

# One-Wire Line System for Transmitting Energy or Information

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**Abstract**—There are three well known types of wire lines for transmitting electrical energy or information: the ordinary two wires line (below A-Line); the so-called single-wire line, where ground is in the role of the second wire; three phase system. This article presents a new electric transmission system named B-Line which uses one line only and does not use ground. One-Wire method is working on all frequencies of power and communication systems. The article indication

that this idea allows to construct: one wire electric line (B-Line) with any voltage with small corona discharge, single-pole's generator, three phase system without neutral wire, high frequency long line, performed using one wire only, one wire antenna, which is equivalent to double dipole (MB Antenna).

**Keywords**—Electrical lines, One-Wire system, three phase system, corona discharge, single-pole's generator, MB antenna

## I INTRODUCTION

Usually in books, articles or lectures authors explain the work of an electrical circuit (A-Line) as the process of current flowing from the generator to the load, and then back to the generator [1]. But it is known that free access electrons move relatively slowly, and the electrical energy is transmitted at light speed. It is possible that the term “current” causes the above description of the electrical circuit. This description may lead to the conclusion that part of the active (real) power returns to the generator, so two wires are needed. Let us compare this with other systems. Today one can read another explanation. “Two currents derive from two terminal of source with opposite phase”. That is energy flows in one direction. If so, can it be that one wire only is enough? Indeed, there are many systems, where we use one channel only. For example fiber optic, waveguide channel, radio channel. The nature uses one channel to. For example channels of the nervous system. There were earlier attempts to perform electrical energy transmission by means of one wire. There is Goubau line, or G-line for short, which is a type of single wire transmission line which is used at UHF and microwave

frequencies. A G-line is a type of waveguide, rather than a wire in an electric circuit [2]. There was experiment based on the Russian patent application 1993 year by Stanislav and Konstantin Avramenko. This is a application of the single-wire electrical energy transmission also, described by Nikola Tesla[3-8] in the 1890

Assuming that the active energy does not return from load to the source, we can attempt to construct a single-wire electrical line (B-Line). The line should not use the ground for the energy transfer from the source to the load. It should not have additional losses compared with conventional two-wire line.

## II. B- LINE MAIN IDEA EXPLANATION

Conventional electric A-line (see figure 1 left part) is a combination of the generator and the load connected by two wires, where potential phases are opposite (differ by  $\pi$ )

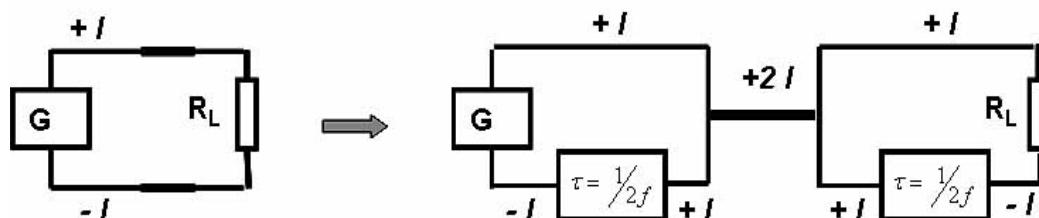


Figure 1. Conventional two wires scheme (A-Line) and proposed B-Line scheme

It would be possible to combine two wires if currents would be of the same amplitudes and same phases.

This can be achieved by inserting phase-shifter in one line. For instance, 10 ms delay line can be used for signal with a frequency of 50 Hz. After the phase shifter, phases and amplitudes of the currents in both lines are identical. Thus both lines can be combined into one. Similarly, phase-shifter can be inserted after dividing line before the load in one of the wires in order to ensure normal load functioning. As a result, the two wire system turns into one-way B-Line system (see Figure 1 right part), but generator and load will “see” the previous (before the phase-shifters insertion) situations.

Except for the use of delay lines the same results can be obtained by inserting: phase shifters in both lines and shifting the phase in a one line by  $\varphi$  and in another line by  $-(\pi - \varphi)$ ; transformer with opposite windings; filters or another phase shifters, for example Hilbert transform. If delay line is used as a phase shifter, then its delay must correspond to half period. In the case of low frequencies, use of delay line is practically impossible, since wire, which corresponds to half wave length, should be 3000 km long. On low frequencies, it is convenient to use transformer with opposite windings as phase shifter. As for high frequencies, delay line (for example stripline) is a good solution. In A-line used bipolar source, it produces two opposite-phase signal. In B-line one-wire system uses a Single-Pole source. He gives one, but double-signal. In the case of the antenna system does not need current dividing. In this case, the antenna is fed double current (see Figure 2).

