

Global Information Grid (GIG)

Topology / Multicast Routing Requirements

13 July 2006

Dow Street, OSD NII
dow.street@linquest.com

Background ⁽¹⁾

- OSD NII and DISA are leading a large-scale system engineering activity to define the overall network architecture for the Global Information Grid (GIG).
- The GIG is likely to push the limits of current approaches and protocols in several areas: routing, QOS, security, etc.
- The GIG Routing Working Group (GRWG) is focused on the IP routing part of the problem (unicast and multicast routing).
- To be economically viable, the GIG will need to heavily leverage commercial hardware and software.
- However, it will be difficult to meet GIG requirements with the current protocols.
- The current planning goes to 2015+, which gives some time for modifying existing protocols or developing a new models.

GIG Network Description ⁽¹⁾

- The GIG will be a large network:
 - working estimate of 10^5 routers, 10^7 hosts within 12 years
 - a few small developments or changes in paradigm could push that to 10^6 routers
- The GIG will include many sub-administrations within a single, overarching technical authority.
- The GIG will have a wide range of node and link types, from carrier class backbone networks to human portable, battery powered devices.
- The GIG will be global in scope.
- The GIG will support critical operations.
- The GIG will (in all likelihood) make use of IPv6 as the packet format and common convergence layer for enabling connectivity.

GIG Network Description ⁽²⁾

There are several key differences between the Internet and the GIG that impact the applicability of the current Internet protocols:

- *pervasive network mobility*
- *the nature of routing commons*
- *requirements for security*

How do these impact multicast?

Pervasive Network Mobility ⁽¹⁾ - Multicast Impacts

- The GIG will comprise a large number of globally dispersed, geographically mobile networks.
- Many of these networks will be carried on vehicles, leading to extensive use of wireless RF.
- Vehicle based networks will make up large sections of the *network infrastructure* as well as connecting to the edge.
- RF capacity is quite limited (no option to over-provision), which makes multicast an critical part of the architecture.
- RF link intermittency and network/node mobility can cause problems for IP multicast tree construction and maintenance.
- E.g. Senders move, receivers move, RPs move or become disconnected, links within the the tree flap, etc
- The GRWG has recently kicked-off a study on IP multicast over dynamic topologies. (not quite MANETs, but rather macro-mobile networks)

Nature of the Routing Commons ⁽¹⁾ - Multicast Impacts

- There is a single overarching authority for all GIG assets with (in theory) dictatorial control over sub-administrations.
- GIG users cooperate to accomplish mission goals and share limited global resources - i.e. *mission-oriented* network commons.
- No underlying business model required to motivate multicast deployment - can decree “turn on multicast!” and it will have *some* effect.
- In reality, the “business case” is already there due to widespread use of RF where efficiency gains provided by multicast are critical.
- Communities of interest (set of group members) within the network are highly dynamic, global, large, and small.
- In some parts of the GIG *today*, multicast makes up more than 60% of the network traffic.
- Both one-to-many (i.e. SSM) and many-to-many (i.e. ASM) information exchange is important. (sensor data, situational awareness)
- QOS for multicast traffic may also be required.

Requirements for Security ⁽¹⁾ - Multicast Impacts

- Security is a principal consideration due to the nature of the environment.
- Widespread use of IPsec gateways (tunnel mode) for user traffic
 - Multicast solution must span multiple network segments with only limited control plan communication between PT and CT networks
 - Limits the applicability of overlays, ALM, etc which require information exchange between user network and nodes within the infrastructure
- Requirement for some control over multicast
 - Group membership control
 - Network resources able to be consumed (total multicast, per group, etc)
 - Rate limiting vs. absolute
- GRWG is currently conducting an analysis of requirements in this area.