



Service availability

27.11.2024.
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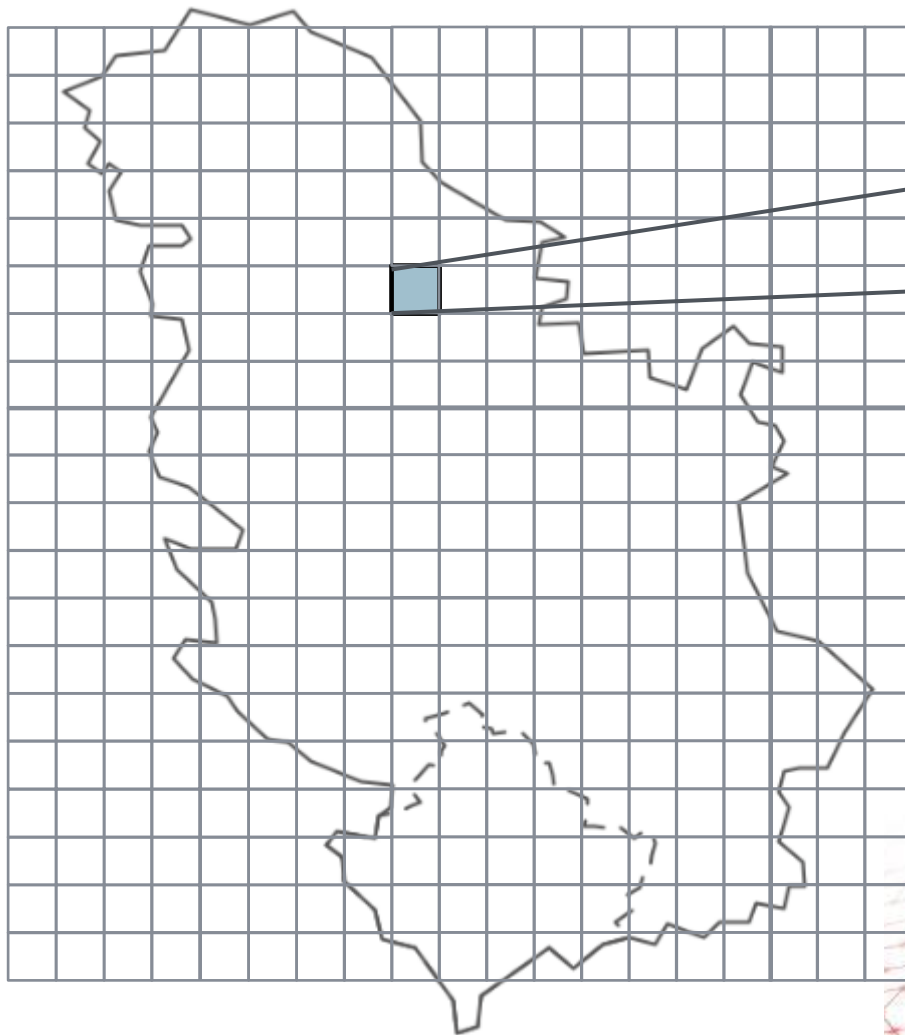
Intro



Legacy Availability calculation

- Calculated per technology (GSM, LTE...) – blending not possible
- Based on UPTIME of system components and each component is of equal importance
- Metrics used and guaranteed by vendors are based on PHYSICAL OPERATIONAL STATUS of equipment, software availability not guaranteed at all
- GSM/UTRAN/LTE availability was 99.82% in week 40 = 99.82% of installed resources (base stations, sectors, cells) were fully available in that period
- Not possible to estimate user impact
- Good measure of **infrastructure stability**
- Each site (un)availability contributes in exactly same way to overall availability

Data



- There are 982,086 data geo points in calculation
- Each square is 80m x 80m
- Territory without population is not represented, there are no uninhabited squares in calculation
- Geo point attributes:
 1. Number of users
 2. Cells with "good enough" coverage of the area, all technologies
 3. length of roads

