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STUDY 23 · 5G RADIO COVERAGE PLANNING

Radio Coverage Plan of the Czech Republic for 5G and Higher-Generation Networks Why coverage maps disagree - with each other and with what user's experience - and three paths to a more truthful picture of 5G coverage

STUDY 23 — prepared by Grant Thornton for the Ministry of Industry and Trade of the Czech Republic under the National Recovery Plan · November 2024

AT A GLANCE

Decision-makers draw on several sources of coverage information that sometimes differ markedly from one another — and from customer experience. The study explains why, and finds most of the differences logical and explainable.

Reporting coverage as received power (dBm) alone — without terminal antenna gain or signal quality — is *regularly very misleading* and a chief source of the perceived mismatch between published predictions and user experience.

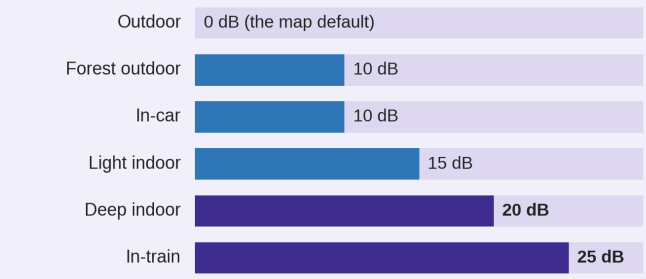
Coverage is service-specific: ultra-reliable low-rate services tolerate weak signal far better than enhanced mobile broadband, so one map cannot serve all 5G use cases — and white spots differ per service.

All Czech 5G networks operate in NSA mode: terminals camp on 4G, and the 5G icon only signals a 5G overlay somewhere within reach of the serving cell.

Czech auction coverage thresholds (e.g. RSRP −118 to −100 dBm, SINR −5 dB) sit at the very edge of terminal sensitivity: coverage can be formally met yet fall well short of the advertised 5G experience.

Same signal, different realities

Additional signal loss by environment (dB) — typically ignored by published maps



Rolling stock often attenuates by more than 30 dB, depending on train position (ch. 7).

Why dBm alone misleads

~80 % of voice calls are made indoors — yet maps usually predict outdoor coverage only

+3 dB more power a terminal needs when channel bandwidth doubles (10 MHz → 20 MHz)

2 inputs coverage needs field strength AND signal quality (SINR); most reports show received power (dBm) only

What the study covers

The study dissects what "mobile coverage" actually means before any number is quoted: the physics of field strength (dBµV/m, dBm) and signal quality, terminal sensitivity as it varies with frequency band and channel bandwidth, coverage environments from outdoor to deep indoor and in-train, and the sharply different coverage needs of 5G service classes. It then examines how coverage is evaluated — physical drive/walk tests versus computer prediction (from Okumura-Hata to the ITU-R P.1812-4 model used by the Czech regulator ČTÚ), what

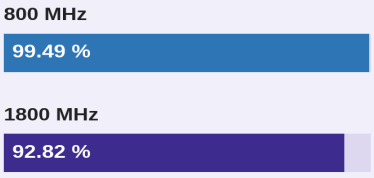
data any prediction requires, and why operator and regulator maps legitimately disagree. Closing chapters assess the feasibility of an independent national prediction tool, white-spot detection, coverage in emergencies and on trains, auction coverage obligations, and three recommended paths to more realistic coverage information

Why the maps disagree — and why coverage is not capacity

Every prediction rests on three pillars: local data (terrain, morphology), a propagation model, and network data only operators possess (site positions, power, antenna patterns, tilt, MIMO). Operators mostly tune their proprietary models; ČTÚ applies a firmly defined ITU model — so their maps must differ.

One operator, two bands

O2 population coverage (ČTÚ V-portal)



Speed needs several bands combined — but each band covers a different area.

Coverage ≠ capacity

One LTE-A sector, 10 MHz (256-QAM, 8×8)

In single-frequency networks rising traffic also erodes coverage at cell edges.

Two predictions, both "right"

Operator model
proprietary, tuned by the operator against its live network

ČTÚ · ITU-R P.1812-4
fixed international method (partial calibration only)

Different model structures → the maps must differ. Neither models interference.

Switching off 2G shrinks coverage

2G radiates 33 dBm in a 200 kHz channel; LTE uses ≥ 1.4 MHz at 23 dBm, so 2G reaches farther. A full 2G shutdown would cost coverage at the edges — in places even emergency services.

White spots depend on the service

A "white spot" is the absence of a required service — and each 5G use-case class (eMBB, URLLC, mMTC) has its own coverage definition, so uncovered places differ significantly service by service.

Resilience can be designed in

When a cell fails, its load shifts to neighbours and overloads them. An "umbrella" macro cell overlaying small capacity cells brings overlap that stabilises coverage in outages.

Measurement is the ground truth

Drive/walk tests are the only source of precise, complete data including interference — but costly. Crowdsourced terminal reports with geolocation could yield a continuously updated map of real coverage.

Coverage on trains — rolling stock attenuates by over 30 dB

In-train repeater	Trackside densification	Frequency-selective windows
Roof antenna + amplifier carries the signal into coaches; no network changes needed	New sites along rail corridors; corridor must be covered ~30 dB stronger than standard outdoor	A grid of interruptions in the metallic window coating lets radio frequencies pass through
Effectiveness: **very good**	Effectiveness: **very good**	Effectiveness: **medium to low**
Cost: **medium**	Cost: **high**	Cost: **low**
Reliability: **medium — needs maintenance**	Reliability: **high — no extra equipment**	Reliability: **high — no extra equipment**

THREE PATHS TO A TRUTHFUL PICTURE OF 5G COVERAGE

1 Extend and unify the definition parameters of coverage
Require all operators to generate maps against richer, unified, markedly more detailed parameters. No fundamental obstacle — only a matter of specifying the prediction task for planning tools.

2 Extend the ČTÚ prediction tool with a tunable model
Combine a calibratable model with the same extended definition. Considerably more complicated: never officially discussed with ČTÚ; technical feasibility is not certain.

3 Build and operate an independent prediction tool
Feasible but relatively costly: server, up-to-date vector morphology, monthly network data from operators or ČTÚ, drive-test model tuning and highly qualified staff.

KEY TAKEAWAY

"Coverage" without a defined parameter set is meaningless — public information is insufficient to define it, and thereby unintentionally misleading. A decision-grade picture of 5G needs unified, service-aware definitions, quality alongside strength — and deployment targeted where services are missing.