ITUEvents

ITU-ML5G-PS-036: Radio Link Failure Prediction Challenge

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22 July 2020

ITU

AI/ML in 5G

Challenge

Applying machine learning in communication networks

ai5gchallenge@itu.int

Register here

Join us on Slack

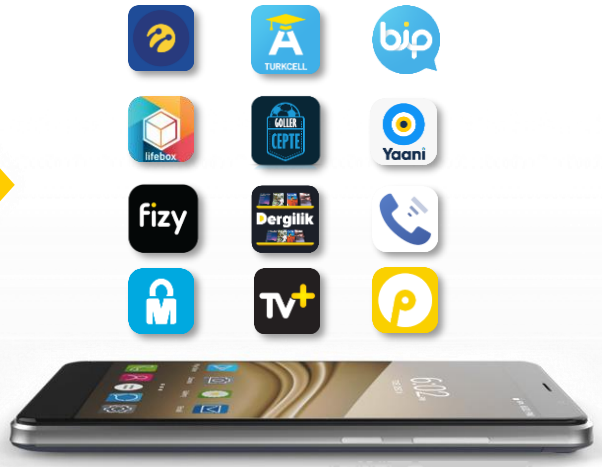
Sponsors

Organizer

Turkcell Group Snapshot

Network Provider

Experience Provider



- **THE DIGITAL OPERATOR**
- **~50 MILLION** TURKCELL GROUP SUBSCRIBERS in **5** COUNTRIES
- **~170 MILLION** DIGITAL SERVICES DOWNLOADS GLOBALLY
- **~86 MILLION** DIGITAL SUBSCRIBERS GLOBALLY
- LISTED ON NYSE & BORSA ISTANBUL **WITH A $5 BILLION MARKET CAP**

R&D Projects

11 R&D Projects

H2020, TÜBİTAK, CELTIC+ funded

SDO Activities

RAN 2

3GPP A GLOBAL INITIATIVE

ITU — Focus Group **Vice-chair**

5G TR FORUMU

5G PPP — 5G IA

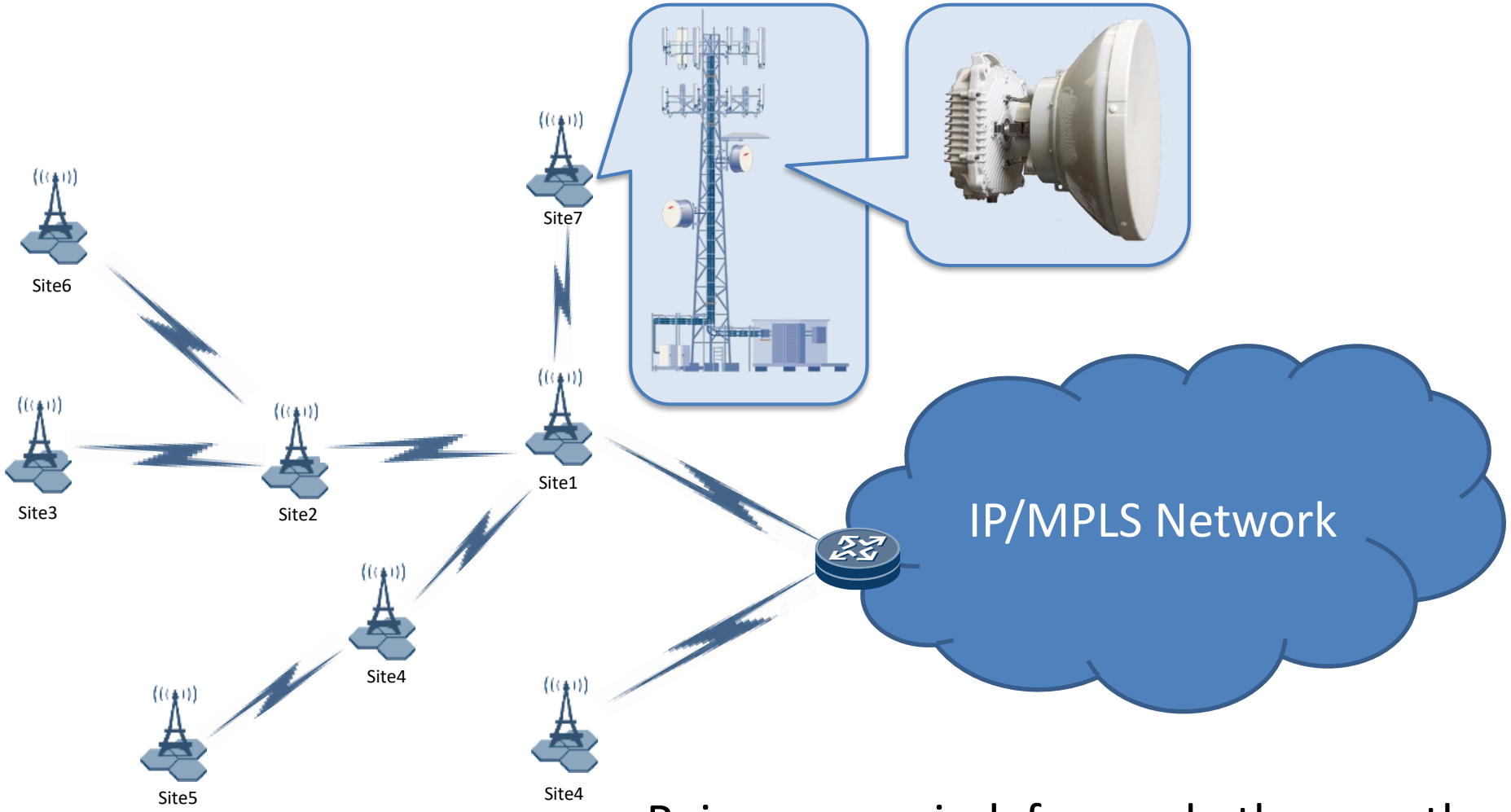
ngmn the engine of broadband wireless innovation