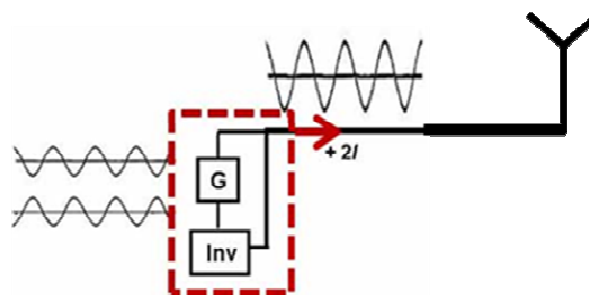


Figure 2. Single-pole's generator principle

### III. SIMULATIONS RESULTS ON FREQUENCIES OF 50 HZ

The proposed idea was checked by ADS program. Series of simulations with different phase shifters and various resistance lines were carried out. Each simulation was carried out for the A-Line and the B-Line (Figure 3). For clarity, the figures below show the conditions and the simulation results including polarity and magnitude of currents. In the proposed B-Line scheme, we added inverters at the input and combined the two lines with resistance 1kOhm. As a result, a common line resistance became 0.5kOhm. The simulation shows that the currents at the input and output have not changed (see Figure 3). The polarity of the load current depends on where the inverters are: at the top or the bottom.

