CLAIMS

1.- A backscatter system (100) comprising:

- a LiFi, “Light Fidelity”, transmitter (110) configured for generating and transmitting an optical signal comprising a sequence of a downlink data signal and a chirp signal, the chirp signal varying from a frequency f_1 to a frequency f_2;
- an IoT, “Internet of Things”, tag (120) comprising:
  - a LiFi receiver (121) comprising a harvester (122), the LiFi receiver (121) being configured for
    receiving the optical signal from the LiFi transmitter;
    converting the optical signal into an electrical signal;
    separating the electrical signal into a DC, “direct current”, component and an AC, “alternating current”, component;
    digitalizing the AC component of the electrical signal;
    harvesting energy from the DC component into the harvester; and
    separating the digitalized AC component of the electrical signal into an AC downlink data signal and an AC chirp signal;
    sending the AC chirp signal to a signal selector (125);
  - a controller (124) configured for
    receiving and processing the AC downlink data signal,
    receiving an information signal from at least one external device and/or for generating an information signal; and
    optionally processing the information signal;
  - the signal selector (125) comprising a multiplexor with two inputs, the first input being connected to ground and the second input being connected to the LiFi receiver for receiving the AC chirp signal, wherein the signal selector (125) is configured for
    receiving, from at least one external device (200) and/or from the controller (124), an information signal;

selecting, by means of the multiplexor, the AC chirp signal or ground signal according to the information signal;

sending the selection of AC chirp signal or ground signal to an RF backscatter module (126);

- the RF backscatter module (126) comprising an absorption impedance (127.1), a reflective impedance (127.2), an RF switch (127) and an RF antenna (128), the RF switch (127) being connected to the RF antenna (128) and being connectable to the absorption impedance (127.1) or to the reflective impedance (127.2), the absorption impedance (127.1) being configured for minimizing the reflection coefficient of the RF antenna and the reflective impedance (127.2) being configured for maximizing the reflection coefficient of the RF antenna, and the RF backscatter module (126) being configured for

  receiving an RF carrier signal, with frequency f_c, from a carrier generator;

  receiving, by the RF switch (127), the selection of AC chirp signal or ground signal made by the signal selector (125), wherein

    if the RF switch (127) receives a ground signal as input:

      the RF switch (127) is connected to the absorption impedance (127.1);

      the absorption impedance (127.1) absorbs all the energy of the RF carrier signal to avoid that the RF antenna (128) backscatters any signal;

    if the RF switch (127) receives an AC chirp signal as input:

      the RF switch (127) varies the impedance of the RF antenna (128) by changing its connection between the reflective impedance (127.2) and the absorption impedance (127.1) at a frequency equal to the frequency of the AC chirp signal;

the RF antenna (128) generates an RF signal multiplying its reflection coefficient by the RF carrier; and

the RF antenna (128) backscatters the RF signal varying the frequency of the RF carrier signal from $f_c + f_1$ to $f_c + f_2$.

2.- The backscatter system (100) according to claim 1, wherein the system further comprises an RF backscatter receiver (130) configured for

- receiving the backscattered RF signal from the RF backscatter module (126); and
- decoding the backscattered RF signal.

3.- The backscatter system (100) according to claim 2, wherein the RF backscatter receiver (130) is configured to decode the backscattered RF signal by:

- multiplying the backscattered RF signal by a conjugate chirp;
- applying a FFT, “Fast Fourier Transform”, on the signal resultant from multiplying the backscattered RF signal by a conjugate chirp to determine energy at different FFT bins;
- demodulating the resultant transformed signal, such that:
    - symbol ‘1’ corresponds to a peak bin at an FFT bin; and
    - symbol ‘0’ corresponds to no peak at any FFT bins.

4.- The backscatter system (100) according to any of the previous claims, wherein the signal selector (125) is configured to:

- select the AC chirp signal if information signal is ‘1’ and selects the ground signal if information signal is ‘0’; and
- select the AC chirp signal if information signal is ‘0’ and selects the ground signal if information signal is ‘1’.

5.- The backscatter system according to any of the previous claims, wherein the LiFi receiver comprises a comparator (123) to carry out the digitalization of the AC component of the electrical signal.

6.- The backscatter system (100) according to any of the previous claims, wherein the LiFi receiver (121) comprises a voltage regulator (129) configured to control the voltage supplied to the controller and the comparator, if any.

7.- The backscatter system (100) according to any of the previous claims, wherein the absorption impedance (127.1) is a matching circuit.

8.- The backscatter system (100) according to any of the previous claims, wherein the chirp signal is an up-chirp signal or a down-chirp signal.

9.- The backscatter system (100) according to any of the previous claims, wherein the LiFi receiver (121) is further configured for harvesting energy from ambient light.

10.- The backscatter system (100) according to any of the previous claims, wherein the LiFi receiver (121) further comprises:

- a low pass filter (121.1) configured for eliminating the AC component of the electrical signal and for obtaining the DC component of the electrical signal and for sending the DC component to the harvester (122); and
- a high pass filter (121.2) configured for eliminating the DC component of the electrical signal and obtaining the AC component of the electrical signal.

11.- The backscatter system (100) according to any of the previous claim, wherein the harvester comprises a capacitor (C) and/or a rechargeable battery.

12.- The backscatter system (100) according to any of the previous claims and claim 10, wherein the LiFi receiver (121) further comprises at least one solar cell (121.3), the at least one solar cell (121.3) being configured for:

receiving the optical signal from the LiFi transmitter (110);

converting the optical signal into an electrical signal;

sending the electrical signal to the low pass filter (121.1) and the high pass filter (121.2).

13.- The backscatter system (100) according to claim 12, wherein the at least one solar cell (121.3) is an array of solar cells connectable among them in parallel or in series.

14.- The backscatter system (100) according to claim 13, wherein the LiFi receiver (121) further comprises a solar cells configuration module, which is configured for

measuring the energy harvested in the harvester (122);

if the energy measured is equal or above a predefined threshold,

connecting the solar cells of the array of solar cells (121.3) in series; and

if the energy measured is below a predefined threshold,

connecting the solar cells of the array of solar cells (121.3) in parallel.

~~15.- A LiFi receiver (121) comprising a harvester (122), an array of solar cells (121.3), a solar cells configuration module, a low pass filter (121.1) and a high pass filter (121.2), wherein~~

~~the array of solar cells (121.3) is configured for:~~

~~receiving an optical signal from a LiFi transmitter (121);~~

~~converting the optical signal to an electrical signal; and~~

~~sending the electrical signal to the low pass filter (121.1) and the high pass filter (121.2);~~

~~the low pass filter (121.1) is configured for:~~

~~eliminating the AC component of the electrical signal;~~

~~obtaining the DC component of the electrical signal; and~~

~~sending the DC component to the harvester (122); and~~

~~the high pass filter (121.2) is configured for:~~

~~eliminating the DC component of the electrical signal; and~~

~~obtaining the AC component of the electrical signal;~~

~~the solar cells configuration module is configured for~~

~~measuring the energy harvested in the harvester (122);~~

~~if the energy measured is equal or above a predefined threshold,~~

~~connecting the solar cells of the array of solar cells (121.3) in series; and~~

~~if the energy measured is below a predefined threshold,~~

~~connecting the solar cells of the array of solar cells (121.3) in parallel.~~