
Stitching and Stitching Computation Service (SCS)

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Stitching Status

- **Multi-aggregate stitching including the following types of GENI Resources are now possible:**
 - ProtoGENI, InstaGENI, ExoGENI, Internet ION
- **Internet2 AL2S being tested now, should be generally available soon**
- **Only certain GENI Resources are "Stitching Certified"**
 - <http://groups.geni.net/geni/wiki/GeniNetworkStitchingSites>
 - requires proper configuration and acceptance testing to get on this list
- **As more sites are added, and use increases, we anticipate there will be need to increase available VLAN resources on some peering links**

Stitching Status

- **GENI AM APIv3 will greatly increase scalability and provision efficiency for large multi-aggregate slices. The high level idea is:**
 - "allocate" will require aggregates to respond to an "any" VLAN request with a "suggested vlan" and "vlan range" of other acceptable VLANs.
 - The single "suggested vlan" should be held for period of time before being released back into the availability pool.
 - There may be multiple rounds of allocate before provision
- **Intermediate steps of using the "any" VLAN request with AM APIv2 has been implemented by ProtoGENI**
 - AM APIv2 and use of VLAN "any" is "vlan producer" mode
 - no ability for multiple rounds and no need to hold resources since provisioning will happen immediately.

Stitching Computation Service (SCS) Status

- **SCS utilized to expand a simple Request RSpec into a complete Request RSpec which includes the following:**
 - full aggregate topology
 - workflow data with dependencies to be utilized by client tools to interact with the individual aggregates
- **SCS Request includes options for**
 - inclusion list (aggregate, node, or link level)
 - exclusion list (aggregate, node, or link level)
- **SCS utilizes Advertisement RSpec as a basis for computation (with total set of possible resources, i.e., VLANs)**
 - client interaction is where real time VLAN resource constraints are considered.

Stitching Computation Service (SCS) Status

- **SCS changes since last GEC**
 - added support for AL2S (now support multiple VLAN translation capable aggregates)
 - addition of "all_paths_combined" to get a single workflow for multiple stitching paths in a single request rspec
 - addition of more GENI resources to the computation engine
 - support for abstract node (node without component id)
 - InstaGeni to ExoGENI peering bug fix
- **Stitching Service Topology Engine**
 - semi-automated: script pulls Advertisement RSpecs, but manual review and testing before they go into the SCS.

Stitching Computation Service (SCS)

Future Ideas

- **Enhance the SCS to make it useful during the "Experimenter to Tool Interaction Phase"**
 - where experimenters may be exploring their options for Experiment topologies and possible stitching options
 - prior to submitting Request RSpec to tools such as OMNI

Stitching Computation Service (SCS)

Future Ideas

- **Experimenter to Tool Interaction Phase, High Level Concept**
 - User tool (such as JACKS) clearly identifies which aggregates are "Stitching Certified"
 - At Request Rspec build time, user tool can interact with SCS to give users options for stitching between aggregates
 - Use of SCS Inclusion and Exclusion options can be utilized to tailor result per User desires
 - SCS may add an option to return multiple possible solutions and the User can select which one they would like

Stitching Computation Service (SCS)

Future Ideas

- **MultiPoint Stitching**
 - initial focus on the AL2S capabilities and feature set available via FOAM/OESS interface (VLAN based slices)
 - also evaluate other multipoint topologies based on Openflow control via Flowvisor on AL2S
- **Stitching as a Service**
 - using the speaks for feature set
- **Additional support for AM APIv3 operations**
 - allocate/provision paradigm will allow for multiple allocate interactions before provision
 - There may be some additional SCS features to help with this, such as multiple options returned

Stitching Computation Service (SCS)

Future Ideas

- **Experimenting with additional use of Real-Time Aggregate information into Stitching Computation Result**
 - augment current use of full advertisement rspec with selective use of real-time resource (i.e. VLANs) data from aggregates as part of stitching computation
 - for scalability reasons the primary real-time resource identification needs to stay with the user tool at aggregate interaction time
 - User tools could collect real time info from aggregates and then tailor SCS request using inclusion or exclusion options

Stitching Computation Service

- **Implementation Status**

- available for operational use
- details available here:
 - <http://geni.maxgigapop.net/twiki/bin/view/GENI/NetworkStitchingAPI>

