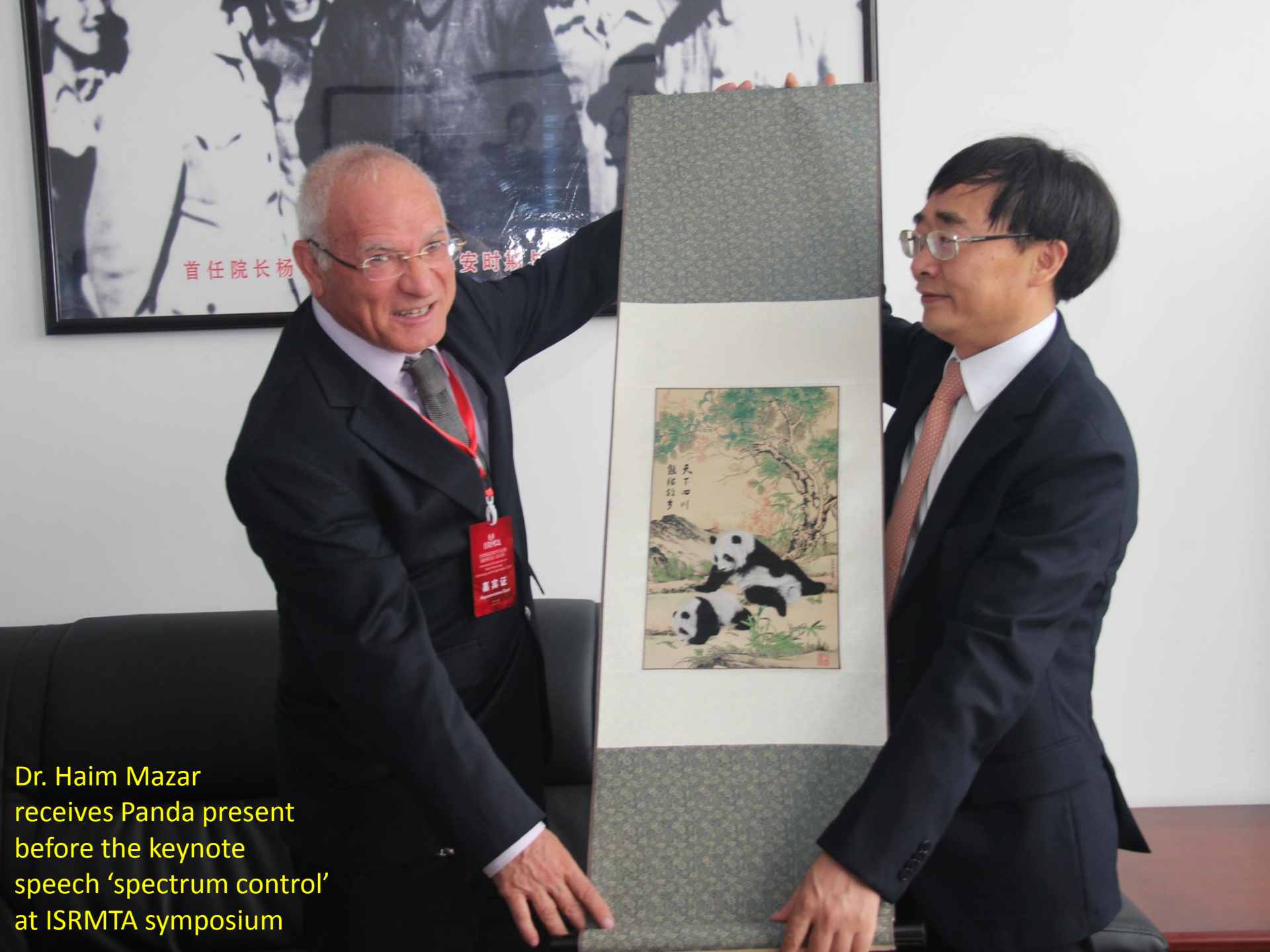
# *keynote speech*: National Spectrum Control – Spectrum Management and Monitoring: New Technologies

## Xihua University; Chengdu, Sichuan, China

12 July 2015

International Symposium on Radio Monitoring Technology and its Application


*Dr. Haim Mazar; Vice Chair* ITU-R Study Group 1 (Spectrum Management)

