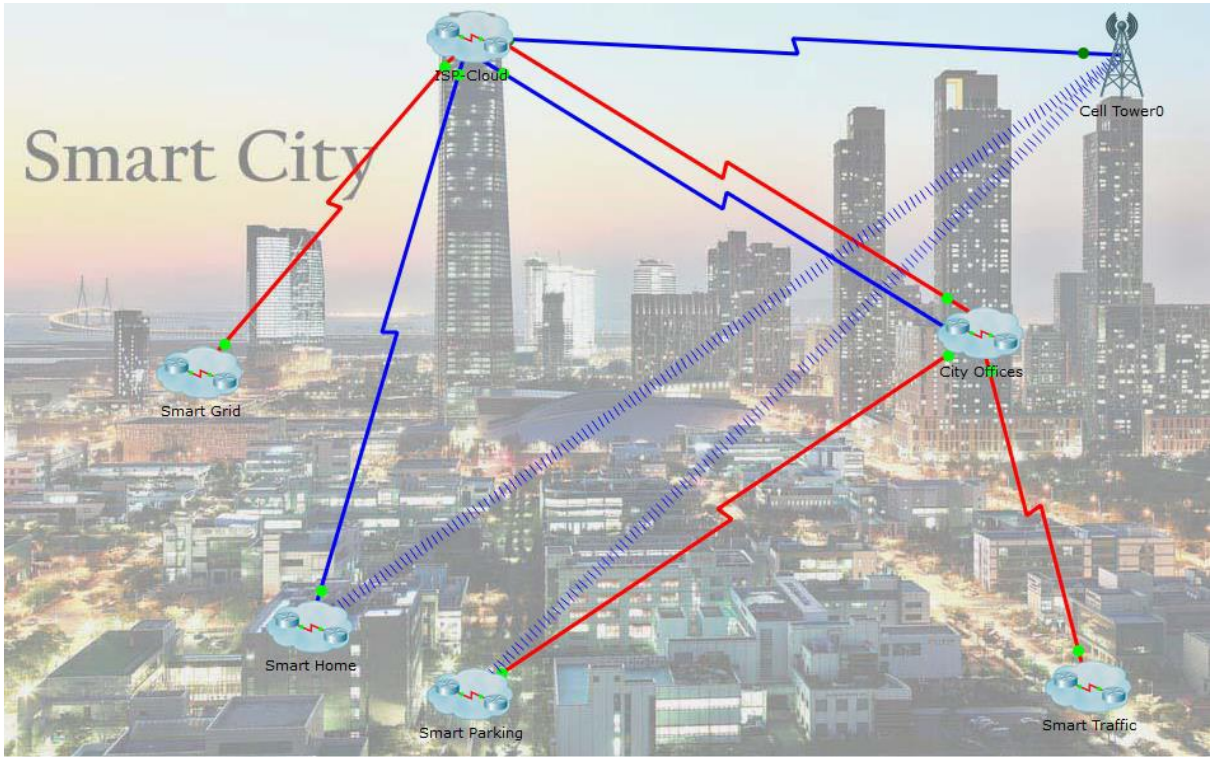
Politechnika Świętokrzyska w Kielcach **Wydział Elektrotechniki, Automatyki i Informatyki**	
Laboratorium Internet of Things	
Temat: **Explore the Smart City**	Autor: **Michał Krzysiek** Grupa: **3ID15B**
Numer laboratorium: **6**	Data wykonania : **16.12.18**



Understanding the devices that comprise the smart city

Because sensors and IoT devices are spread through the smart city, the proper network infrastructure must be in place before they can communicate. The Smart City is a metropolitan area network (MAN) comprised of smaller networks. These networks are often connected by WAN links which allow communication across large geographic distances. The ISP Cloud provides city wide access to various individuals and organizations.

a. Click the **ISP Cloud** and examine the resources that it offers to the city.

b. Click the back button. Which city networks are connected using the red serial cables?

-Smart Grid
-ISP-Cloud
-City Offices
-Smart Parking
-Smart Traffic

Note: Packet Tracer labels connections between network devices but it can be turned off for the sake of readability. To turn labelling off, go to Options > Preferences > Interface Tab > uncheck **Always Show Port Labels in Logical Workspace.**

c. Which city networks are connected using the blue coaxial cables?

