REMOTE ACCESS TO WIRELESS COMMUNICATIONS SYSTEMS LABORATORY– NEW TECHNOLOGY APPROACH

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Remote Laboratory

The limitations of traditional laboratories are:

- lack of enough work area,
- expensive instrumentation,
- lack of personnel,
- time assigned to a laboratory,
- their availability in non-working office hours

The integration of telecommunication technologies and computer science with virtual instrumentation allowes:

- real, remote laboratories to be developed and accessed through Internet in real time,
- a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories.

- **<u>Wireless Communications</u>**

Wireless communications is the fastest growing segment of the communication industry.
Antennas are essential components of all equipment for wireless communications.

Parameters used to test the performance of an antenna are:
- radiation pattern,
- directivity,
- gain,
- polarization,
- Impedance
- bandwidth.

Architecture of Remote Laboratory for Wireless Telecommunications

The course "Wireless Communication Systems" gives students an overview of:

- the characteristics of different types of antennas used in wireless communications
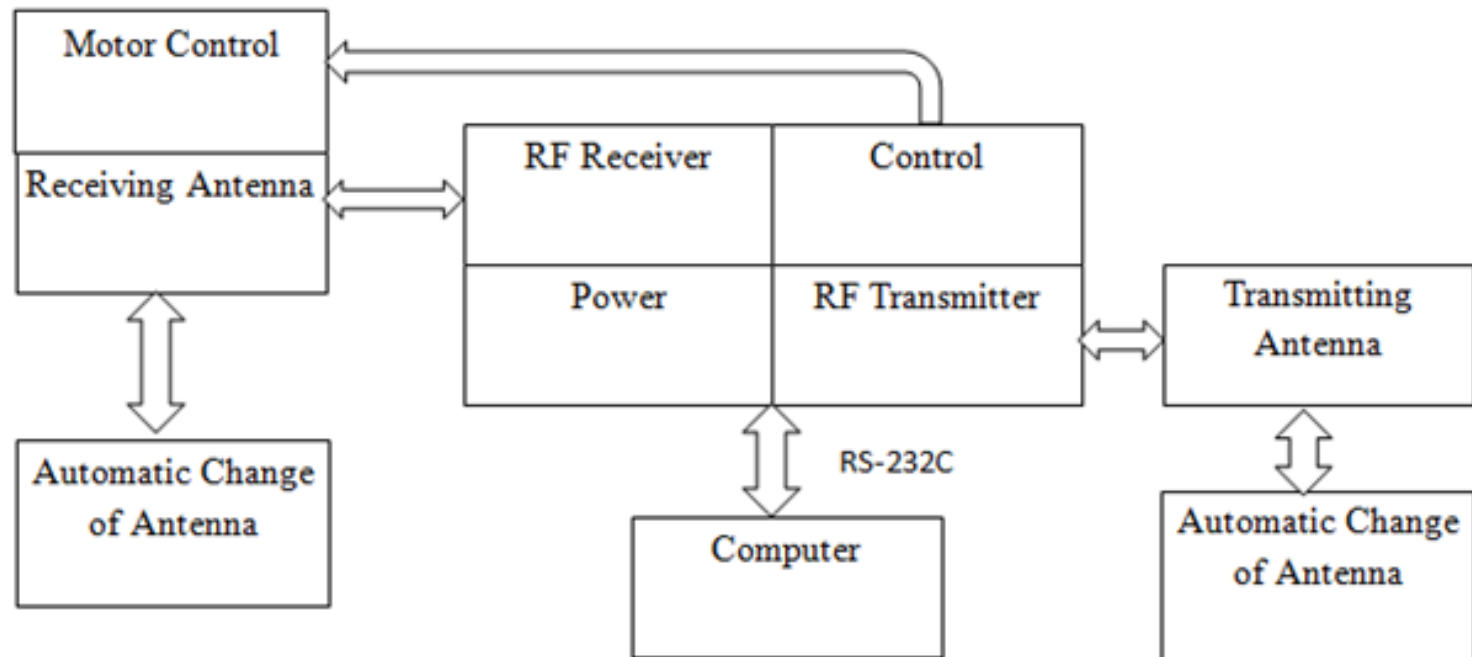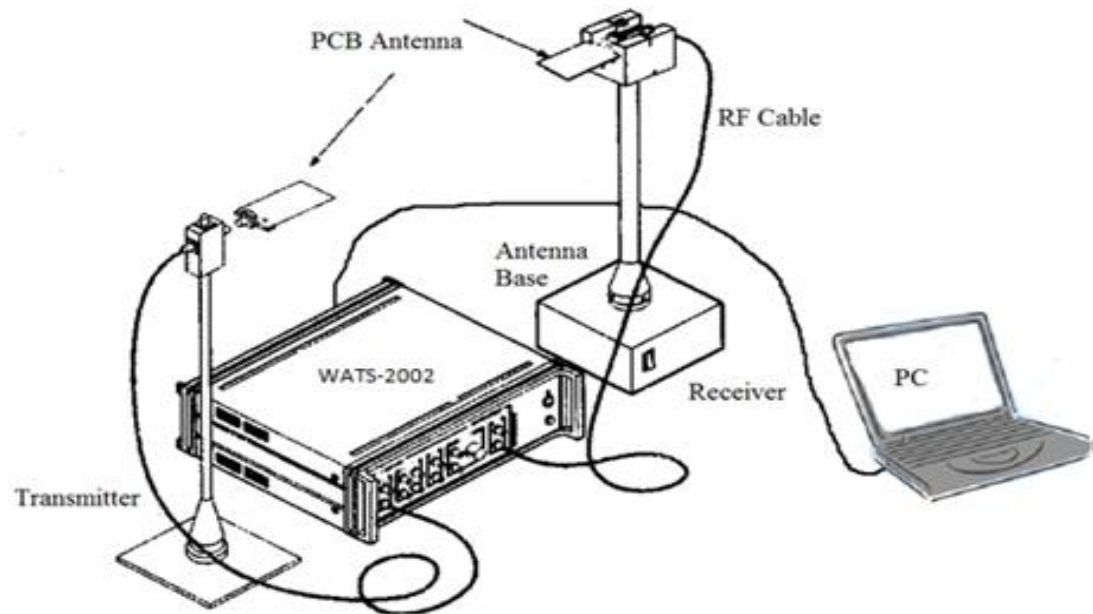- the wave propagation in mobile communication.