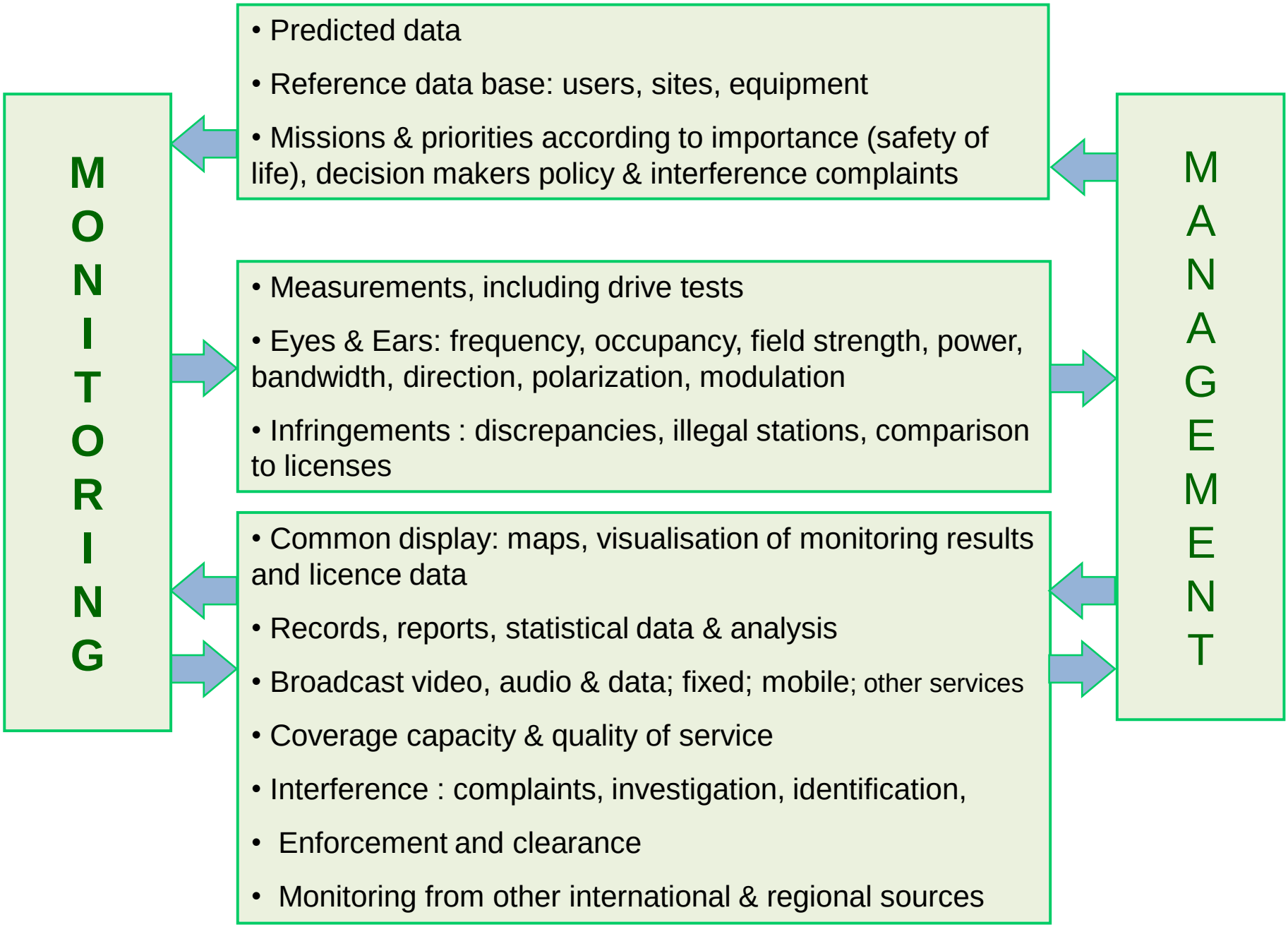



Dr. Haim Mazar
receives Panda present
before the keynote
speech ‘spectrum control’
at ISRMTA symposium