Service availability calculation



Served by **1** server



Draft for internal discussion

Service availability calculation



Served by **2** servers

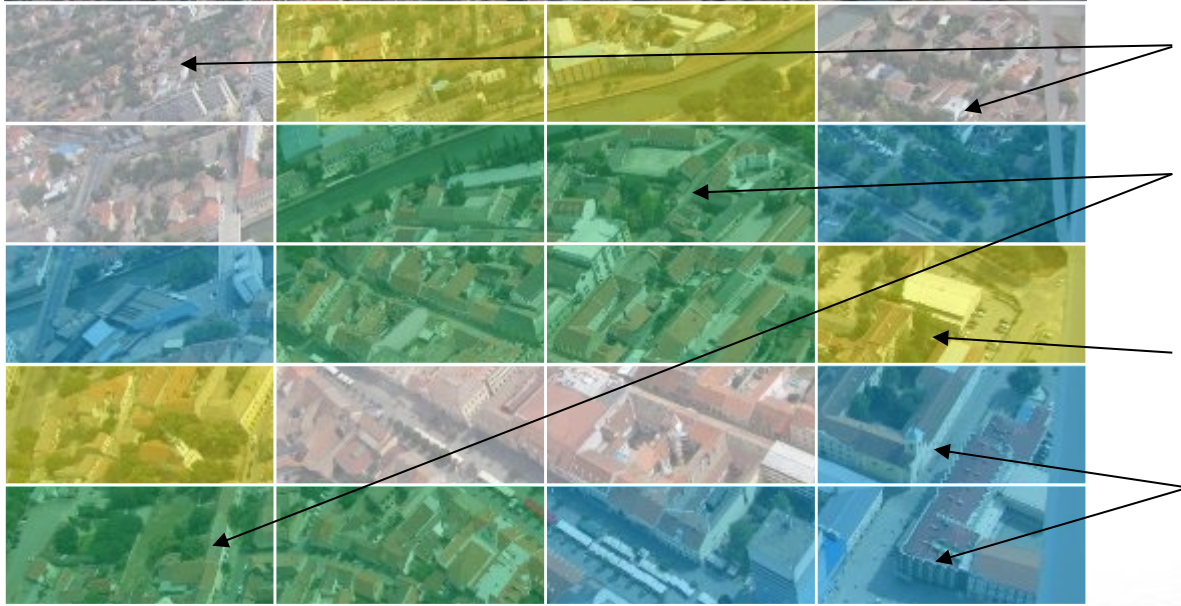


Served by **1** server



Draft for internal discussion

Service availability calculation



Served by **1** server



Served by **2** servers



Served by **1** server



Served by **4** servers



Draft for internal discussion

Service availability calculation



Outage of one server,
potential impact

Service not available where
single server

Calculate congestion for
alternative servers...

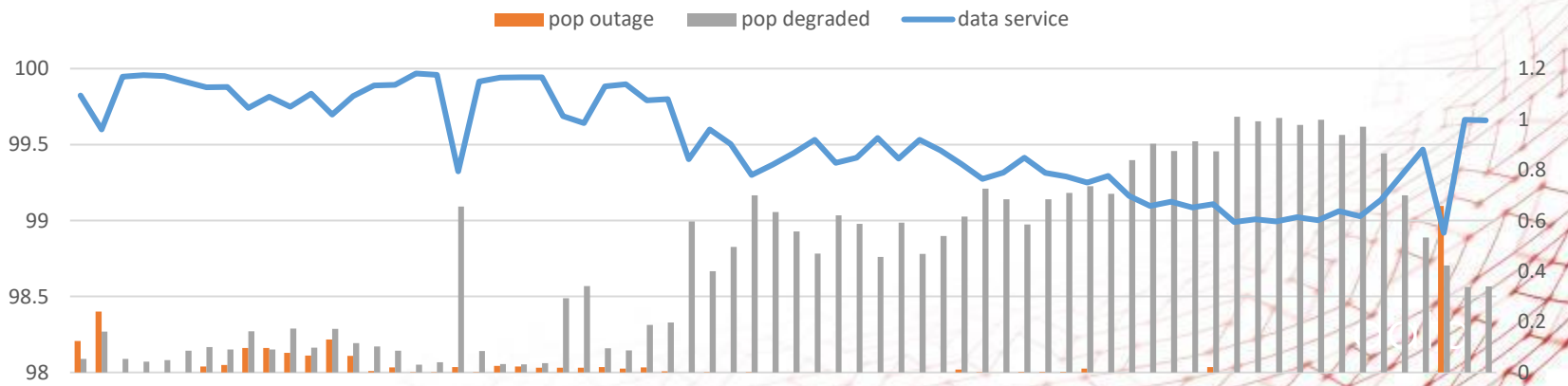
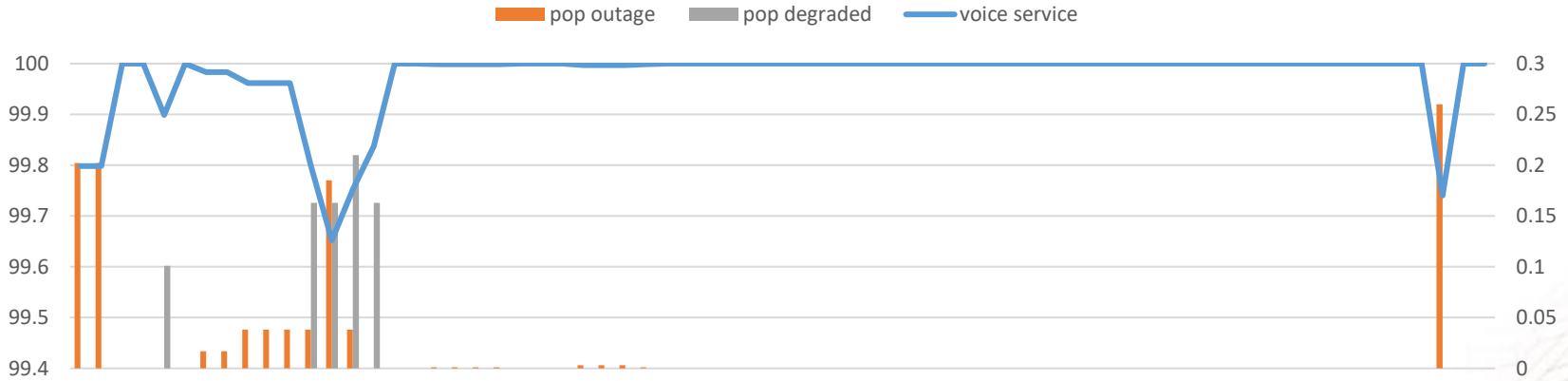
Alternative servers congested