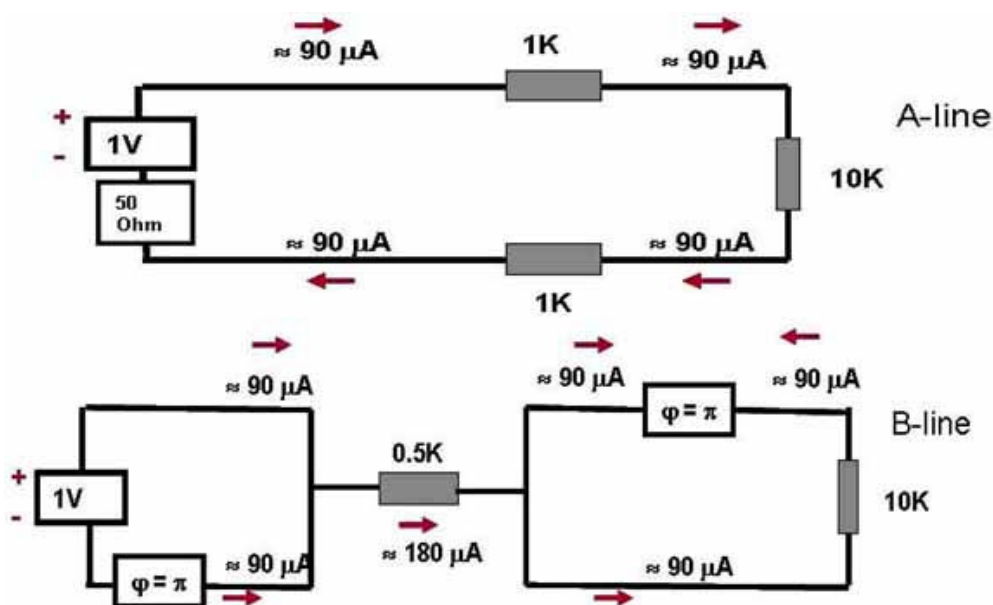


Figure 3. Equivalent A-line and b-Line B-Line versions

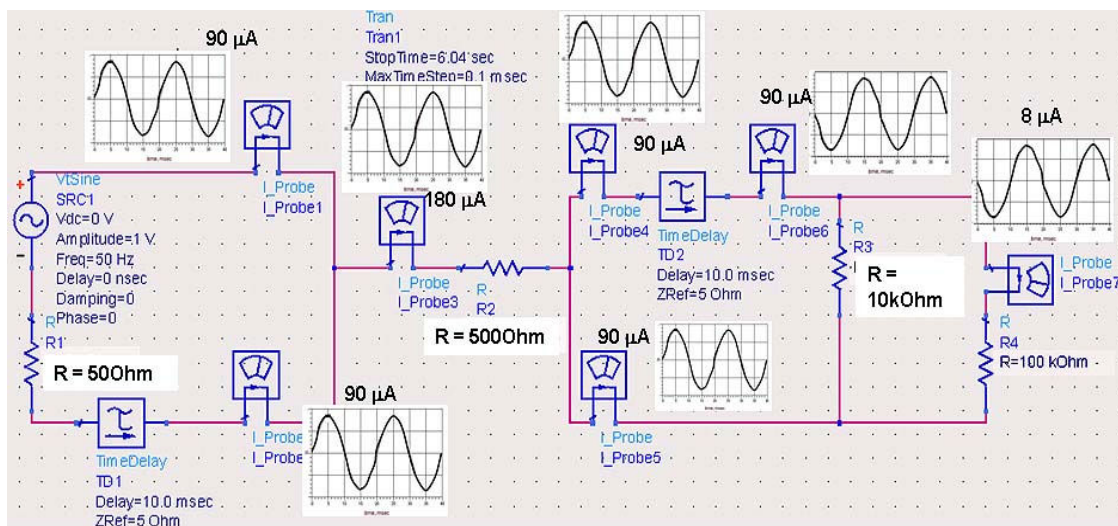


Figure 4, B-Line version (on Figure 3) simulation results

Figure 5 shows another simulation results of B-Line corresponding to the scheme shown in Figure 3. The current phase one wire can be inverted with the help of a transformer with opposite windings. The bottom ends of the windings should not be connected, otherwise the current will flow from one winding into another.

As in other similar cases, zeroing can be done with the help of the ground. B-Line with ideal 1:1 transformers simulation is shown on Figure 5.

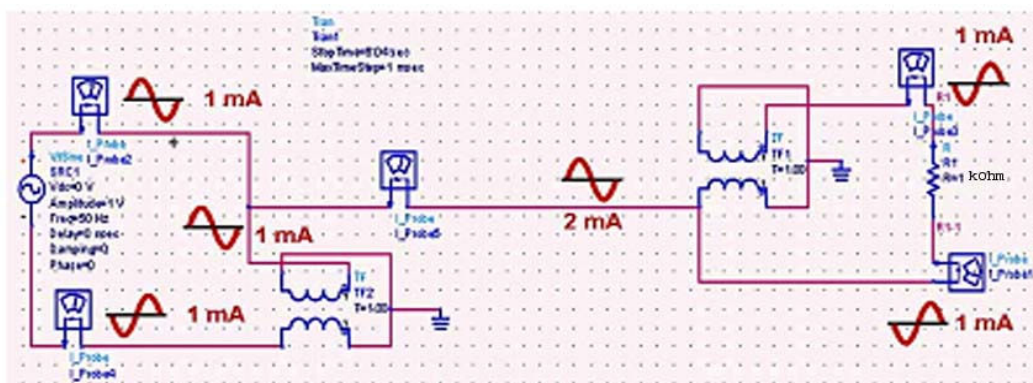


Figure 5, B-Line with transformers simulation result

#### IV. ABOUT GROUND USING FOR ZEROING

In the discussions opponents of this proposal said the following: “If you implement ground, then ground is the second line”.

In the proposed B-Line scheme, the current of the second line does not go into the ground. It flows into the first line after inverting the phase.

Taking into account importance of this issue, we give some proofs of the fact that ground does not participate in signal transduction in the proposed system. Although one proof would be sufficient.

The proof number one. Return to the figure 5. In accordance with Ohm’s law, in a case of the source with a voltage of 1V and 1kOhm load, the current is equal to 1mA. This is exactly the obtained in the simulation. If some other current flowed into earth, the current in the lines would be lower. The result of simulation shows that there is no other current except the current in lines. The proof number two is combined scheme, where there are transformer and delay line (see Fig. 6). Here ground is in transmitter part only. The proof number three is changing ground by wire. The scheme on Figure 7 is working, but scheme on figure 8 does not work.

Several models were built, aiming experimental verification of the proposed ideas. All voltages and currents in the model coincided with the results of the simulation. We checked that there was no ground involvement in signal transduction through the neutral wire of three-phase system. To do this, we performed

tests on model with dividing transformer at the input. See Figure 9 for this model scheme and Figure 10 for the photo.