# Sources of the presentation

- 44 years of RF experience at all radio communications services
- 30 years of RF Spectrum Licensing and Monitoring
- Development of two Computer Aided Techniques for National Spectrum Management
  - Spectrum Management 'Shraga'
  - Spectrum Management System 'Iris';
- Wiley new Book '**Radio Spectrum Management: Policies, Regulations, Standards and Techniques**'
- Recommendation ITU-R SM.1370 Design guidelines for developing automated spectrum management systems
- ITU Handbook Computer-aided Techniques for Spectrum Management (CAT) 2015
- ITU National Spectrum Management 2015

# Interrelation of national spectrum management & monitoring functions



# National Monitoring (1)

Derived from coverage and propagation and national policy

- China (Mr. Chang Ruoting, Dr. Ding Jiaxin and Mr. Wang Zhixin )
  - HF Monitoring: SRMC responsibility; 9 stations: Beijing, Harbin, Shanghai, Fujian, Shenzhen, Chengdu, Yunnan, Shanxi and Urumqi; Beijing is ITU international monitoring station
  - VHF/UHF Monitoring: provincial stations implement VHF/UHF monitoring, including listening, measuring and interference location.
  - Space Monitoring: SRMC responsibility; in Beijing and Shenzhen
- France
  - 46 (in 2013, 57 in 2006) monitoring stations, controlled from 7 regional offices
  - 6 regional services (Aix- Marseille, Donges, Lyon, Nancy, Toulouse and Villejuif) operating 35 fixed V/UHF DFs & 11 fixed with movable directive antennas, connected to 7 centers. In addition 4 mobile DFs, 25 transportable stations, 24 laboratory vehicles & 1 vehicle for SHF to monitor the satellites and radar bands. To monitor HF a fixed ant. field of 34 hectares in *Centre de contrôle* ***international*** Rambouillet: 6 diamond high gain ant. for global control, 1 DF on a mobile laboratory vehicle & access to the Ministry of Defence network.
  - ANFR may close the French remote controlled stations

# National Monitoring (2)

- Germany (Ralf Trautmann)
  - About 85 fixed monitoring stations (manned ones, as well remote controlled ones with and without direction finders)
  - 99 measurement vehicles
- UK (Steve Ripley)
  - Ofcom's monitoring station: Baldock in Hertfordshire
  - 70 field cars
  - network of remotely accessible monitoring stations across the UK
- USA (James Higgins): approx. 110 monitoring site- including fixed, mobile and portable
  - 23 FCC offices include 1 fixed monitoring VHF/UHF, 2-4 mobile DF/monitoring vehicles at each office & transportable/portable sites.
  - FCC operates 14 fixed HF sites