Fig.1 System Configuration

- The different types of antennas are changed in the system automatically without participation of an operator.
- This automatic change is made by means of an external antenna-switching controller board (EASCB).
- The innovative automated system for antenna change is the main part of the Wireless Communications Remote Lab.

Educational Objectives and Performance-based Learning

The experiments are carried out by means of done using WATS-2002 equipment
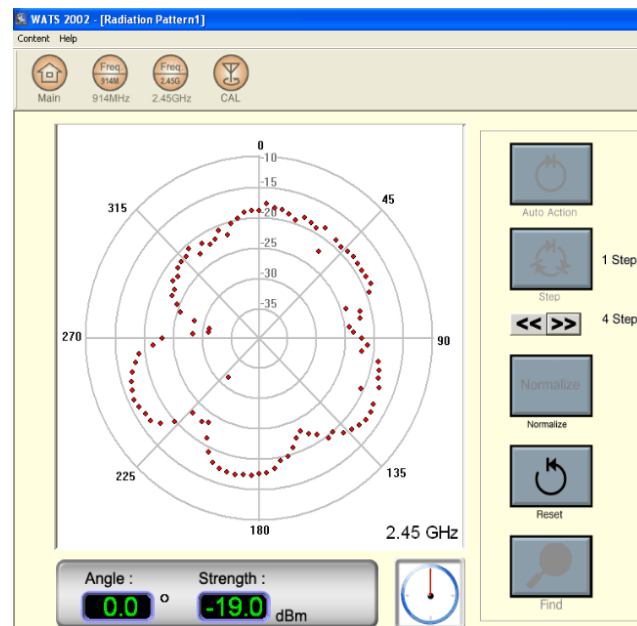
Mobile Communication Propagation

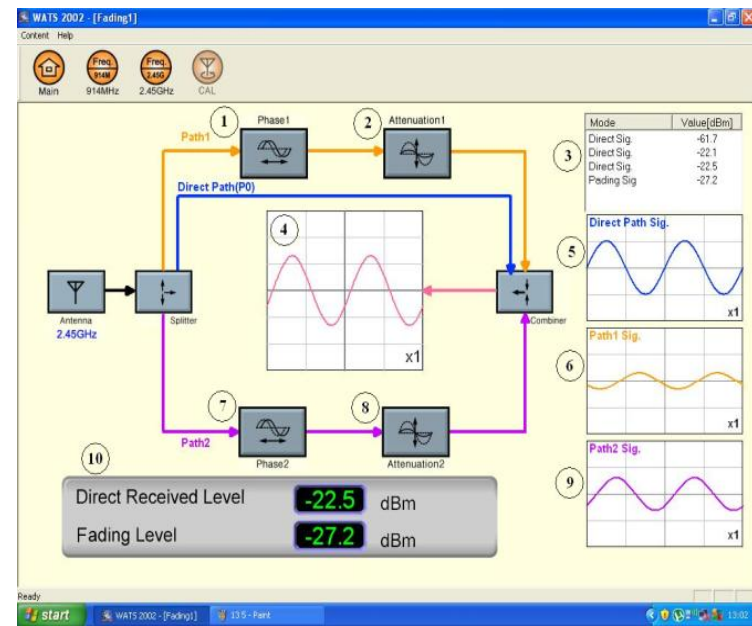
Fig.3 Radiation pattern measuring experiment screen

