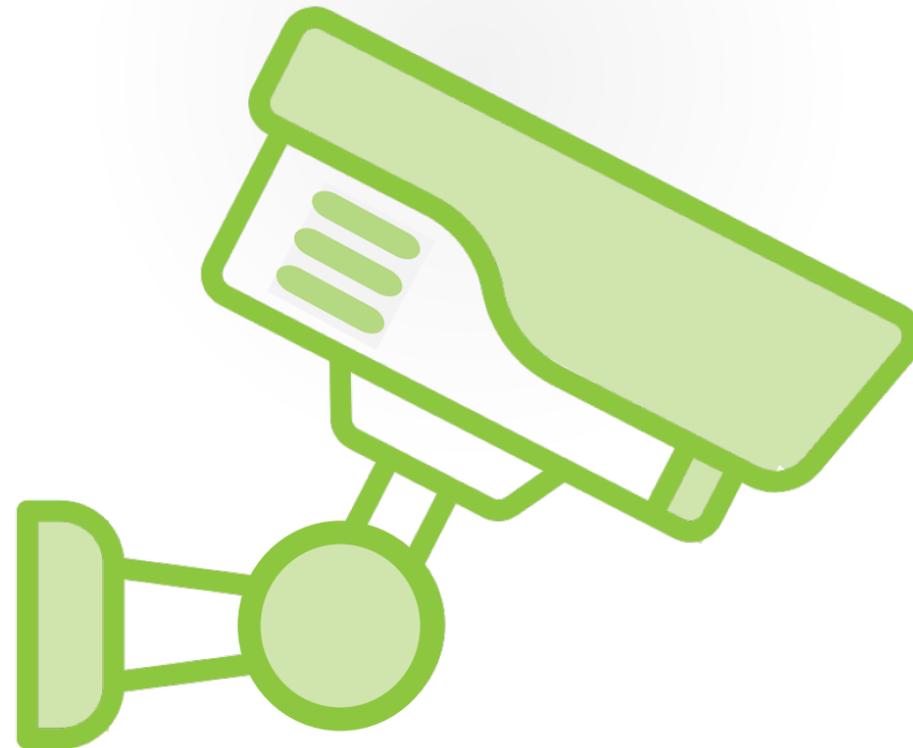
LTE

On remote sites, such as construction sites, there is often no internet link available. Apollo offers camera lights with built in LTE modems which overcome this obstacle by using cellular internet connectivity.

Our sister company, M2M Dynamics (www.m2m-dynamics.com) offers complete VPN solution, including carrier data connectivity, VPN service and maintenance. However, keep in mind that the amount of data in a video stream is very high, which leads to a high monthly cost for such a link.

There are several solutions to manage this:

- Lowering the resolution
- Transmitting the amount of frames per second
- Establishing the VPN on demand only



LTE/DVR

Another way to overcome the problem of cellular overload is to include the DVR in the street light camera. Apollo offers DVRs with 128/256GB memory cards and 4 analog inputs with HD resolution, an LTE modem and a GPS receiver to show the location of the street light camera on a map.

During regular operation, a low resolution frame is transmitted per second, leaving the data stream under 100 kB/s. If an alarm occurs the DVR can be accessed remotely and a high resolution stream of the event can be downloaded.

The DVR can also act as a SIP speaker phone, a microphone and a speaker can be installed in the pole. Additionally, there are digital I/O lines available to be connected to actors and sensors around the camera street light on a project-specific base.

Software: Gateway Dashboard

The screenshot displays the Apollo Metro Gateway Dashboard in a web browser. The browser address bar shows the URL 192.168.12.70. The dashboard header includes the text "APOLLO METRO" and "19219088". Below the header, there is a control panel with a slider for "Lum 10 - 100%" and buttons for "Set Lum" and "ON/OFF". The main area contains a table with 15 columns: NR., Update Time, My ID, My Gateway, My Group, Temp Board, Temp LED-Board 1, Temp LED-Board 2, Temp LED-Board 3, Current, Voltage, Lum in Percent, RSSI, ON/OFF, Lum 10 - 100%, and SET Lum. The table lists 8 rows of data. At the bottom of the dashboard, there are three buttons labeled "home", "setup", and "update".