-Smart Home
-ISP-Cloud
-Cell Tower
-City Offices

d. Click the **City Offices** cluster. Why are there two connections leading to it from the ISP Cloud?

-Pierwsze połączenie jest wykorzystywane do transmisji danych.
-Drugie odpowiada za sterowanie ruchem miejskim.

e. Click the back button. Which city networks are wirelessly connected to the Cell-Tower?

-City Offices
-Smart Parking
-Smart Home

f. Which devices in the Smart Home are connected to the Cell-Tower?

-Tablet
-Smartphone

a. Which devices in the Smart Parking cluster are connected to the Cell-Tower?

-SmartPhone0
-S-Parking-RT

Step 1: Interacting With the Smart Parking Cluster (City Offices Personnel)

The devices in the smart parking cluster can be monitored and controlled remotely through any computer in the city offices cluster. Because all smart parking cluster devices connect to the **City IoT Server** which hosts a web-based interface, tablets, smartphones, laptops or desktop computers can be used to interact with the smart devices.

a. Click the **City IT Laptop** in the City Offices cluster.

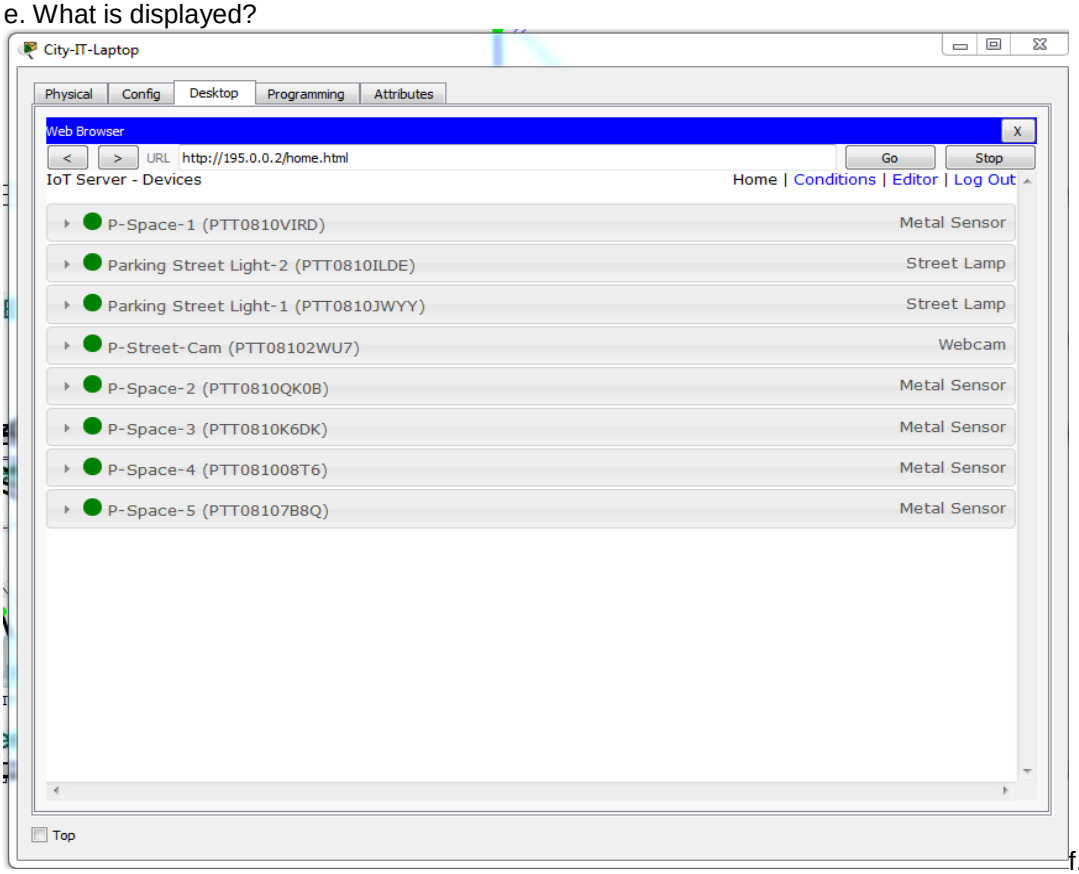
b. Navigate to Desktop > Web Browser.

c. In the URL address bar, type in 195.0.0.2. This is the IP address of the City IoT Server.

d. Use Park/Park as the username and password to log into the City IoT Server.