- **Stitching Sites**

- <http://groups.geni.net/geni/wiki/GeniNetworkStitchingSites>

- **Production SCS**

- <http://oingo.dragon.maxgigapop.net:8081/geni/xmlrpc>

- **Development SCS**

- <http://geni.maxgigapop.net:8081/geni/xmlrpc>

ION and MAX AM Status

- **Adjusted configuration to no longer need MyPLC and Postgres database.**
 - Just using SFA and the MAX AM software now
 - This configuration has been deployed on MAX now
 - To be deployed on ION AM after GEC20
- **Fixed some bugs to make ION AM more stable on restart**
 - no longer necessary to block incoming request during restart
 - fixed "new project site" error
- **Deployed GENI Monitoring Infrastructure local datastore to MAX and ION AMs.**

End

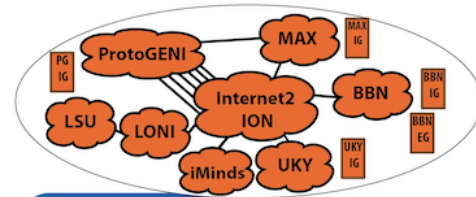
Stitching Computation Service Overview Slides

GENI Stitching

- **Objective for GENI Stitching is to provide "network interconnects" between Slivers across multiple Aggregates:**
 - "network interconnects" today means Layer2 VLANs circuits
- **These Layer 2 VLANs paths may cross a large variety of network types**
 - campus, regional, wide area, exchange points
 - multiple methods for provisioning VLANs
 - static pre-configuration of a range of VLANs
 - dynamic VLAN provisioning (OSCARS, OESS, OpenFlow, NSI, others)
 - some networks will have a GENI AM

Stitching

Architecture



Advertisement RSpec w/stitching

AMs

- pulled via GENI AM ListResources
- preloaded for all DCN w/o GENI AM
- indicates DCN true or false

Topology Service

Stitching Computation
workflow computation

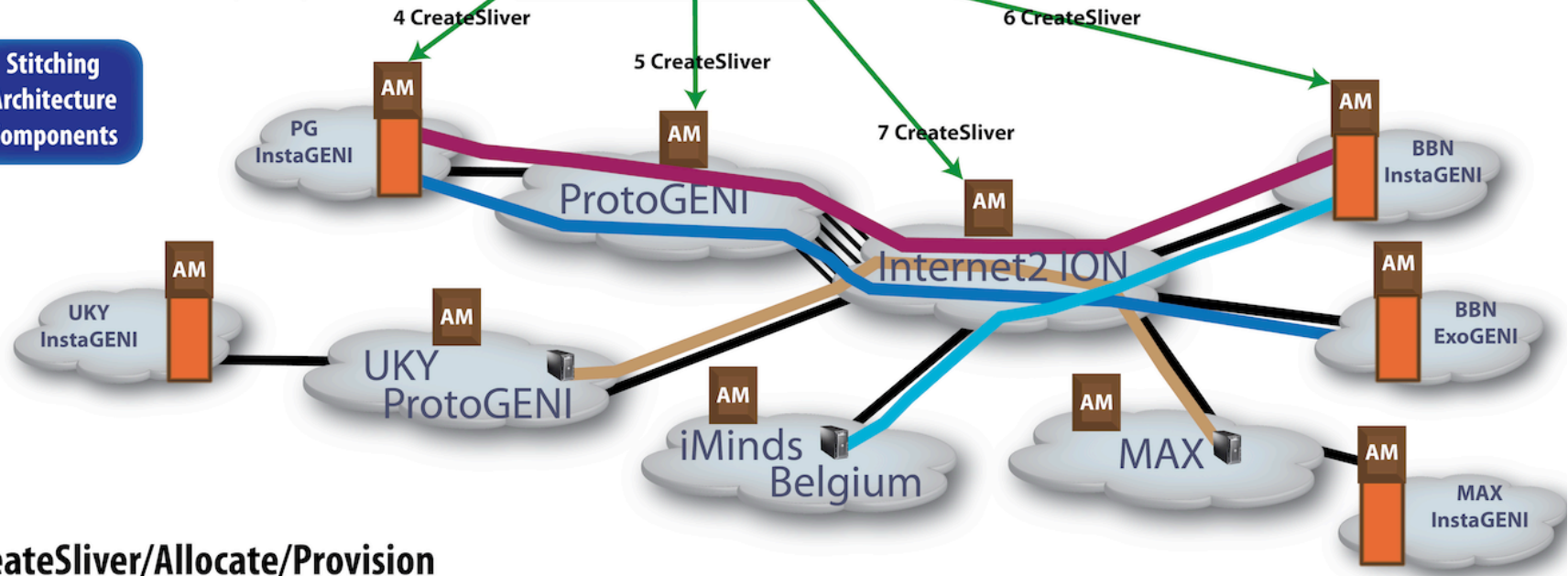


OMNI (client tool)
workflow



- workflow logic**
- CreateSliver (v2 API)
 - Allocate/Provision (v3 API)