NR.	Update Time	My ID	My Gateway	My Group	Temp Board	Temp LED-Board 1	Temp LED-Board 2	Temp LED-Board 3	Current	Voltage	Lum in Percent	RSSI	ON/OFF	Lum 10 - 100%	SET Lum
1	0	2	0	1	0	0	0	0	0 A	0 V	0 %	124	ON OFF		SET
2	2.11 11:31	3	0	1	30.2	40.7	0.0	0.0	2.8 A	45.3 V	90 %	68	ON OFF		SET
3	2.11 15:51	4	0	1	28.8	0.0	0.0	0.0	45.6 A	0.0 V	90 %	79	ON OFF		SET
4	2.11 11:31	5	0	1	30.8	39.6	0.0	0.0	3.0 A	45.5 V	90 %	67	ON OFF		SET
5	2.11 11:29	7	0	1	30.6	39.2	0.0	0.0	2.7 A	45.2 V	90 %	70	ON OFF		SET
6	2.11 11:28	10	0	1	31.1	41.8	0.0	0.0	2.8 A	45.4 V	90 %	68	ON OFF		SET
7	2.11 11:29	12	0	1	30.3	43.0	0.0	0.0	2.9 A	45.3 V	90 %	82	ON OFF		SET
8	2.11 13:28	14	0	1	31.9	0.0	0.0	0.0	56.2 A	0.0 V	90 %	83	ON OFF		SET

Software: Lighting Server Dashboard Windows

apollo METRO SOLUTIONS

Apollo Metro Gateway - Server

home master system inventory gateways sLog shell logout

Map 19219088-Naples Gateway apollo

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	2	1	124/0 ₂	32 F ₂	32 F	0.0 A	0.0 V	0 W	0 %	0 %	87/3113	50	0	19219192	SL5-2
2	SetLum	offline ₂	3	1	68/67 ₂	86.36 F ₂	105.26 F	2.8 A	45.3 V	126.84 W	90 %	90 %	86/3106	50	2.11 11:31	221124072	SL5-2
3	SetLum	online ₂	4	1	82/78 ₂	82.4 F ₂	32 F	25.6 A	0.0 V	0 W	90 %	90 %	85/3112	1	2.11 14:51	28088176	SL5-2
4	SetLum	offline ₂	5	1	67/62 ₂	87.44 F ₂	103.28 F	3.0 A	45.5 V	136.5 W	90 %	90 %	84/3105	50	2.11 11:31	19236052	SL5-2
5	SetLum	offline ₂	7	1	70/68 ₂	87.08 F ₂	102.56 F	2.7 A	45.2 V	122.04 W	90 %	90 %	82/3104	50	2.11 11:29	222183120	SL5-2
6	SetLum	offline ₂	10	1	68/68 ₂	87.98 F ₂	107.24 F	2.8 A	45.4 V	127.12 W	90 %	90 %	79/3109	50	2.11 11:28	223064132	SL5-2
7	SetLum	offline ₂	12	1	82/69 ₂	86.54 F ₂	109.4 F	2.9 A	45.3 V	131.37 W	90 %	90 %	77/3108	50	2.11 11:29	234078128	SL5-2
8	SetLum	offline ₂	14	1	83/78 ₂	89.42 F ₂	32 F	56.2 A	0.0 V	0 W	90 %	90 %	75/3100	50	2.11 13:28	222101132	SL5-2

Map 221152036-Markus Gateway - 1

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	1	1	50/53 ₂	79.88 F ₂	70.16 F	0.5 A	42.4 V	21.2 W	10 %	10 %	Gartenhaus 1/0	50	2.11 07:00	221213156	SL5-2
2	SetLum	online ₂	2	1	47/47 ₂	79.7 F ₂	67.64 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Gartenhaus 2/0	2	2.11 14:51	223172032	SL5-2
3	SetLum	online ₂	3	1	47/55 ₂	81.14 F ₂	68.54 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Gartenhaus 3/0	4	2.11 14:49	222239212	SL5-2