ONF

TELECOM INFRA PROJECT

The Challenge

Background



Rain, snow, wind, fog, and other weather-related phenomena affects the performance of radio links

A 2017 Survey on Weather-based disruptions

A Survey on Network Resiliency Methodologies against Weather-based Disruptions

Massimo Tornatore *, Joao André [xiii], Péter Babarczi ¶, Torsten Braun **, Eirik Følstad ‡‡, Poul Heegaard ‡‡, Ali Hmaity *, Marija Furdek §, Luisa Jorge ‡, Wojciech Kmiecik [xii], Carmen Mas Machuca [x], Lucia Martins [xiv], Carmo Medeiros [xiv], Francesco Musumeci *, Alija Pašić ¶, Jacek Rak‖, Steven Simpson [xi], Rui Travanca ††, Artemios Voyiatzis †

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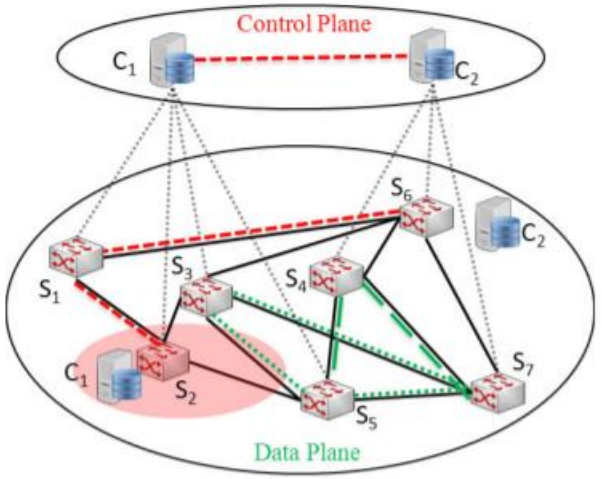
‡ Instituto Politécnico de Bragança and INESC Coimbra, Bragança, Portugal
§ KTH Royal Institute of Technology, Stockholm, Sweden
¶ MTA-BME Future Internet Research Group, Budapest University of Technology and Economics (BME), Hungary
‖ Gdansk University of Technology, Faculty of Electronics, Telecommunications and Informatics, Poland
** University of Bern, Switzerland, † SBA Research, Vienna, Austria
†† Dept. of Civil Engineering, Universidade de Aveiro, 3810-193 Aveiro, Portugal
‡‡ Norwegian University Of Science and Technology, Trondheim, Norway
[x] Technical University Munich, Germany, [xi] Lancaster University, United Kingdom
[xii] Wroclaw University of Technology, Poland
[xiii] National Laboratory for Civil Engineering (LNEC), Lisbon, Portugal
[xiv] Dept. of Electrical and Computer Engineering & INESC, University of Coimbra, Coimbra, Portugal

Fig. 1. Antennas mounted on a lattice tower (on the left), antennas mounted on a monopole (on the right).



A 2009 paper on the effects of weather and foliage

IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 58, NO. 8, OCTOBER 2009 4023

The Effects of Tropical Weather on Radio-Wave Propagation Over Foliage Channel

Yu Song Meng, *Student Member, IEEE*, Yee Hui Lee, *Member, IEEE*, and Boon Chong Ng, *Senior Member, IEEE*

ig. 1. Plantation under measurement.