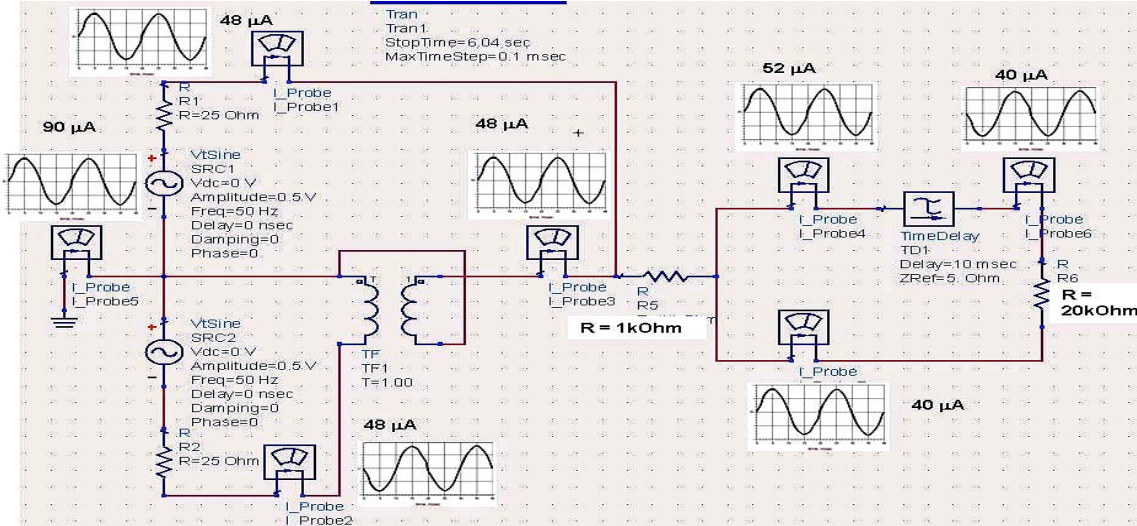


Figure 6. B-Line with transformers and delay line simulation results

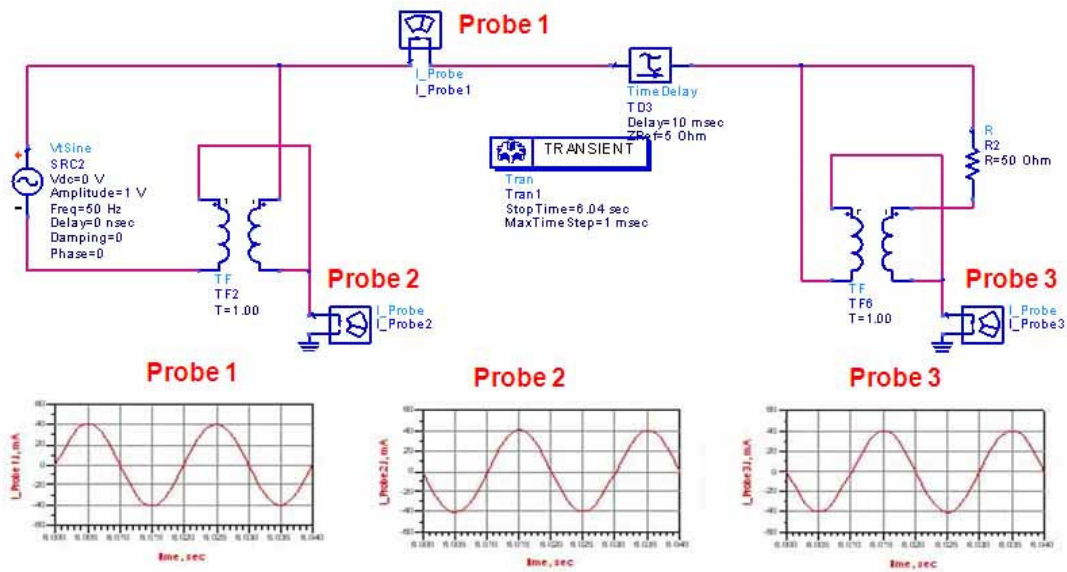


Figure 7. One B-Line version with transformers grounding.