Stitching Architecture Components



→ CreateSliver/Allocate/Provision

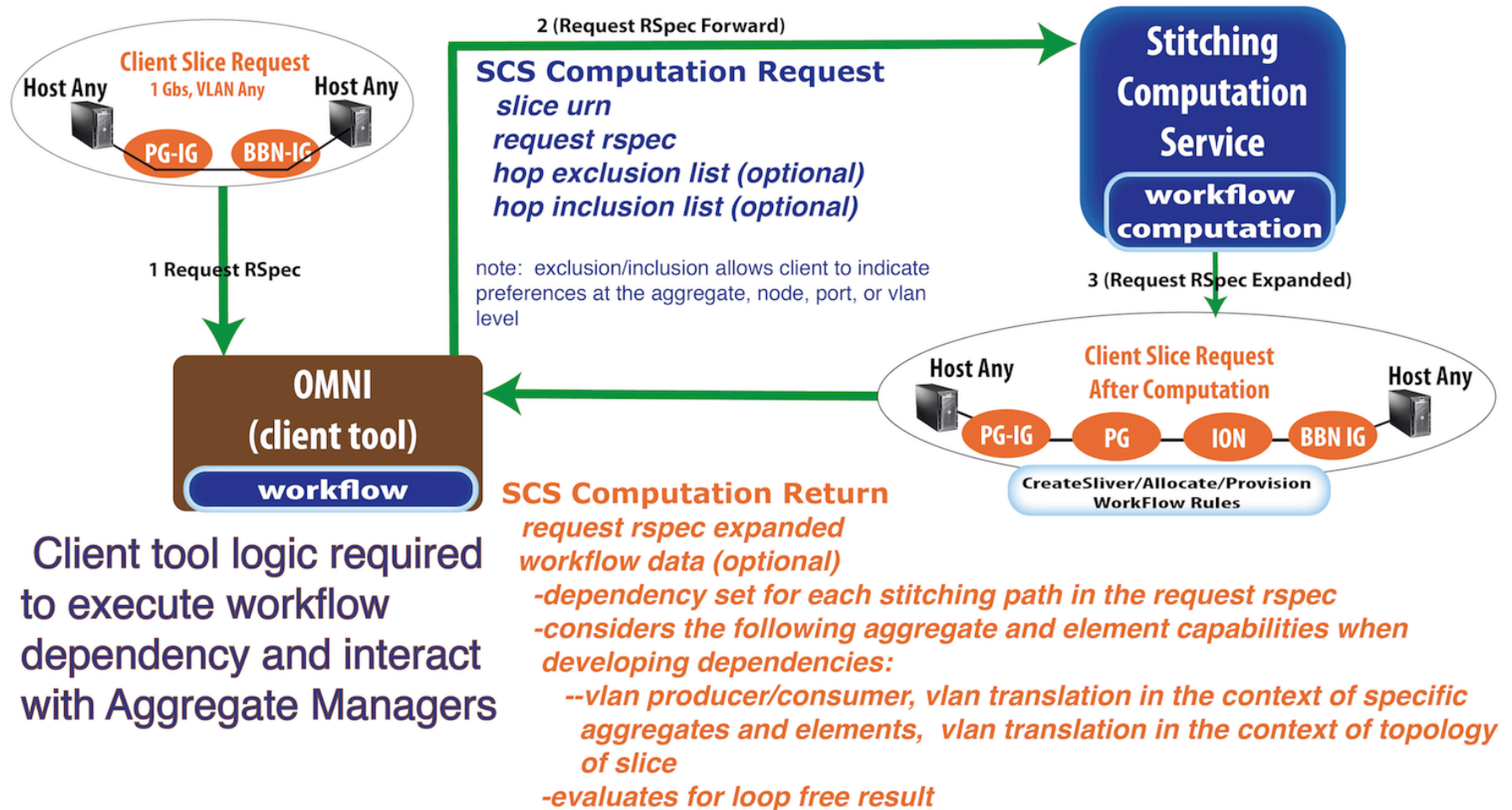
2 (Request RSpec Forward)
3 (Request RSpec Expanded)
CreateSliver/Allocate/Provision WorkFlow Rules