Fig.4 Multi-path fading experiment screen

External antenna-switching controller board (EASCB)

- We triedcto automate the swapping of the antennas on the given telecommunications kit – WATS-2002 of Man&Tel Co.,Ltd.
- The kit has two outputs – one for 900MHz bandwidth and one for 2.4GHz bandwidth. It also has the corresponding inputs – 900MHz and 2.4GHz.
- The transmission channel is built from 10 output antennas and 7 receiving antennas. At a single time only one antenna may transmit and one may receive data.
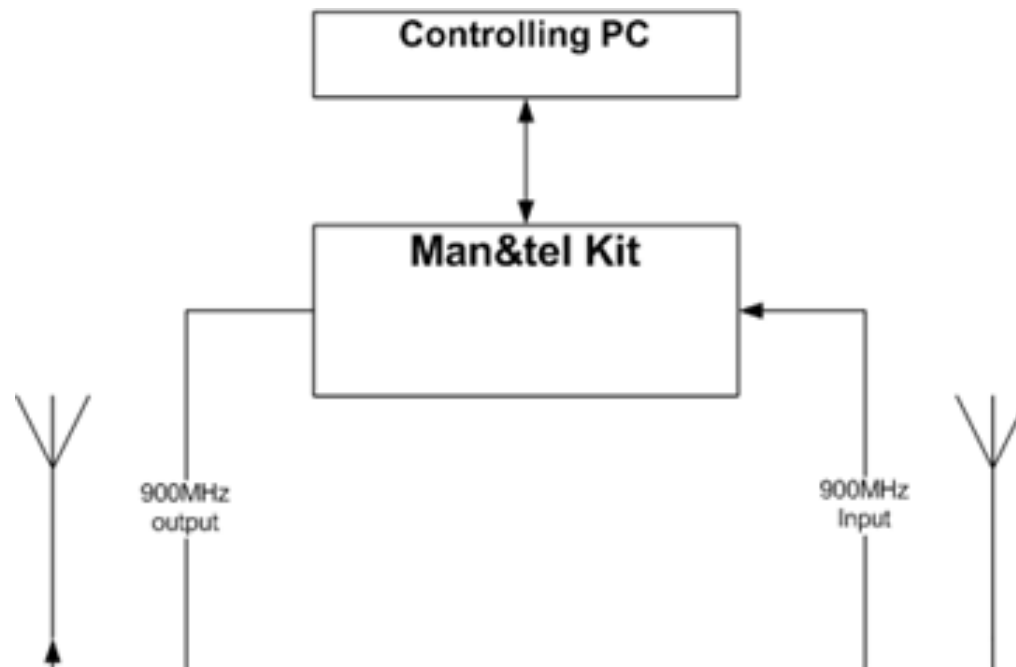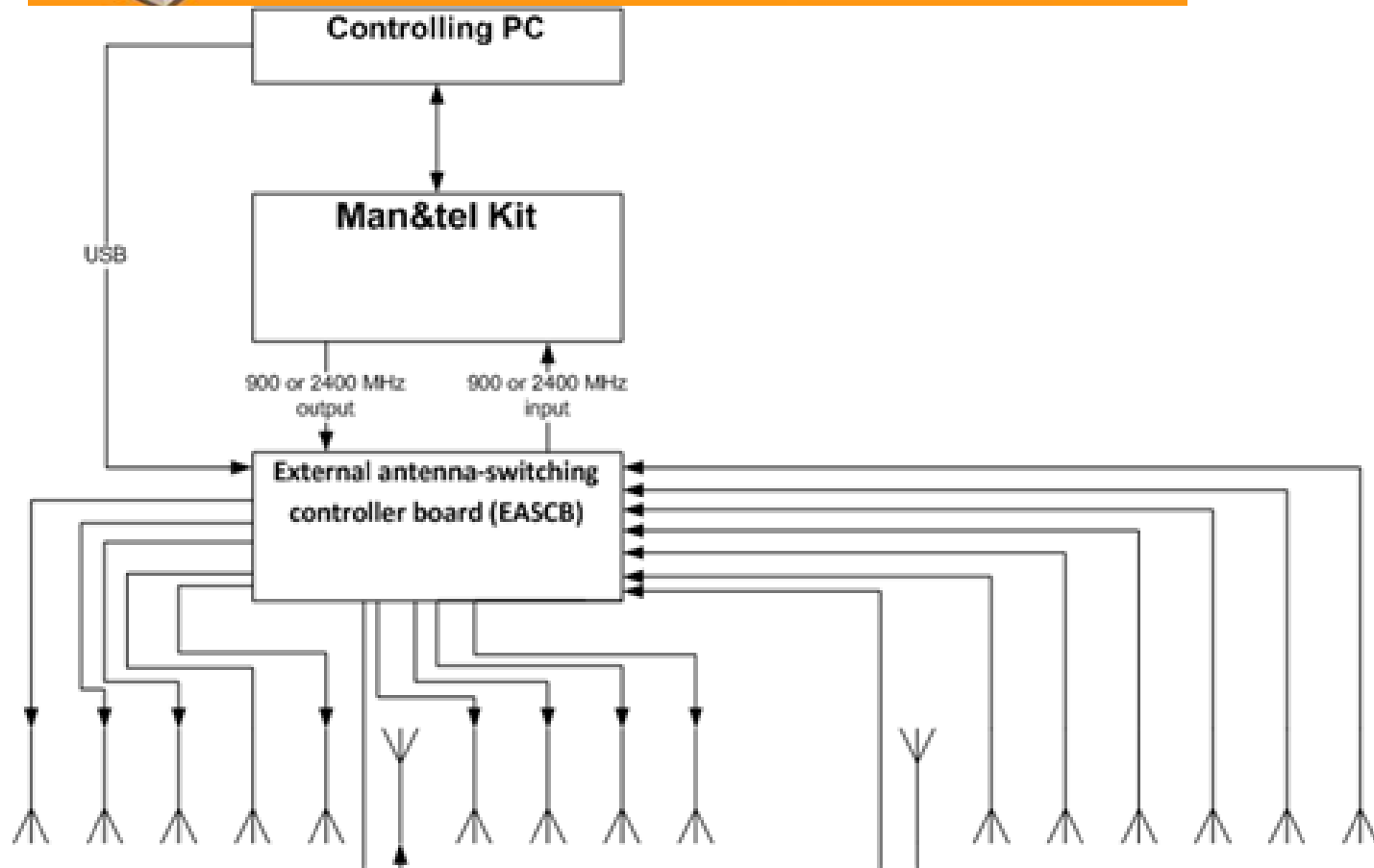
Fig.5 900MHz transmission and reception