Note: You may have to a few minutes until the all the network devices become online and the parking meters can reach to IoT registration server.

e. What is displayed?



f.

The parking meters register themselves with the server and send status updates periodically. Click the **P-Space-1** meter to expand it.

What is the value displayed?

g. Without closing the **City IT Laptop** window, go back to the smart parking cluster and click and drag the red car onto parking spot 1. Parking spot 1 is the leftmost parking spot in the cluster.

h. Go back to the **City IT Laptop** window and look for **P-Space-1** (expand it if necessary).

What is the value displayed now?

-20

The parking spaces sensors are PT metal sensors configured to respond to metal objects (the cars in this case) when placed close enough.

Step 2: Interacting With the Smart Parking Cluster (Regular Citizens)

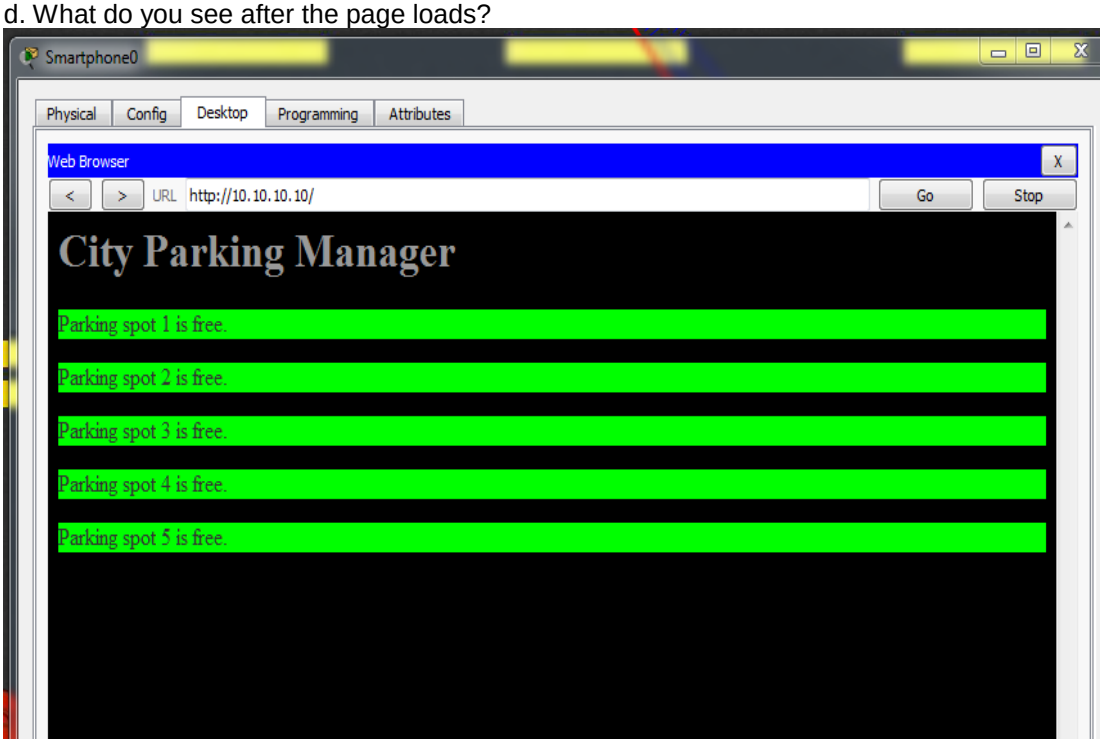
a. While useful as a monitoring tool for city administration, regular citizens shouldn't have access to the interface in the server. To allow citizens to monitor what parking spaces are available in a given street, another web page has been designed.

Close the **City IT Laptop** window and navigate back to the **Smart Parking** cluster.