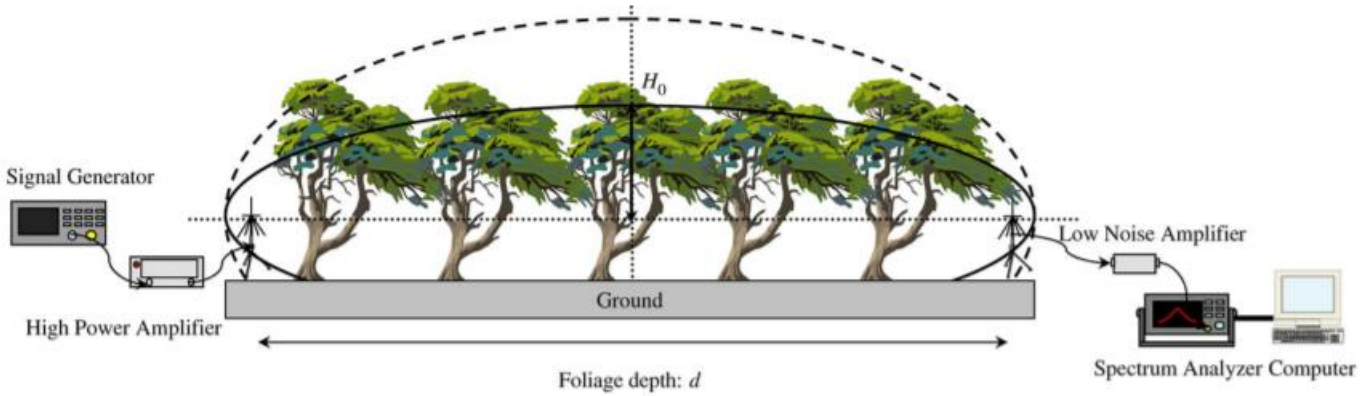
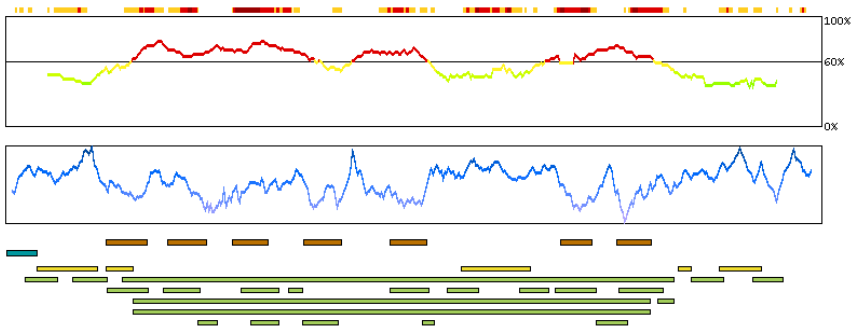


Fig. 2. Schematic diagram of the measurement setup and generic views of the first Fresnel zones (240 MHz _ _ _ _; 700 MHz _____).

Problem

- Given the region-wise, historical data sets on radio link (RL) performance and weather forecast predict the RL failures to assess risks



Dataset

- Training data includes pre-processed and anonymised RL KPIs from our networks and time-aligned weather data.
- RL data
  - KPI data includes date/time, frequency band, link length, error and failure statistics, availability ratio, stability score, capacity, modulation (128QAM, 256QAM, 512QAM, …)
- Weather data
  - Forecast data includes status, temperatures, humidity, wind speed and direction for the following 5 days (Recorded twice a day)
  - Measurement data includes temperatures, humidity, wind speed and direction, precipitation and overcast (Recorded hourly)
- Distances
  - A matrix that gives distance for weather stations and RL sites

rl-kpis

type	RL equipment vendor
datetime	Date and timestamp
end-point	link end-point (NEAR/FAR)
mlid	Mini link ID
mw_connection_no	Unique internal connection ID
site_no	Site no
site_id	Site ID
polarization	RL antenna polarization (Vertical/Horizontal)
card_type	RL modem card type
adaptive_modulation	Whether adaptive modulation is available
freq_band	Frequency band
link_length	Distance between two sites (LOS)
severaly_error_second	Count of 1 sec periods with error that covers >=30% of the frame
error_second	Count of 1 sec periods with error
unavail_second	RL unavailable operation duration in seconds
avail_time	RL active time in seconds
bbe	Indicator of performance degredation. Background bit error count.
rxlevmax	RL received power level
scalibility_score	enabled
capacity	RL capacity
modulation	Modulation deployed

rl-sites

site_no	Site no
site_id	Site ID
clutter_class	E.g. average-dense-urban, open in urban, sparse tree, etc.

met-stations

station-no	Weather station no
clutter_class	E.g. average-dense-urban, open in urban, sparse tree, etc.

distances

RL_xyz	Radio link site
WS_123	Weather station no

Submissions

- Predictions for RLF for the test data set (in CSV format)
- Trained ML model
- Design documentation and documented code
- Presentation on the approach, solution and results

Evaluation criteria

- Participants must use the provided data set to **train** a machine learning algorithm
- The output of the ML algorithm should be able to **predict** the performance obtained in a **new** network deployment
- The choice of the ML approach is decided by each participant
- A test data set will be provided to evaluate the performance of the proposed algorithms
- The evaluation of the proposed algorithms will be based on the average squared-root error obtained along with all the predictions compared to the actual result in each type of deployment
- The winners will be given prizes (and may be invited to publish the results in an academic publication or present in a conference, etc)

Turkcell Contacts & Challenge website

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https://www.itu.int/en/ITU-T/AI/challenge/2020/Pages/Turkcell.aspx

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