G05 Transportation, Energy and Communication Infrastructures: Criticality, Security and Regional Impacts in the Transition Era

For Ordinary Sessions (O-)

Title: Demand–Coverage-Based Location Optimization of Data Centers in Southeast Korea: A Grid-Based Maximal Covering Location Problem (MCLP) Approach

Abstract (200 – 400 words)

In Southeast Korea (the Busan–Ulsan–Gyeongnam region), rapid diffusion of AI, cloud services, and broader digital transformation is expected to increase demand for data-center capacity. At the same time, site selection is constrained by power availability, land supply, disaster risks, and regulatory restrictions, which can reinforce both nationwide concentration in the Seoul Capital Area and intraregional spatial bias. This study aims to identify optimal data-center locations from a demand-fulfillment perspective and to propose a practical framework for screening feasible candidate sites by incorporating multidimensional location conditions, including environmental, infrastructural, and socio-economic factors. Methodologically, the study applies a 1 km grid-based Maximal Covering Location Problem (MCLP). Demand weights are constructed using proxies for data-center usage intensity, including the concentration of firms and employment (e.g., establishments and workers), public-sector and urban-core demand, and related activity hubs. Candidate sites are pre-screened by excluding areas with existing data-center locations, land-use restrictions (zoning), designated hazard zones, and flood-risk areas. To reflect real-world feasibility beyond pure coverage maximization, we additionally examine an extended model that introduces a “soft-penalty” index capturing slope, climate conditions, accessibility to power and communications infrastructure, transportation accessibility (operations and workforce considerations), and employment-related socio-economic conditions (e.g., education and quality-of-life proxies). Because the true service area of large-scale data centers is uncertain, the coverage radius (S) and the number of new facilities (P) are evaluated through scenario-based sensitivity analyses. We expect high demand weights to emerge along major industrial and business corridors, while dense residential cores with elevated disaster exposure and stronger regulatory constraints are largely excluded from candidate sets, yielding optimal solutions that converge toward low-risk, regulation-light zones near (but typically outside) urban cores and around industrial hubs. The study provides empirical evidence for a regional dispersion strategy by reframing data-center planning as an integrated optimization problem combining demand coverage, regulation, and risk. Limitations include restricted access to direct measures of traffic and grid headroom, motivating the use of public-statistics-based proxies and future validation with more granular power and telecom data.

Keywords (Max. 5): Data center, facility location, maximal covering location problem (MCLP), grid-

based optimization