Map 223032100-Markus_Gateway - 2

NR	SETALL	Status ₂	My ID	Group	RSSI ₂	Board ₂	LED ₂	Current	Volt	Watt	Percent	soll Percent	pole	V.T	last Update	Lamp ID	Type
1	SetLum	offline ₂	1	1	47/47 ₂	83.12 F ₂	71.6 F	0.1 A	0.1 V	0.01 W	0 %	0 %	Labor 1/0	360	2.11 11:23	222177016	SL5-2
2	SetLum	offline ₂	2	1	47/0 ₂	32 F ₂	32 F	0.0 A	0.0 V	0 W	0 %	0 %	Labor 2/0	150	0	222222068	SL4

Gateway Aktive: 3 lights Aktive: 4 11.02.2020 - 09:52 Uhr GW SERVER RUN Version: 20201217

Software: Lighting Server Dashboard Windows

The screenshot displays the Apollo Metro Gateway - Server dashboard. The browser address bar shows the URL `ap.dvrptr.de/gw_server/`. The dashboard header includes the Apollo logo and the title "Apollo Metro Gateway - Server". Below the header is a navigation menu with buttons for "home", "master", "system", "inventory", "gateways", "sLog", "shell", and "logout".

The main content area features a map of Radio Road. A tooltip for "RADIO RD Pole:84" is visible. The map shows several green dots representing active gateway locations and red dots representing active light locations. The map includes labels for "Radio Road", "CR 856", "Industrial Boulevard", "Corporate Square", "Wells Fargo", "Collier County Tower", "My Florida Green", "Airport Pulling Road", and "Donna Street".

The dashboard footer contains the following information:

- Gateway Aktive: 3
- lights Aktive: 3
- 11.02.2020 - 10:20 Uhr
- GW SERVER RUN
- Version: 20201217

Software: Lighting Server Dashboard Windows

apollo METRO SOLUTIONS

Apollo Metro Gateway - Server

home master system inventory gateways sLog shell logout

street lamp Profile 221124072

Data					
My_ID	Group	Device_ID	pole	type	serialnr
3	1	221124072	86/3106	SL5-2	221124072

technical data					
channel	Gateway	max Temp	max Volt	max Ampere	Percent
0	19219088	73.7	45.4	2.9	93

Map

Leaflet | © Apollo

Gateway Aktive: 3 lights Aktive: 3 11.02.2020 - 10:25 Uhr GW SERVER RUN Version: 20201217

Software: Lighting Server Dashboard Windows

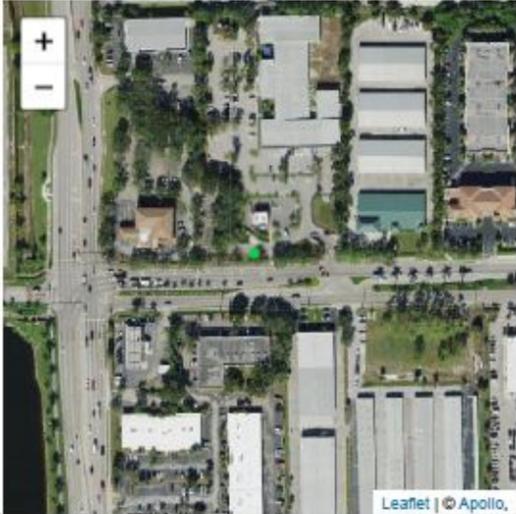
http://ap.dvrptr.de/gw_server/123/lp.php?Light=221124072

street lamp Profile 221124072

Data					
My_ID	Group	Device_ID	pole	type	serialnr
3	1	221124072	86/3106	SL5-2	221124072

technical data					
channel	Gateway	max Temp	max Volt	max Ampere	Percent
0	19219088	73.7	45.4	2.9	93

Map



1 of 1

02-Nov-20, 10:26

Software: Radio Configuration Android

The screenshot shows a web browser window displaying the APOLLO METRO interface. The browser's address bar shows the URL 192.168.4.1. The interface has a dark theme and displays the following information:

- Version: 2.0.1.8 - 20201069
- Device ID: 80:1F:12:5A:D7:77
- MAC Address: 222000028
- Section: **local light control**
- Table with columns: MyID, My Group, My Gateway, Temp Board, Temp LED, Voltage, Current.
- Current status: 90% (indicated by a green slider bar)
- Control buttons: ON, OFF, flash, SET
- Footer navigation: home, setup, update

