EARTH OBSERVATION SYMPOSIUM (B1)
Earth Observation Data Management Systems (4)

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NOVEL ARCHITECTURE FOR REAL-TIME EARTH OBSERVATION AND DISASTER MANAGEMENT

Abstract

The proposed novel, flexible and expandable information architecture integrates a grid of active RFID (aRFID) geospatial/area nodes communicating with microsatellites and networks of a/pRFID devices (systems-on-chips, labels, buttons, etc.) with linkages into the legacy cyberspace and rests on the constellation of satellites, mobile autonomous platforms, flexible engineering systems, and agile and reconfigurable structures for real-time Earth observation, data processing, dissemination, and actionable communication (real-time command and control and decision-making). The novelty and practical value of the proposed cyberspace is in its focus on the "RF-carried" data flows sustained by the active RFID grid, microsatellites and constellation of satellites in a geo-stationary orbit. Active RFID-embedded linkages will tap into the legacy data repositories as needed; whereas, wireless data flows, satellite data residence, and links that "commute to and from" microsatellites and geostationary satellites will pull back from the reliance on the Internet. Specific elements of the proposed information architecture function as follows: individual aRFID devices, dedicated, special-purpose, real-time data gathering and processing systems-on-chips, each assigned to a specific task are networked and communicate with aRFID geospatial nodes; the nodes gather and store data from clusters of aRFIDs, run continuous, dynamic, stochastic models, and sustain two-way, real-time and scheduled communications with one or more Low-Orbiting Satellites (LOSs); a multiplicity of LOSs, placed in a variety of polar orbits to maximize their access by Nodes, communicate with Geostationary Satellites (GSOs) and may have inter-satellite links with one another; and GSOs communicate with LOSs, selected Nodes and legacy Earth-based control stations and relay to other satellite constellations in Geosynchronous orbits. This study examined the performance of the various communications links and determined that the global information architecture is viable, and its most critical communication link, the aRFID – LOS link leg, will enable a continuous data transfer rate at 200Kb/s – 400 Kb/s, whereas, on the discrete basis, the data transfer rate may reach 10Mb/s – 16Mb/s. Information subarchitectures that do not involve communication with LOS/GSO, e.g., ubiquitous sensor circuits continuously communicating with aRFID networks and nodes for real-time monitoring of natural and man-made risks, fault prevention and autonomous control were also described as they apply to condition based maintenance of engineering systems (i.e., oil pipes and rigs, lubrication oil systems, workplace industrial hazards). Parametric cost estimating systems consisting of the discrete piece-linear models, Rayleigh function, and log-linear functions were developed for each application scenario (US30$M-$300M) and for the global information architecture (US640M).