Stitching Architecture Components

- **Stitching Extension**
 - for Advertisement, Request, and Manifest RSpecs
- **Stitching Computation Service**
 - with workflow rule generation
- **Workflow Execution Stitching Functions**
 - for integration into clients such as OMNI, Flack, GENI Portal, and others
- **Stitching Topology Service**
 - collects Advertisement RSpecs from GENI AMs
- **GENI AM API (v2, v3) Stitching Processing**
 - v3 has features to facilitate Stitching with negotiation

Stitching Computation Service (SCS)

SCS used at slice instantiation time by tools like OMNI



Stitching Computation Service

- Includes a workflow data generation option, which provides guidance to client tools (Omni) for interaction with AMs.
- Workflow data returns array of recursive dependencies indicating proper sequence and associated actions for Aggregate requests
- The following information/capabilities are utilized to calculate dependencies
 - vlan producer/consumer status
 - vlan translation capabilities
 - vlan continuity (position of specific aggregates in the expanded RSpec and available vlan range size)
 - evaluates for loop free result
- Advertisement RSpec information is utilized as needed to calculate expanded RSpec and dependencies

Stitching Computation Service

- **SCS Request**

- slice urn
- request rspec
- options
 - hop_inclusion_list (list of hops (aggregate, node, or link) to exclude from the expanded request rspec)
 - hop_exclusion_list (list of hops (aggregate, node, or link) to include in the expanded request rspec)
 - workflow data request
 - hold path (hold computation result for a preconfigured amount of time)
 - all_paths_combined (consider all path elements together as part of computation)

Stitching Computation Service

- **SCS Response**

- expanded request rspec
- workflow data (if requested)
 - struct of {path_id: dependencies} map, where path_id corresponds a stitching path in "service_rspec"
- dependencies data
 - hop_urn: string
 - aggregate_urn: string
 - aggregate_url: string
 - import_vlans == 0 or 1
 - dependencies: array of recursive structs referring to further dependencies

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Stitching Service

Possible Future Focus Areas

- **Support for multi-point topologies with bridged broadcast domains of different types**
 - initial focus on AL2S provisioning
- **Expand Stitching Technologies to include other options beyond VLANs**
 - OpenFlow
 - GRE Tunnels
 - Stateless Transport Tunneling (STT), Virtual Extensible LAN (VXLAN), NVGRE, others
- **Support interactions associated with AM APIv3**
- **Include more precise definition of path types and characteristics (technology types, latency, others)**

Stitching Service

Possible Future Focus Areas

- **Some of these will required enhancements to multiple components of the GENI Stitching Architecture**
- **Stitching Extensions for the Advertisement, Request, and Manifest RSpecs**
- **Stitching Computation Service**
 - Topology Computation and Workflow Rule generation
- **Workflow Processing**
- **Aggregates will also have to support other stitching technologies**

Stitching Computation Service

Possible Future Focus Areas

- **Currently Stitching Computation is utilized at Slice Instantiation time by tools, like OMNI, during the "Tool to Aggregate Interaction Phase"**
- **Tool to Aggregate Interaction Phase**
 - After tool has received Request RSpec from user
- **We plan to enhance the SCS to make it useful during the "Experimenter to Tool Interaction Phase" phase as well**
- **Experimenter to Tool Interaction Phase**
 - where experimenters may be exploring their options for Experiment topologies and possible stitching options
 - prior to submitting Request RSpec to tool
- **And possibly during the Experiment Operation Phase**

Stitching Computation Service

Possible Future Focus Areas

- **Experimenter to Tool Interaction Phase**
- **As part of Request RSpec build process, Experimenter (via Tools integration) can query SCS to learn about options such as:**
 - Options for stitching between two or more aggregates
 - Queries may include exclude or include constraints
 - Constraints may be specific aggregates, or stitching technology types, bandwidth parameters
 - Upon review of options gathered from SCS during this phase, a Request RSpec can be generated for submission to slice set up tool.

End