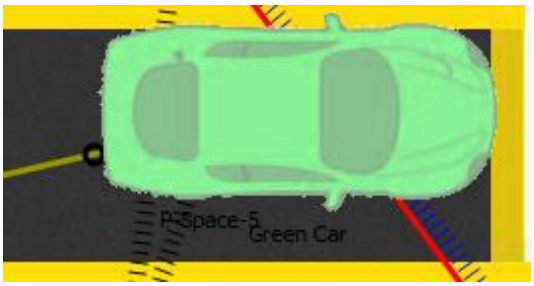
b. Click the **Smartphone** and open its web browser by navigating to **Desktop Tab** > **Web Browser**.

c. Type in 10.10.10.10 in the address bar. 10.10.10.10 is the address of the parking server, represented by the PT-MCU.

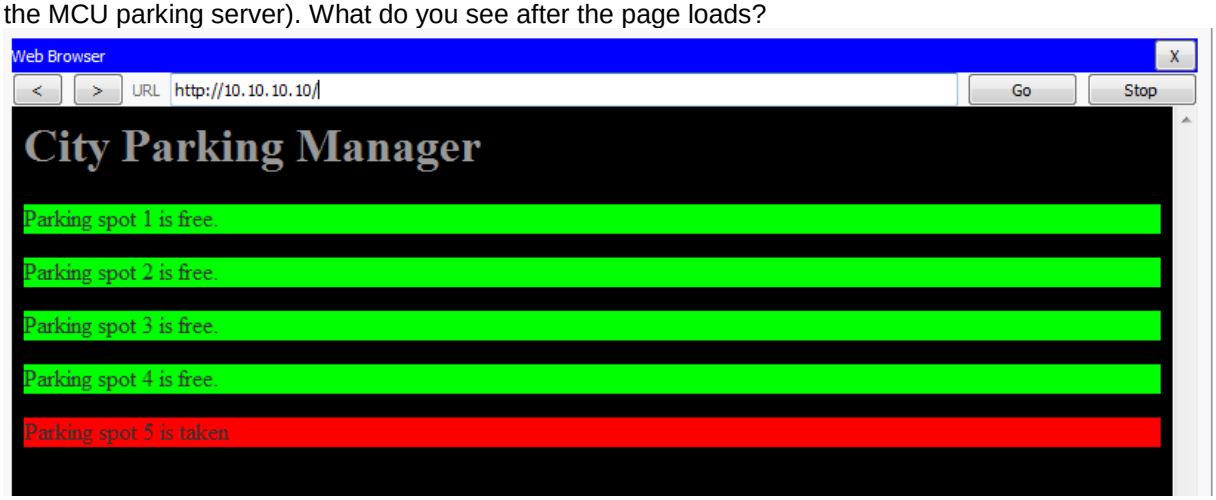
d. What do you see after the page loads?



e. Without closing the **Smartphone**'s window, drag the green car onto **Parking Spot 5. Parking Spot 5** is the rightmost parking spot in the **smart parking** cluster.



f. Go back to smartphone's window (the web browser should still be displaying the page loaded from the MCU parking server). What do you see after the page loads?



g. The parking spots not only report to the **IoT Registration Server** hosted in the **City Offices** cluster, but also report to the local parking server. This allows for citizens to browse and learn about parking spot availability even before they get to the street.