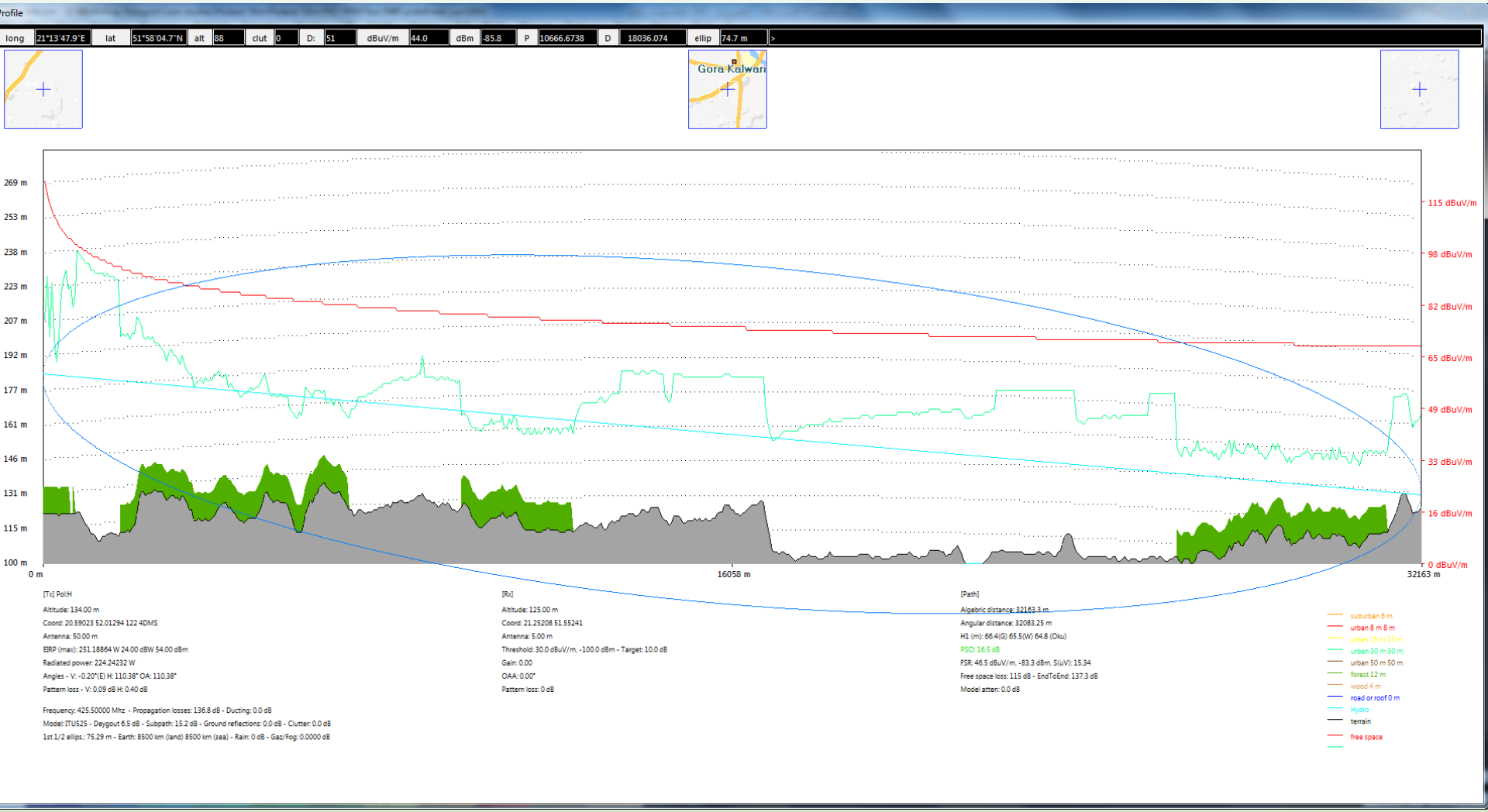
# Items which need to be regulated

1. RF allocations to radio services; follow ITU Radio Regulations
2. Assignment of licence and RF to Tx Stations
3. Fee collection: RF License & annual fees
4. Equipment Type approval; EU R&TTE is liberal
5. Coordination with neighbour countries (no borders to the ElectroMagnetic waves)
6. Notifying ITU to the Master International Frequency Register (MIFR) e.g. http://www.itu.int/ITU-R/eBCD/ePub.aspx
7. External relations: toward ITU, International and Regional orgs see http://eprints.mdx.ac.uk/133/2/MazarAug08.pdf p. 179

# Roles of the National Spectrum Management

1. Avoid and solve interference
2. Design long and short range RF spectrum
3. Support engineering: propagation, coverage…
4. Coordinate with military wireless services
5. Advance new wireless technologies (such as digital audio and video, cognitive radios)
6. Coordinate with other Administrations
7. Advance new technologies and efficient import of equipment
8. Serve your clients, the public: be transparent
9. Reduce RF human hazards

# ATDI ICS telecom – profile analysis window the basics of all engineering work



# Roles of RF monitoring

- Ensuring operation of transmitters in conformity with national and international regulations and licence conditions
- Verification of proper technical and operational characteristics of authorized transmitters
- Detection and location of unauthorized transmitters and interference
- identification and resolution of interference problems
- Measuring spectrum occupancy
- Validation of propagation and sharing models

# Analyses in multi-domains

uses data from Recommendation ITU-R SM.2039 Table 1

| Level vs. Time | Level vs. Frequency | Frequency vs. Time | In- phase vs. Quadrature-phase | Space vs. Frequency |
|---|---|---|---|---|
| amplitude, pulse, eye-diagram | spectrum, occupancy, unwanted emissions, mask of emission, noise | frequency stability, RF offset, frequency hopping | constellation-diagram, EVM (Error Vector Magnitude), phase offset | multi-channel direction finding |

