CENTRAL PLACE INDEXING: OPTIMAL LOCATION REPRESENTATION FOR DIGITAL EARTH USING HIERARCHICALLY INDEXED MIXED-APERTURE HEXAGONAL DISCRETE GLOBAL GRIDS

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ABSTRACT:

The Digital Earth concept provides a compelling vision of a next generation geospatial computing application where vast quantities of distributed geospatial big data can be visualized, manipulated, analyzed, and simulated in real-time and in a manner accessible to a broad spectrum of end users. The vast majority of existing virtual globes — like almost all existing geospatial applications — are built upon approaches to the computer representation of raster and vector location that were originally developed primarily to mimic the way in which geospatial visualization and geo-referenced analysis was conducted in the pre-computer age. But, as convenient and powerful as these approaches have proven, a revolution in our fundamental approach to geospatial computing will be required in order to fully realize the promise of the Digital Earth vision. In particular, a fundamentally new location representation will be required that accurately reflects the topology of the earth, explicitly acknowledges the essential discreteness of computer location representation, and which is optimal in terms of representational efficiency and semantic fidelity. In this paper we present a systematic evaluation of the design requirements and alternatives that have led us to the optimal known system for computer location representation, which we call Central Place Indexing (CPI). CPI uses multi-precision mixed-aperture hexagonal discrete global grids to efficiently represent vector and raster location in geospatial systems, and provides a uniform optimal hierarchical spatial indexing for such representations. We provide a precise definition for CPI systems, and an overview of basic CPI algorithms.