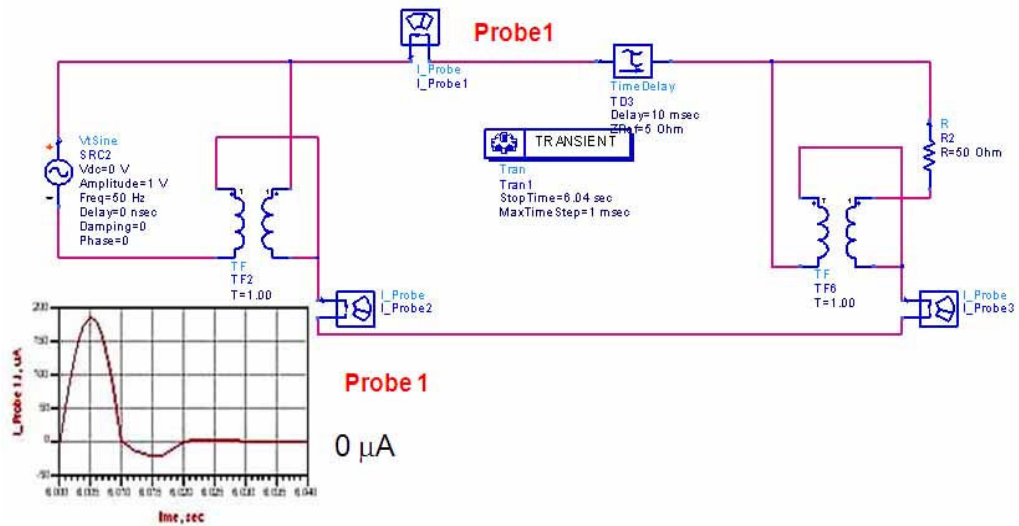


Figure 8. B-Line with version of figure 7 with wire instead ground

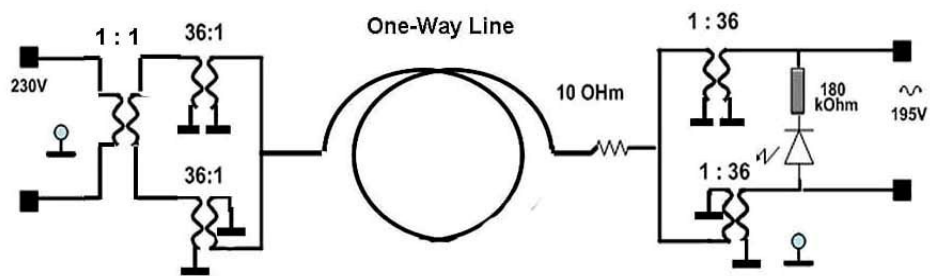


Figure 9, The scheme of B-Line model with dividing transformer

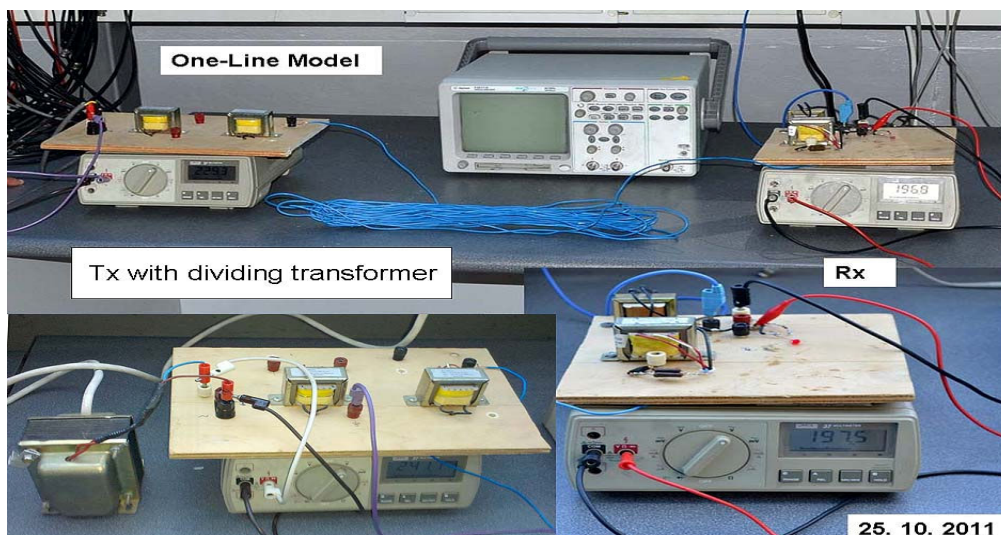


Figure 10, Photo of B-Line model with dividing transformer

### V. POSSIBLE ADVANTAGES OF B-LINE IMPLEMENTATION ON LOW AND HIGH FREQUENCIES

**The cost of the system** There is no doubt that use a single wire instead of two or three wires should significantly reduce the cost of electrical system.

**Corona discharge** Corona, or crown - is a self-discharge that occurs in highly non-uniform fields, in which the ionization processes can occur only in a narrow region near the electrodes, for example the electric field of overhead power lines wires.

When two oppositely charged corona wires ions of opposite sign move in opposite directions, the radiation level increases.

**B-Line as the high-frequency coherent long line.** In practice it is difficult to obtain ideal matched long line. This difficulty is caused by different effect of neighboring elements of the device on each of the two lines. In the case of one-wire line such problem does not exist. It should be noted that if the A-Line is matched with the load, there is no signal loss. Similarly, if the B-

Obviously, the resistance of a wire line in the B-Line is equal to half the resistance of a wire in the A-Line.

Even given the complexity of the design of modern high-voltage wires and towers, one can expect a significant reduction in price

In the low field strength - in the middle between the wires - there is a partial recombination of the ions. Much the same part of them penetrates the crown area of the opposite polarity, increasing the field there. As a result, the ionization rate increases, the current crown, and, consequently, the energy loss increases. This regime is called bipolar corona crown.

line (having the A-Line as a prototype) remains matched with load, no signal loss appears. On high frequencies one can implement CST program. This program allows simulating different elements including electrical lines. One can see on figure 11 Long line examples and on figure 12 its B-line prototype. Simulation results one can see on Figure 13.