# Priorities in Licensing: derived from worldview and policy considerations

- national security
- emergency communications
- law enforcement
- safety-of-life, aviation, maritime
- space communications
- Scientific

# How to manage the RF Spectrum

1. Follow Regional Allocations and Assignments; try to ease circulation of equipment
2. Coordinate (bi-lateral and multi-lateral) with your neighbours
3. Even in China, don't invent specific allocations; with whom do you want to be identified? Follow its rules and standards
4. Transparency; light touch(?); central-based or market-oriented? Auctions?
5. Try **not** to allocate to fixed transmitters and receivers (e.g. TV from air), if there is an alternative (cable or satellite)
6. Allocate RF spectrum with a vision towards implementing in many cases markets
7. Ensure the effective (reuse) and efficient (bits/hertz) use of the RF Spectrum
8. Decrease Interference by assigning: min power, min bandwidth, max RF

# Trends in Spectrum Management: decrease time scales & wireless innovation & entering new technologies

- WARC-1992 designated 1,885-2,025 MHz & 2,110-2,170 MHz for IMT-2000; in NTT DoCoMoJapan operated UMTS in 2001
- 2.6 GHz was allocated at WRC-2000; LTE systems at 3GPP band 3 UL 2,500 MHz–2,570 MHz and DL 2,620 MHz–2,690 MHz were launched end of 2010
- 790-862 MHz was agreed at WRC-2007. Vodafone launched its 800MHz LTE network in Germany in December 2010.
- 694-790 MHz (called the '700 MHz band'), in ITU Region 1, started at WRC-2012 & may come into force in 2015. German regulator, raised on 19 June 2015 €5.08 billion in 700 MHz, the GSM bands (900 MHz and 1800 MHz) & L-band (1452–1492 MHz)

# Trends in Spectrum Management: spectrum efficiency

- Despite spectrum scarcity, most spectrum is unused even in developed countries
- Only FM, Cellular and 2.4 GHz (train problems in Shenzheng from 2.4 GHz Wi-Fi) bands are densely globally occupied
- Cognitive Radios & white space devices improve the spectral efficiency
- Advanced spectrum sharing licensing:
  - Licensed Shared Access (LSA) in Europe or
  - Dynamic Access to Spectrum (DAS) in America

# Promoting New Technologies

- Australia decided in 2000 to license only digital technologies
- Defining what is harmful interference; don’ t exaggerate with to both directions
- Ultra Wide Band (UWB)
- soft defined radios  (SDR), cognitive radio systems (CRS) and white space devices improve the spectral efficiency.
- MIMO and other adaptive antenna technologies can readily change the C/I
- Power Line Telecommunications advance broadband

# Techniques reducing interference

- Dynamic Frequency Selection (DFS)
- Spread Spectrum modulation
  - direct-sequence spread spectrum (DSSS)
  - frequency-hopping spread spectrum (**FHSS**)
- Detect And Avoid (DAA)
- Listen Before Talk (LBT)
- Transmitter Power Control (TPC)


Internet +
Intelligent
trum Sensing
Management

# Related author's publications & presentations

- Worldwide, Regional and National Unlicensed and Unprotected RF allocations, for Wireless Network Access (including Social Issues) ; ITU-T workshop all-star network access; Geneva, 2-4 June 2004
- *An Analysis of Regulatory Frameworks for Wireless Communications, Societal Concerns and Risk: the Case of Radio Frequency (RF) Allocation and Licensing* Boca Raton Florida: Dissertation.Com, 2009
- A Comparison Between European and North American Wireless Regulations, presentation at the 'Technical Symposium at ITU Telecom World 2011' www.itu.int/worl2011 on 27 October 2011; hyperlink to the slides presentation, 27 October 2011
- International, Regional and National RF Regulation and Standardization; presentation at "Ruppin Academic Center", 31 December 2013
- Academic_Course_Engineering_2015.pdf
- Academic_Course_Services_2015.pdf
- Academic_Course_Regulation_EMC_HumanHazards.pdf

U may visit my web site http://mazar.atwebpages.com/; Dr. Haim Mazar (Madjar) mazar@ties.itu.int



Any Questions ?

# ISRMTA Exhibition


Chang Ruoting; director frequency planning division; radio regulatory bureau of the Ministry of Industry and Information Technology ; P.R. China