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Radio Link Failure Prediction

Project for WIN « Wireless Intelligent Networks » students

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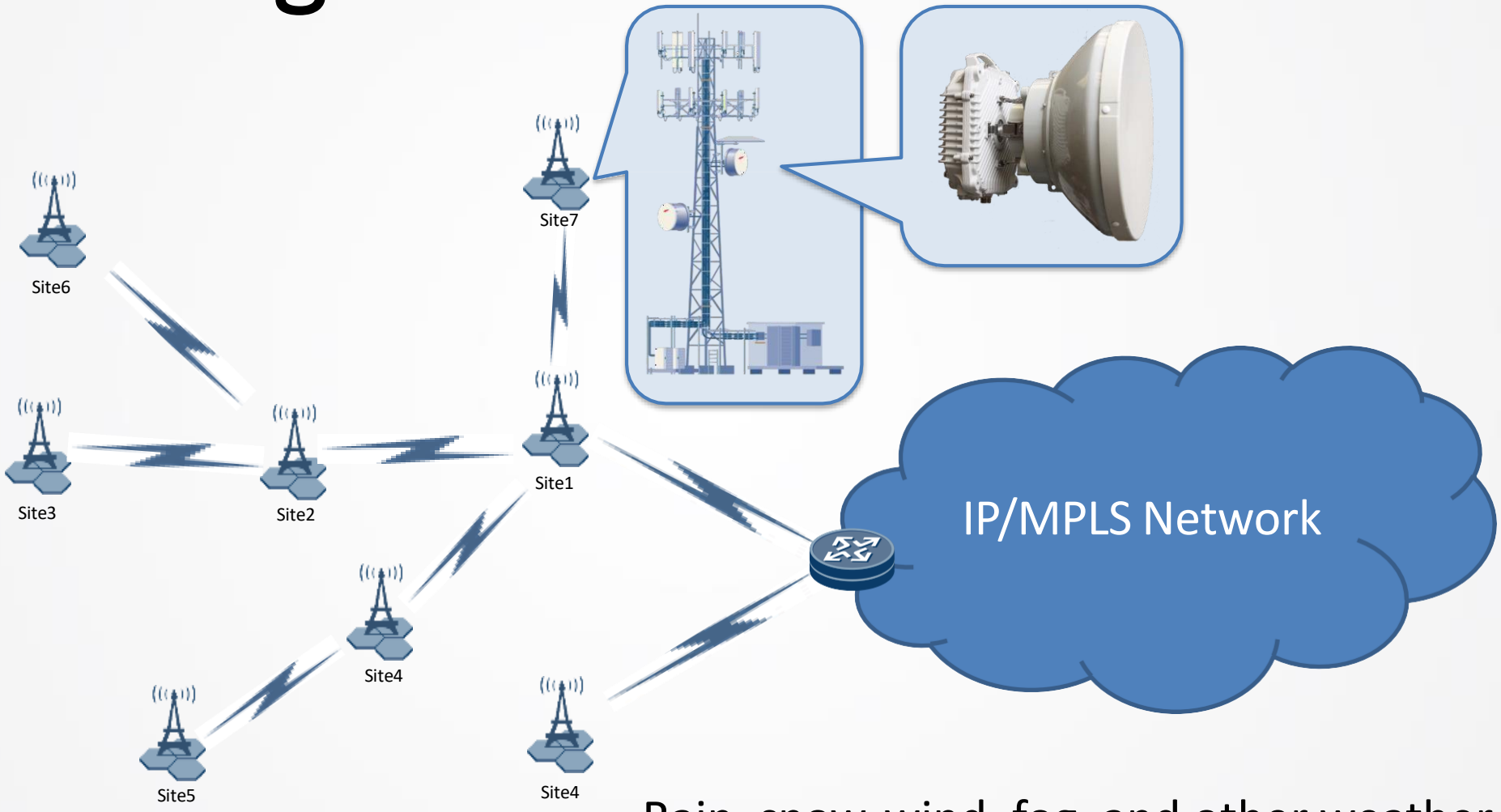
Background



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

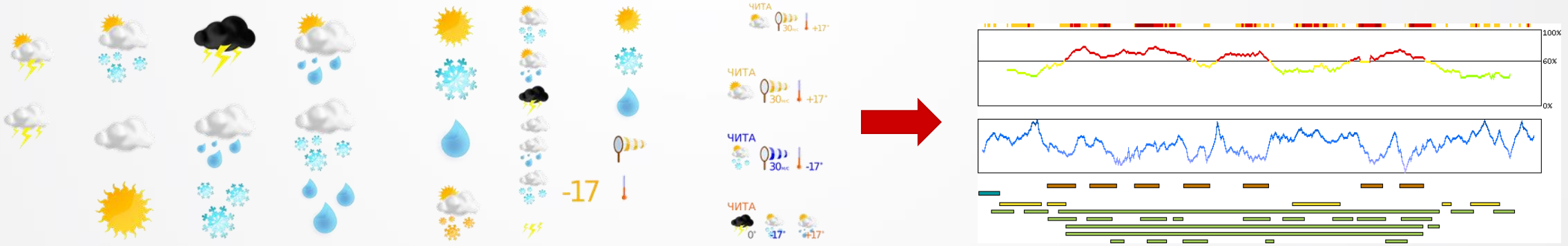
Network resiliency against weather-based disruptions

- The impact of weather conditions on wireless channel quality, is modeled with a specific emphasis on the structural impact of winds on cellular towers.
- Protection strategies were proposed in wireless networks (mostly, WMNs and FSO network), wired networks and converged networks.
- The importance of these topics is expected to grow in the next years considering the important role that wireless links are expected to play in 5G networks (both in the access and backhaul segments) and the increasing occurrences of extreme weather conditions associated to global warming.

Source: M. Tornatore et al., "A survey on network resiliency methodologies against weather-based disruptions," 2016 8th International Workshop on Resilient Networks Design and Modeling (RNDM), Halmstad, 2016, pp. 23-34, doi: 10.1109/RNDM.2016.7608264.

Problem

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



Datasets (1/2)

- Training data includes pre-processed and anonymised RL KPIs from the 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

Datasets (2/2)

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

Evaluation criteria

- Data Collection & feature engineering
- Students 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/DL approach** is decided by each group.
- The **test dataset** will be provided to the students to evaluate the performance of the proposed algorithms.
- Different evaluation criteria should be proposed and used.

Thank you

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