

# Training Course

## "Microwave Link Engineering"

### Path 1 - Propagation & Design Issues

### Path 2 - Installation & Maintenance

**A 3 to 6-day Course with Customer options (Path1 and/or Path2)**

**Torino (Italy), Oct. 21 - 26, 2013**

You are invited to attend the course on "**Microwave Link Engineering**" organized by Radio Engineering Services (\*).

### **TO WHOM IS ADDRESSED**

The Course is designed to meet the needs of both system planning engineers (hop and network design, propagation analysis, performance predictions), and of field and operation engineers (commissioning, installation, and maintenance).

The first three days ("common path") provide a general overview of design and installation topics; they are self-sufficient if you only require a general overview in both areas.

In the fourth and fifth days, the course splits in two parallel sessions, each devoted to a more specialistic presentation of propagation/design and of installation/maintenance topics, respectively.

### **CUSTOMER OPTIONS**

We offer four customer options:

- Overview : 3-day course (Monday to Wednesday);
- Overview + More on Propagation/Design : 5-day course (Monday to Friday);
- Overview + More on Installation/Maintenance : 5-day course (Monday to Friday);
- Comprehensive (All the above) : 6-day course (Monday to Saturday).

A Sw tool for MW link design (HERALD Professional) will be used for demonstration and design exercises. The Educational Herald release will be installed on participant's Pc and is included as a part of Course documentation (complete lesson material in pdf files).

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(\*) Radio Engineering Services (R.E.S.) is a teamwork of Communications professionals based in Torino (Italy). They are active in Consulting and Training Services in the Mw Communications field, as well as in Sw development for Mw Systems design, simulation and automated testing.

## **COURSE PROGRAM**

### **\* Monday** (common path)

**Course Presentation** : Introduction to common path and to specialized paths. Installation of Herald Educational on participants' Pc.

**Introduction to MW Digital Radio** : General radio system overview. Transmitter and Receiver architecture, Full Indoor & Split systems, Trunk & Access Equipments. PDH and SDH transmission principles; IP protocol application in MW equipments. Basics on Site survey. Installation topics.

**Basics on Radio propagation** : Free Space Propagation, basic radio link equation, free space loss. Terrestrial radio links, propagation in the atmosphere, overview of main impairing factors. Link Budget and Fade margin.

**Comments, Q & A.**

### **\* Tuesday** (common path)

**Path Profile, Clearance, Obstruction Loss** : Effect of atmospheric refraction, equivalent earth curvature. Fresnel ellipsoid and visibility criteria (ITU-R Recs.). Obstruction loss estimate.

**Path Profile, Ground Reflections** : Path geometry, reflected ray loss and phase shift, major factors. Reflection coefficient. Rx power vs. antenna height and k-factor. Use of Rx diversity configuration.

**Multipath Propagation** : Atmospheric refractivity gradient, multiple ray trajectories. Rayleigh fading, activity factor. Narrowband/Wideband (frequency selective) fading. Prediction models. Countermeasures (equalization, diversity).

**Rain Attenuation** : EM wave interaction with atmosphere (water vapor, oxygen, raindrops). Rain attenuation vs. rain-rate, frequency, and polarization. ITU-R rain statistics. Prediction models.

**Comments, Q & A.**

### **\* Wednesday** (common path)

**Project Examples** : General criteria in MW Network Planning; Review of design steps. Sw tool for MW link design; Single-hop project. General criteria for path and site selection. RF channel arrangements. Interference analysis. Example of a multi-hop project.

**Topics in System Installation** : Indoor and Outdoor installations. Rack Assembly; branching configurations in indoor and outdoor systems; cables and waveguides. Basic criteria for grounding connections. Parabolic Antenna characteristics; Antenna Assembly. First set-up of equipment; Antenna Alignment.

**Basic criteria in System Maintenance** : Alarm Analysis and action over. Replacement procedures.

**Networking Overview** : Introduction to IP Protocol. Transport of IP Traffic in New generation of MW equipments. Layer 2 & Layer 3 Supervisory Networks.

**Comments, Q & A.**

END OF 3-DAY COURSE

**\* Thursday Morning** (common path)

**More on System Design :** RF bands for MW systems, ITU Radio Regulations and ITU-R Recs. Classification of interference sources in linear, radial and meshed networks. Performance degradation caused by interference. Radio Hops with passive reflectors. Performance Objectives, ITU Recs. Link availability and transmission quality. Performance objectives vs. propagation impairments.