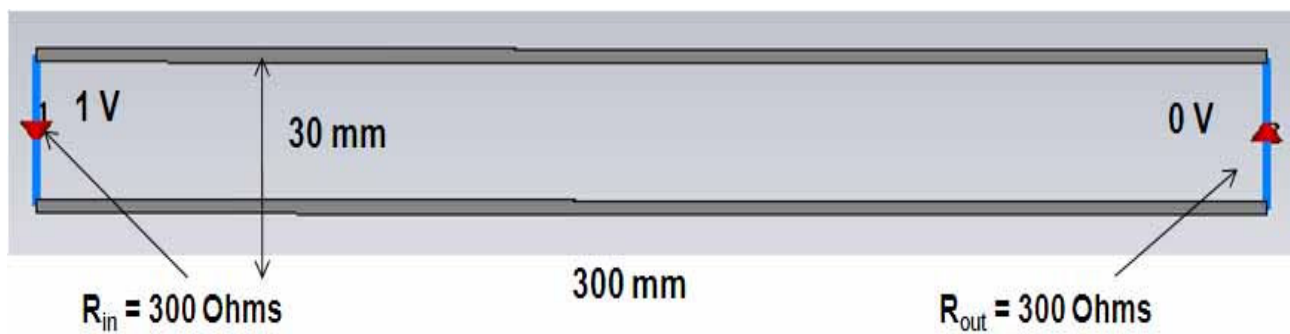


Figure 11, Common long line example



Figure 12, One-wire long line

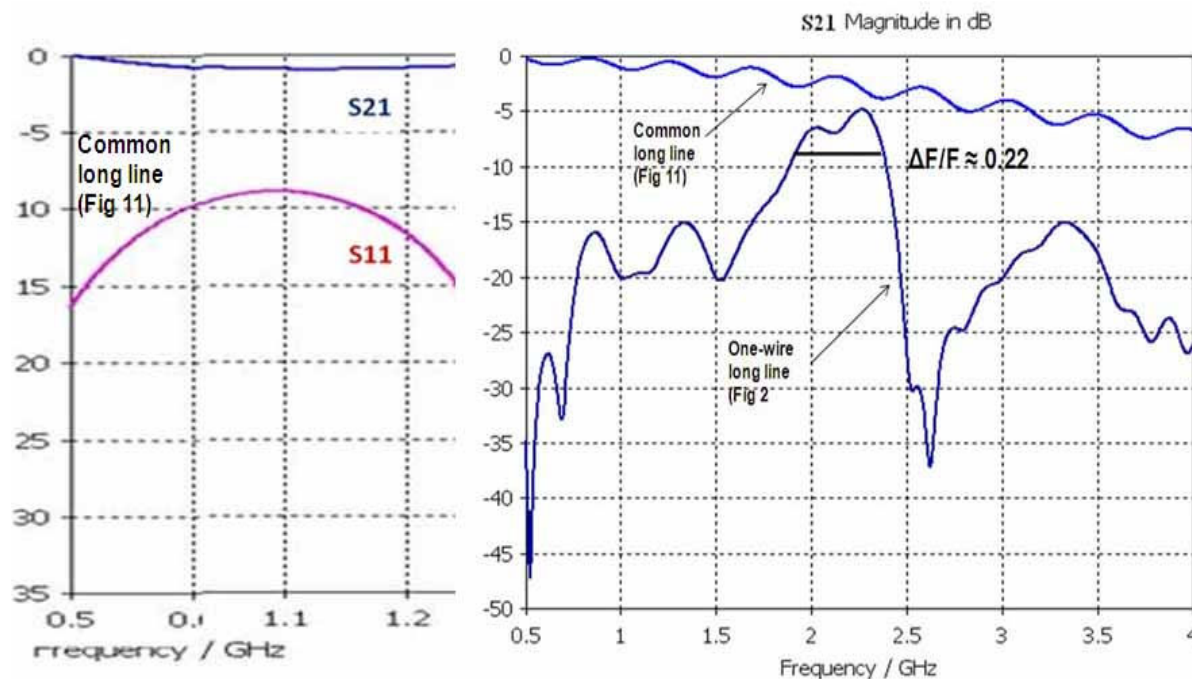


Figure 13, Simulation results on common and one-wire long lines

The known long line (A-Line) has infinitely wide band. This is an advantage, but also disadvantage. It is advantage because you can transmit multiple signals with different frequencies. However, in a real system there is always some noise. Even if it is weak, it will be large since the band is infinitely wide (of course, if the noise is white). Of course, you can use a filter at the input of the receiver. But this is often a problem. The

**Using B-Line on antenna construction** B-Line principle allows to build monopole with dipole parameters (MB antenna [9]). This idea is clear from this Figure 14.