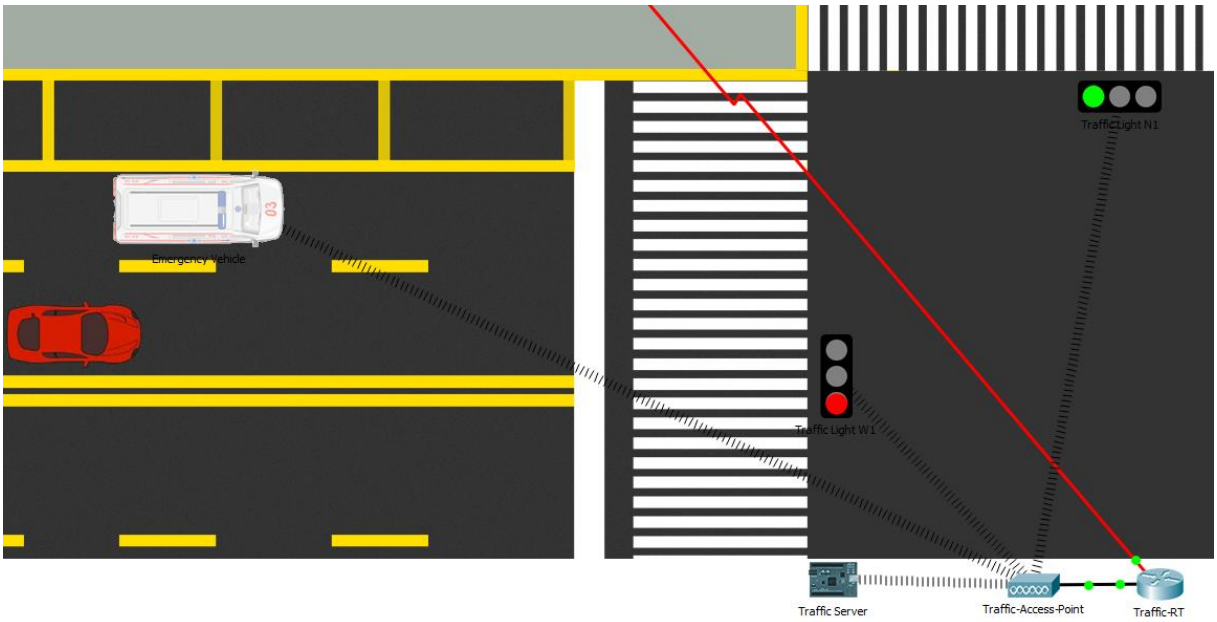
h. Take some time to explore the code running in the Parking Server MCU.

Part 3: Smart Traffic

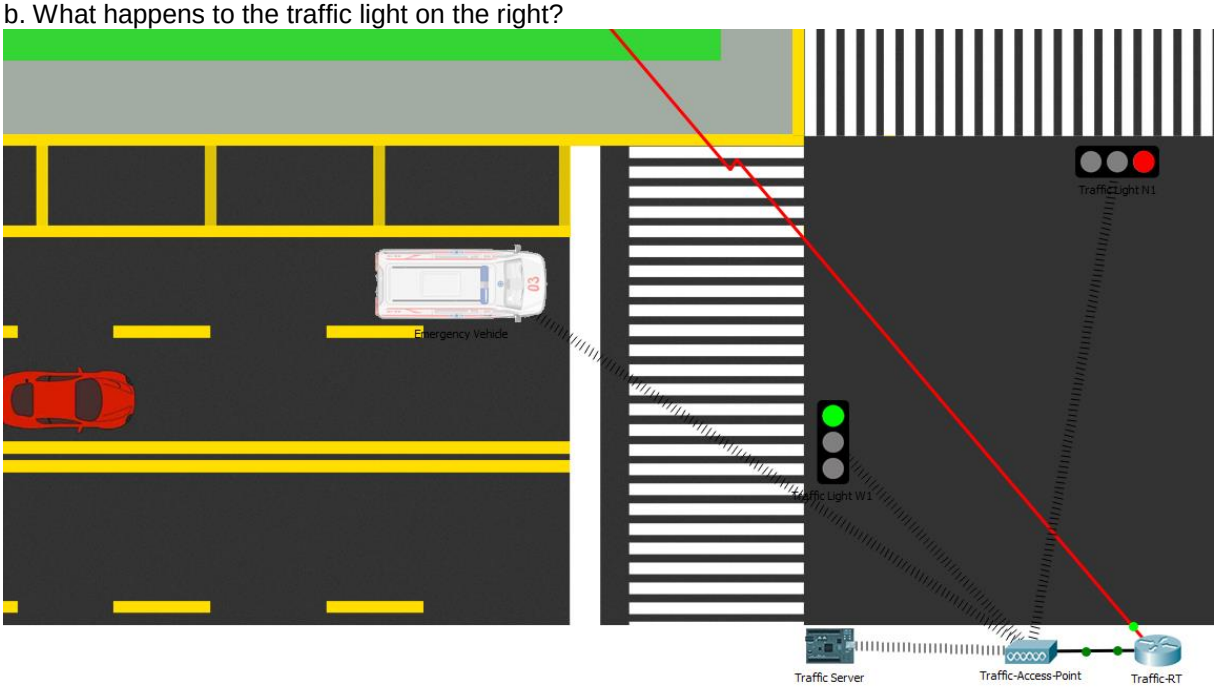
Another component of the smart city is **Smart Traffic**. In this example, **Smart Traffic** allows emergency vehicles such as ambulances or paramedics to communicate with the traffic light system and request free passage in case of an emergency. Navigate to the **Smart Traffic** cluster.

a. In this example Street Light 1 and Street Light 2 are playing the role of traffic lights. The paramedics are responding to an emergency. As the Paramedics vehicle gets closer to the traffic lights they turn green.