Fig.6 Plan of the EASCB system, the antennas pointing to the top are the transmitting/receiving ones

Problems occurring with high-frequency signals

1) high-frequency signals flowing through cables cause magnetic fields around the cables and closely situated devices- the so called magnetic induction;
2) high-frequency signals can be very easily attenuated;
3) keeping signal integrity of high-frequency signals is very hard and if not done properly could cause data distortion or complete loss;
4) standing-wave problems which will make the signal to noise ratio – SNR, smaller.

Possible solutions

- We decided to use the standard analog multiplexer ADG904 – absorptive version.
- It is a 4:1MUX/SPT4 chip, which means we can use it either as a one input – four output device, or in reverse: four input – one output.
- In order to meet our requirements we will have to use four such multiplexers.

- We decided to use an USB chip, which will be controlled via USB connection and it on the other side will control the multiplexers.
- The cheapest and easiest to employ is PIC 18F4550 – by Microchip©. It costs around 5€ (depends on the dealer) and is easy and cheap to program.
- It also comes in DIP (dual inline package) package, making it easy to solder and use on a circuit board. It has an integrated USB interface and is very easy to configure on the destination machine as a HID (Human Interface Design) device.

Conclusions

▸ The idea of implementation of a remote access experimental laboratory for wireless communication systems has being presented.

▸ The future work in this area will concentrate on realization of the External antenna-switching controller board (EASCB) and extending the range of experiments available in the system and on implementing help systems for the more complex experiments detailed in the experimental roadmap.

Thank you for your attention!