Alternative servers not
congested (no impact on
service in that area)

Service Availability calculation

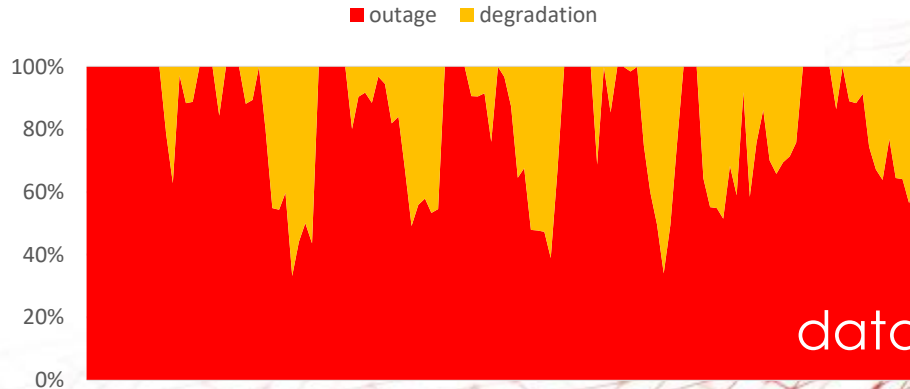
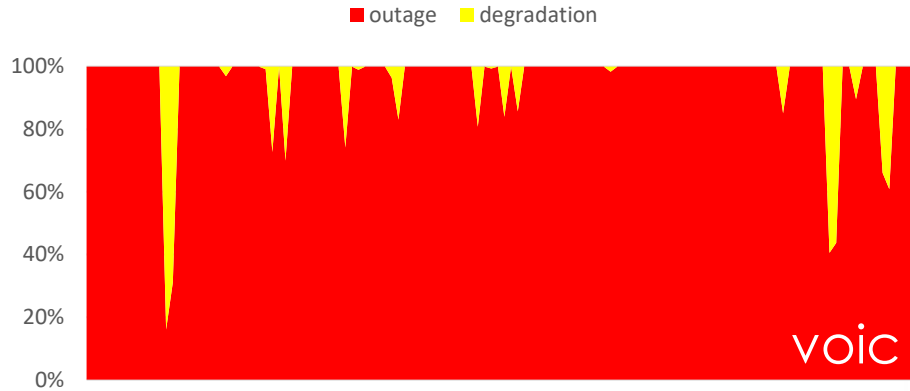
- Calculation is based on number of **users** affected by network outages rather than availability of network equipment itself
- Building block for all calculations is 80m x 80m bin with some people inside
- Split of 2G/3G/LTE voice users is used – assigning user to distinct technology
- 2G layer is considered as potential backup for 3G and LTE voice users
- 3G layer is considered as potential backup for LTE voice users
- 3G layer is not considered at all for data service availability, only LTE
- When outage is detected and if at least **one** of remaining servers is congested it is considered as degradation of service for voice
- When outage is detected and if at least **half of total data** servers are congested or in outage it is considered as degradation of service for data