MyID	My Group	My Gateway	Temp Board	Temp LED	Voltage	Current
4	1	0	27.22	0.00	0.00	12.49

Software: Radio Configuration Android

The screenshot displays the APOLLO METRO web interface for radio configuration. The browser address bar shows the URL 192.168.4.1. The page title is APOLLO METRO. The interface includes a header with version information (2.0.1.8 - 20201069) and a MAC address (.80:1F:12:5A:D7:77). The main content area contains a table of configuration parameters:

rxFrequency / txFrequency	channel 1 - 451.3625 MHz
RF Power	255
My_ID	4
My_group	1
Server_ID	0
GatewayModus	OFF
LightType	TriplePower
timezones	(GMT) Western Europe Time, London, Lisbon, Casablanca
StartLumination	90

Below the table is a red **SAVE** button. At the bottom of the interface, there is a navigation bar with three buttons: **home**, **setup** (highlighted in yellow), and **update**. An **Expert** button is also visible below the table.

Software: Video Dashboard



Software Data Base



Apollo Metro Gateway - Server

home master system **inventory** gateways sLog shell logout

Inventory

Show 10 entries

↓ circuit_ID	↑ type	↑ pole	↑ lat	↑ long	↑ carte_ID	↑ node	↑ gw	↑ channel	↑ new
29 A	High Pressure Sodium	2	26.48476249	-81.43449993	2634	15	65734	0	edit delete
29 A	High Pressure Sodium	4	26.48698082	-81.43454994	2635	0	0	0	edit delete
29 A	High Pressure Sodium	5	26.48803583	-81.43456993	2636	0	0	0	edit delete
29 A	High Pressure Sodium	8	26.48575749	-81.43488494	2637	0	0	0	edit delete
29 A	High Pressure Sodium	10	26.48634249	-81.43721994	2638	0	0	0	edit delete
29 A	High Pressure Sodium	12	26.48570415	-81.4355316	2639	0	0	0	edit delete
29 A	High Pressure Sodium	14	26.48421915	-81.4347316	2640	0	0	0	edit delete
29 A	High Pressure Sodium	3	26.48588582	-81.43454327	2641	0	0	0	edit delete
29 A	High Pressure Sodium	6	26.48750582	-81.43478994	2642	0	0	0	edit delete
29 A	High Pressure Sodium	7	26.48638416	-81.4347766	2643	0	0	0	edit delete

Showing 1 to 10 of 4,967 entries Previous 1 2 3 4 5 ... 497 Next

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Gateway Aktive: 3 lights Aktive: 3 11.02.2020 - 10:23 Uhr **GW SERVER RUN** Version: 20201217

Sensors

lights in use

MASTER INFO

223032100 - Markus_Gateway - 2

NR	AKTIV	MyID	Group	RSSI	TempBoard	TempLED1	TempLED2	TempLED3	Current	Voltage	LightPercent	sollLightPercent	StartLum	PE	HID	Lamp-ID	V.N2
1	online	1	1	47/47	28.7	27.1	0.0	0.0	0.1	0.1	0	0	0	0	0	222177016	2.11 18:07
2	offline	5	1	47/47	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0	288	1	223056096	1.11 12:38
3	offline	2	1	47/0	0	0	0	0	0	0	0	0	0	150	0	222222068	0

SENSOR

NR	AKTIV	MyID	Group	RSSI	TempBoard	pressure	temperatur	humidity	Current	blue_light	ambient_light	red_light	green_light	PE	HID	DS-ID	V.N2
1	online	3	1	47/47	0	1005.71	25.92	46.56	0	10	42	21	15	0	101	223049216	2.11 18:07

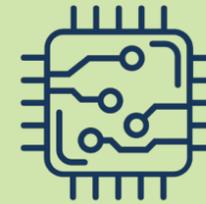


- Temperature
- Humidity
- Illumination
- Gun Shot
- Etc.

Using Street Lights as Ubiquitous Universal Technology Platform



Apollo Metro Solutions
Luminaires can be used as a
“telecom hotel” for all kinds
of sensors, actors, telecom
platforms for any smart city
application.



Apollo Metro can develop
any application in house,
both on the hardware
as well as on the software
side.