In contrast to the known solutions, equivalent of MB antenna is dipole with two half wave lines (see Fig 15).

filter introduces loss and increased the noise factor. The proposed single-wire system (B-Line) is a selective system

B-Line is compatible with the source and load, and in this sense is not different from the usual long line. It is selective, but rather broadband (Figure 13). It has no requirements of symmetry, which is often a problem when using long line inside the apparatus.

At point B the current is not terminated, it continues to flow to the source. This fact increases the effective height of antenna. Lines AB and BC equipotential, and they can be combined. The delay line is small and shielded so that it does not radiate. Given the size of the antenna MB ( $\lambda/2 + \lambda/2$ ) compared to the half-wave dipole, ( $\lambda/4 + \lambda/4$ ) we can expect an increase in gain no less than 3 dB.

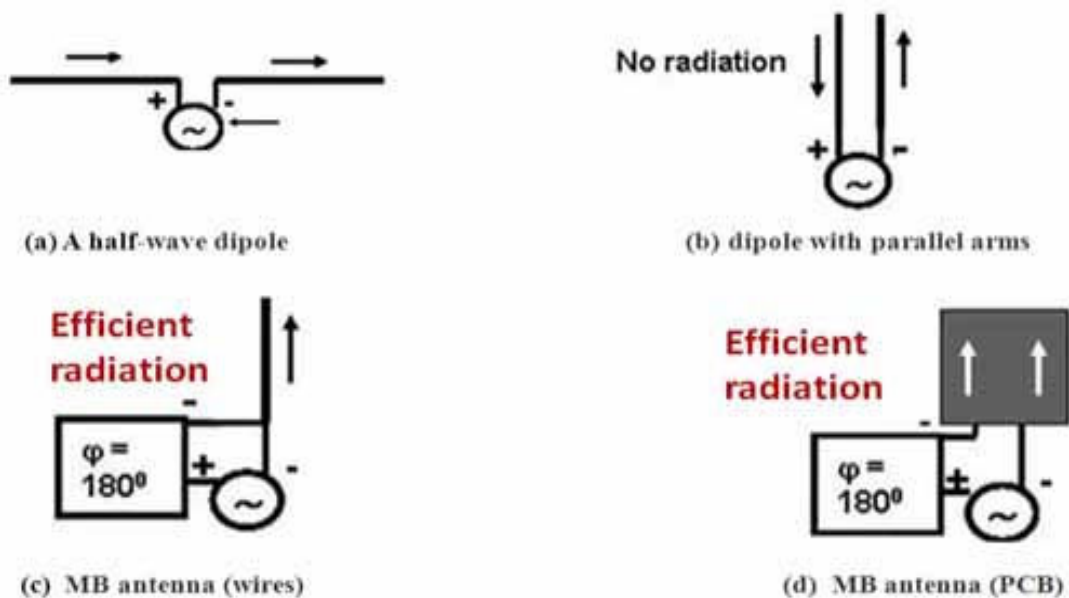


Figure 14, from dipole to MB antenna

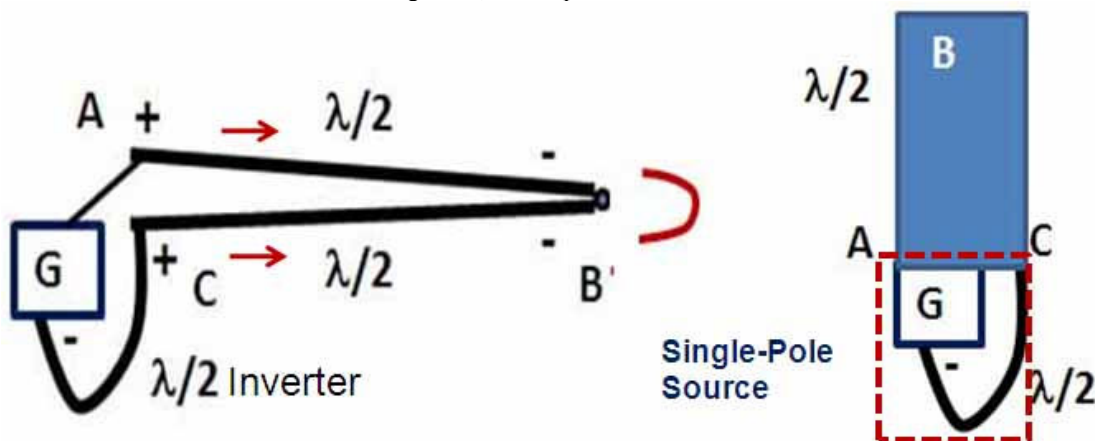


Figure 15, MB antenna principle and using in handset

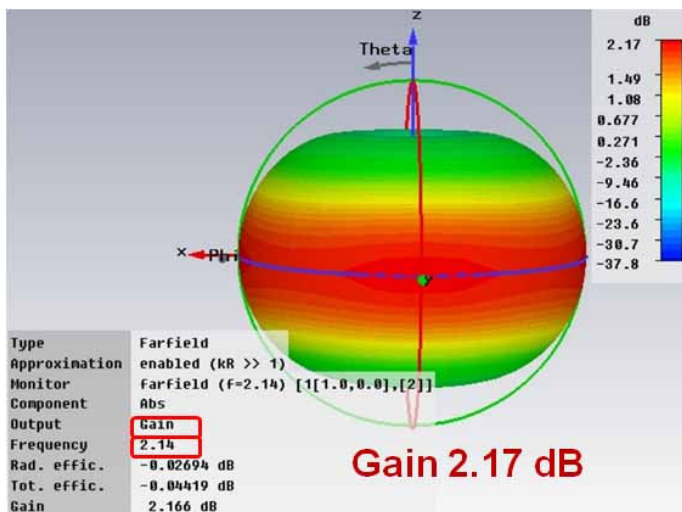


Figure 16, Dipole simulation results



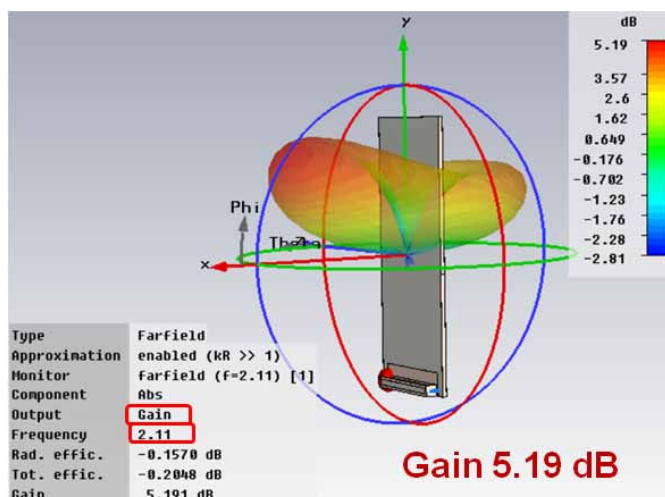


Figure 17, MB antenna simulation results

Comparative simulation of conventional dipole antenna (Fig. 16) and the antenna MB (Fig 17) confirmed the possibility of increasing the gain by 3 dB.

Let us compare MB antenna(  $\lambda/2 + \lambda/2$ ) and half-wave dipole, ( $\lambda/4 + \lambda/4$ ) by Friis transmission formula:

$$\frac{P_R}{P_T} = \frac{\lambda^2 G_T G_R}{(4\pi d)^2}$$

Increasing MB antenna gain (G) by 3 dB in transmitting and by 3 dB in receiving allows increased distance (d) by two times. Studies and simulations show that the radiation resistance of antennas MB is about 20 Ohm.

So one can improve the sensitivity of the receiver in the case of an ideal input amplifier is inversely proportional to the square root of the resistance of the radiation

Maybe main MB antenna advantage is exclusion such an element as an antenna from Cell Phone

## VI. CONCLUSION

- One-way method for connection between source and load by one line – (method B-Line) was proposed and checked

- Grounding in version with transformers and filters is not second connection line; the grounding is required for winding of transformer dividing .

- It is possible to suppose that using one-way method can considerable decrease the electrical lines cost.

- B-Line method allows decreasing energy loss in high-voltage electric transmission lines
- It is possible to achieve decreasing of electrical lines radiation, especially when compared to three phase systems where there is high voltage between lines.
- B-Line method allows simplifying the high-frequency long lines and improving their options, including easing the requirements for symmetry and a good matching.
- B-Line method allows building MB antenna with big gain. In this case the radiating element can be Printed Circuit Board (PCB)

And another one:

There is only one wire, so

- no voltage between wires,
- no isolation problems,
- no corona effect,
- no losses due to resistance between wires.

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