Click and drag the paramedic's truck and place it closer to the traffic light on the right that is currently red.



b. What happens to the traffic light on the right?



c. Move the paramedics away from the traffic light on the right and place it close to the red car.

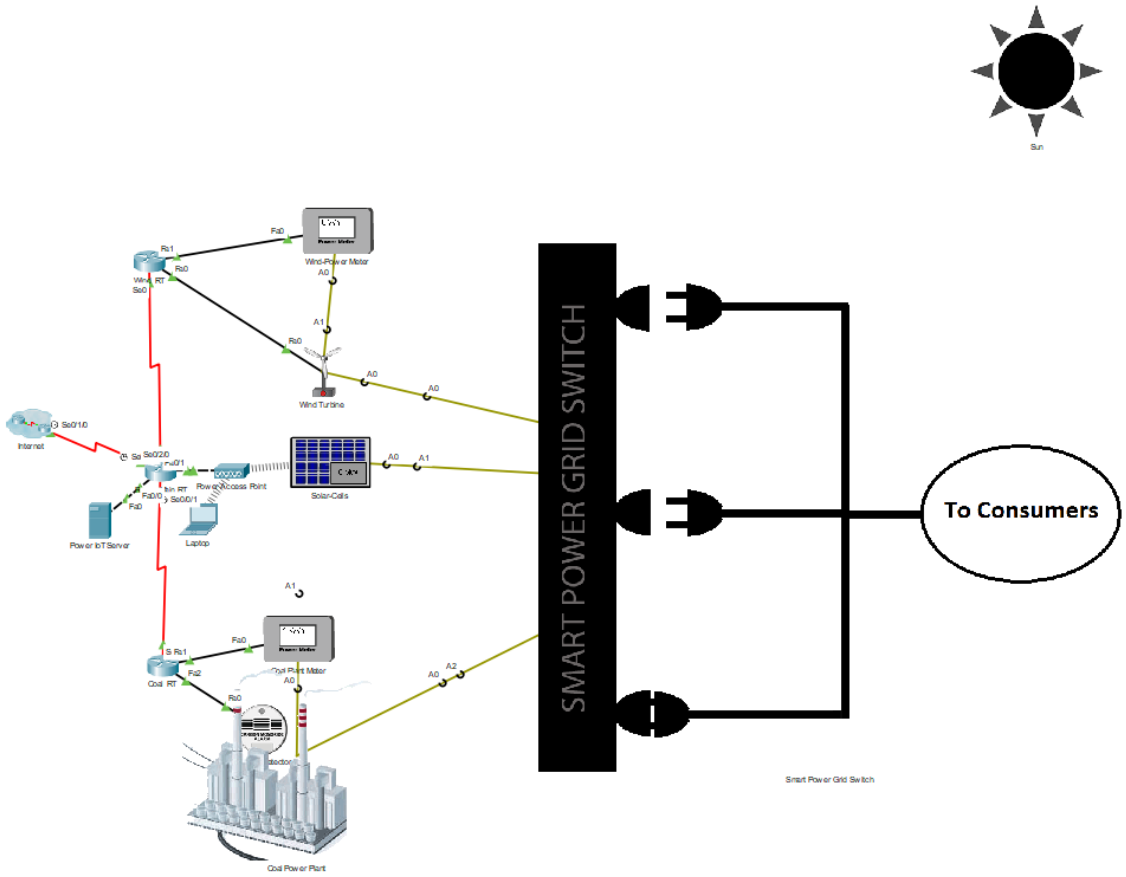
What happens to the traffic light?

-Podczas zbliżania się pojazdu uprzywilejowanego do skrzyżowania pojazd łączy z Traffic-Acces-Point aby umożliwić bezpieczny przejazd karetce w momencie gdy pojazd się oddali światła przywracają domyślną pracę świateł.

d. The paramedics vehicle sends a message to the MCU controlling the traffic lights and requests passage. The MCU recognizes the paramedics as a legitimate emergency vehicle and grants it passage by turning the light green. The MCU also turns related lights red to ensure safe passage. When the emergency vehicle has passed safely, the MCU returns system back to its normal operation.

e. Take some time to analyze the code running in the MCU in the ambulance by navigating the **Programming** tab.