**\* Thursday Afternoon** (specialized paths)

**Propagation & Design Issues**

**Practical problems in MW link design :** Sw tools; Digital maps (resolution, accuracy, coordinate systems); Interface to other Sw apps (Google Earth, Excel, ...). Equipment & Antenna libraries (NSMA file formats). Propagation models, role of ITU-R Recs.  
**Design Exercises :** Network Topology; Tx/Rx Configuration.

**Installation & Maintenance**

**Indoor Installation (split system) :** IF Cable; Grounding Connections, Rack Assembly; Indoor Unit Connection, PSU Connection.  
**Full Indoor System Installation :** Rack Layout Sheet 1; Mechanic Rack Specification; Positioning Metal Fittings  
Rack Cable Run: Typical Layout, Elliptical Waveguide connections;  
Elliptical Waveguide Indoor Run & Installation.

**Comments, Q & A.**

**\* Friday Morning** (common path)

**Networking Overview :** Introduction to IP Protocol. Use of IP Protocol in MW equipment. Layer 2 & Layer 3 Networks.

**\* Friday Afternoon** (specialized paths)

**Propagation & Design Issues**

**Design Exercises :** Path analysis (obstructions, reflections); Multipath (occurrence factor, outage prediction); Rain (Unavailability prediction); Interference analysis; Performance Objectives.

**Installation & Maintenance**

**Outdoor Installation :** Parabolic Antenna characteristics, Antenna Assembly, Antenna Polarization. Outdoor Units, Mounting frames, Grounding Connections. Accessories and installation materials. Flexible Wave guide; Elliptical Wave guide connections & installation. Accessories, Characteristics, typical Fixing

**Comments, Q & A.**

END OF 5-DAY COURSE

**\* Saturday** (comprehensive option)

Lessons given in "Specialized Paths" (Thursday and Friday afternoons) will be repeated on Saturday, if some student wish to attend both paths.

Additional Topics: Upon request, a special session can be arranged for small student group on training topics listed in our Course offer (see "Training" at [www.radioengineering.it](http://www.radioengineering.it)).

## INSTRUCTORS

\* **Claudio Crini** : since 2000 is a Certified Guest International Trainer at the Siemens I&C Training Institute for Mw Radio Networks; PDH/SDH Radio Systems; Transport Systems; Supervisory Systems. He graduated in Telecommunications Engineering at Florence University (1980). Employed in G.T.E Telecommunications SpA as "Chief Executive Field Engineer " for Microwave Radio Link Systems (1981-1984) with experiences in: Planning, installation and commissioning of digital Mw links in Italy, Nigeria, Ireland, Morocco, Scotland, Belgium, Turkey. Employed in O.T.E. Radiocommunications SpA (1984-1988) as Technical Project Manager for civil and military projects: NATO Radar Sites and several civil airports, in Italy, C.A.O. (Civil Aviation Organization) of EGYPT, Italian Police, U.A.E. (United Arab Emirates) Police. Employed in ELETCA SpA (1988-1991) as General Manager, Telecommunications Department. Since 1992 he worked as telecommunication consultant for Site surveys, Mw planning, installation and commissioning (Ericsson – Nigeria; Consultel – Sudan; Imart – Italy; Italtel – Russia; Nuova Pignone – Syria). From 1995 to 2008 his main activity has been Trainer for Siemens Telecomunicazioni S.p.A. From 2008 he worked as External International Trainer in Nokia Siemens Networks. He can be contacted by mail at [sidicomcr@gmail.com](mailto:sidicomcr@gmail.com).

\* **Luigi Moreno** : is a Radio Communications Consultant with more than 30 years' experience. A graduate of the 'Politecnico di Torino' (Italy), he was at CSELT (Telecom Italia Research Labs) (1973-82), then at GTE Telecomunicazioni (1982-85). Since 1985, his activity as a consultant includes many assignments with manufacturing and operating companies (software developments for radio system simulation, analysis, and testing; design of radio links and networks; training courses). He has been a delegate at several ITU-R meetings and a teacher at SSGRR (Telecom Italia Training School). He served as an IEEE Transactions Technical Reviewer. He is the author of some 30 journal and conference papers and of two patents for mobile radio receivers. He can be contacted by e-mail at [l.moreno@radioengineering.it](mailto:l.moreno@radioengineering.it).

## COURSE LOCATION

The Course will take place in Torino, at the BEST WESTERN Hotel Crimea. In a perfect position - a short distance from the city centre yet in a peaceful residential area between the hills and the river Po - Hotel Crimea offers the comfort for fruitful training in a quiet and ideal environment.

You can fly to Torino (North-West Italy) from Rome or from other main airports in Europe (Frankfurt, Paris, London, and more). Alternatively, you can reach Torino with High-Speed Trains from Milan, Rome, or Paris.