Results – one day



Results

Total service outage is much more likely than degradations for voice, not so for data



Results

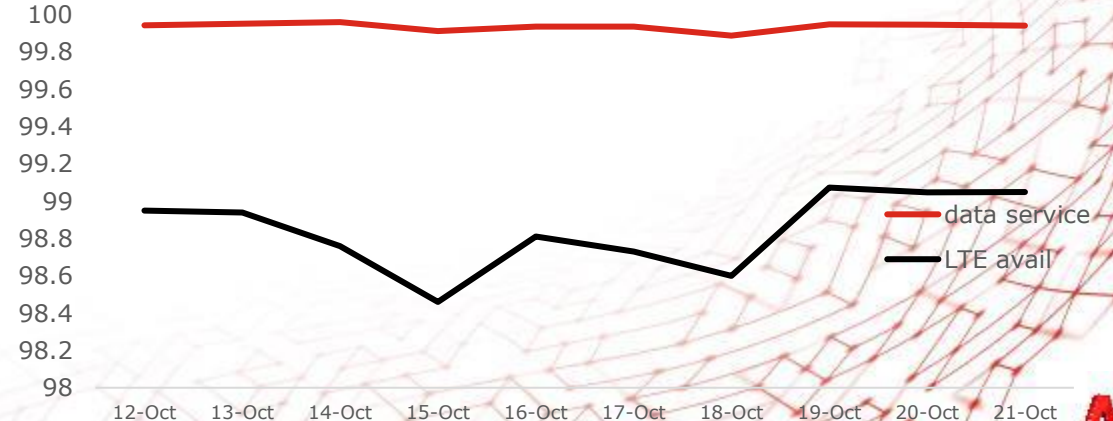
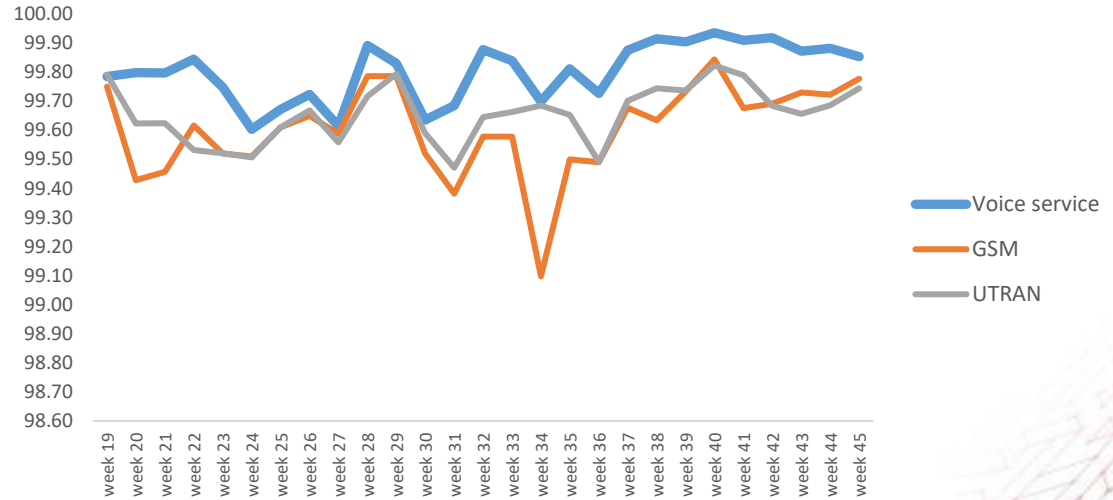
99.80% of population enjoyed full availability of voice service

99.87% of population enjoyed full availability of data service

LTE, 2G and 3G are both considered voice servers

3G is not considered as backup data server for LTE users

Availability - voice service



Impact analysis

- On a specific day there were **690** users that had problems with voice service between 11:15 and 11:30
- Of those affected, **110** had complete outage and **550** experienced congestion
- During whole day, for average 106 users voice service was unavailable (overall number of active voice users is in 1.2-1.3 Mio range)
- During whole day, for average 821 users data service was unavailable (overall number of active data users is in 1.6-1.7 Mio range)



Site	users affected
WGM3127_Milanovac_1	355
WNI4005_Autoput_Aleks	225
SO_2665_Kula_extended	43
WNI4272_Sveti_Prohor_Pcinjski	34
WKG3424_Puhovo	33
WKS3258_Mrmos	1



Thank you

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Đorđe Dubaić
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