Explore the Smart Grid



Step 1: Understanding the devices that comprise the smart grid

Different types of devices are necessary for smart grid operation. Network devices are required to allow communication within the smart grid. Solar cells, wind turbines, and a coal plant are responsible for generating energy. Meters and sensors are used to capture data and facilitate energy source monitoring.

a. Review the Smart Grid. How many routers do you see in the smart grid? What are their names?

Są 3 routery:
-Pierwszy : Power Main RT
-Drugi : Wind_RT
-Trzeci: Coal_RT

Note: Packet Tracer labels connections between network devices but it can be turned off for the sake of readability. To turn labelling on, go to **Options** > **Preferences** > **Interfaces** tab > and checkmark **Always Show Port Labels in Logical Workspace.**

b. What is the function of routers?

-Połączenie rozgałęzień sieci oraz zczytanie produkcji energii przez różne źródła energii.

c. A wireless access point is being used in the smart grid. What is its name? What is its function?

-Bezprzewodowy puntk dostęu to Power Access Point i są do niego podłączone:Solar-Cell i Laptop

d. Is there a way to tell which power source is actively producing energy?

-Tak. Produkcję energii można odczytać z mierników umieszczonych przy źródłach energii

e. What device is responsible for switching between the different power sources?

-Smart Power Grid Switch

f. How does the Smart Power Grid Switch decide which power source to use?

-**The power grid's location observes sunlight from 6h to 18h (6am to 6pm). Due to proximity to the ocean, the wind usually blows from 3h to 22h (3am to 10pm). The program ensures that solar power is the most preferable power source. If no solar power is available (no sunlight), the program switches over to wind power, if available. If no wind is blowing, the program falls back to coal-based power.**

g. What is the IP address of the Power IoT Server?

- 100.2.0.1

h. The Laptop is used by technicians to monitor the amount of power? Use the Web Browser to remotely connect to the Power IoT Server. You will need to know the username and password in order to login to the Server. You can discover the username and password by examining other devices in the Smart Grid. What is the username and password and with which device did you discover it?

-Nazwa użytkownika: |Power|

-Hasło: |power|

-Znalezione w : Wind-Power Meter, Solar-Cells, Coal Plant Meter

Step 2: Exploring the Smart Power Grid Switch Program

The Smart Power Grid Switch has the capability of running programs. In this example, the program was written in Javascript. It monitors the power levels from all sources (wind farm, solar panels and coal plant) and decide what source is the best.

a. Click the **Smart Power Grid Switch**.

b. Navigate to the **Programming** tab. If the **Programming** tab is not visible, click the **Advanced** button at the bottom of the window to display the advanced tabs.

c. On the left side of the Programming tab, double-click **power_switch(Javascript)** and then double-click **main.js.** The Javascript program running on the Smart Power Grid Switch should appear on the right portion of the Programming tab.

The power grid's location observes sunlight from 6h to 18h (6am to 6pm). Due to proximity to the ocean, the wind usually blows from 3h to 22h (3am to 10pm). The program ensures that solar power is the most preferable power source. If no solar power is available (no sunlight), the program switches over to wind power, if available. If no wind is blowing, the program falls back to coal-based power.

d. What is the section of the program that makes this preference (solar > wind > coal) clear?

```
    if (solar > 0) {
        console.log("Switching to Solar Power...");
        analogWrite(A3, 1);
    } else if (wind > 0) {
                console.log("Switching to Wind Power...");
                analogWrite(A3, 2);
            } else if (coal > 0) {
                    console.log("Switching to Coal Power...");
                    analogWrite(A3, 0);
                } else {
                    console.log("Blackout!");
                    analogWrite(A3, 5);
                    }
    delay(100);
}
```

Wnioski

Laboratorium przebiegło pomyślnie i bez większych trudności.

W tym labolatorium zostały nam pokazane rozwiązania jakie stosuje się w energetyce, inteligentym domu, na inteligentnym parkingu oraz w bardzo ważnej dziedzinie naszego życia czyli operowaniu ruchem ulicznym.