GEANT's Pan-European ONOS ICONA Deployment Delivers Benefits of Open Source SDN to Europe's Research and Education Networks

GEANT Testbeds Service deploys breakthrough ONOS ICONA application live on pure OpenFlow-based research and education networks for faster event recovery

ROME, Aug. 20, 2015 /PRNewswire/ -- GEANT (http://www.geant.net/Pages/default.aspx) and the Open source SDN Network Operating System (ONOS (http://onosproject.org/)) community today announced they have actively deployed ONOS on GEANT's pan-European testbed network allowing researchers to define, build, test and rebuild highly scalable, high capacity virtual networks quickly, easily and cost-effectively. GEANT is running a new Inter Cluster ONOS Network Application (ICONA) – developed by CREATE-NET (http://www.create-net.org/) and the University of Rome Tor Vergata (http://web.uniroma2.it/home.php?newlang=english)/CNIT (http://www.cnit.it/node/100) in collaboration with the ONOS project – to efficiently manage the intercommunication of geographically distributed ONOS clusters and deliver faster controller response time during network events such as failures or congested links.

Organizations may connect to a network slice offered on the GEANT Testbeds Service (GTS (http://services.geant.net/gts)), a virtual network environment comprised of OpenFlow where ONOS and the ICONA app are deployed, to access powerful self-contained networks for experimentation and early pilot deployments of new technology or distributed applications.
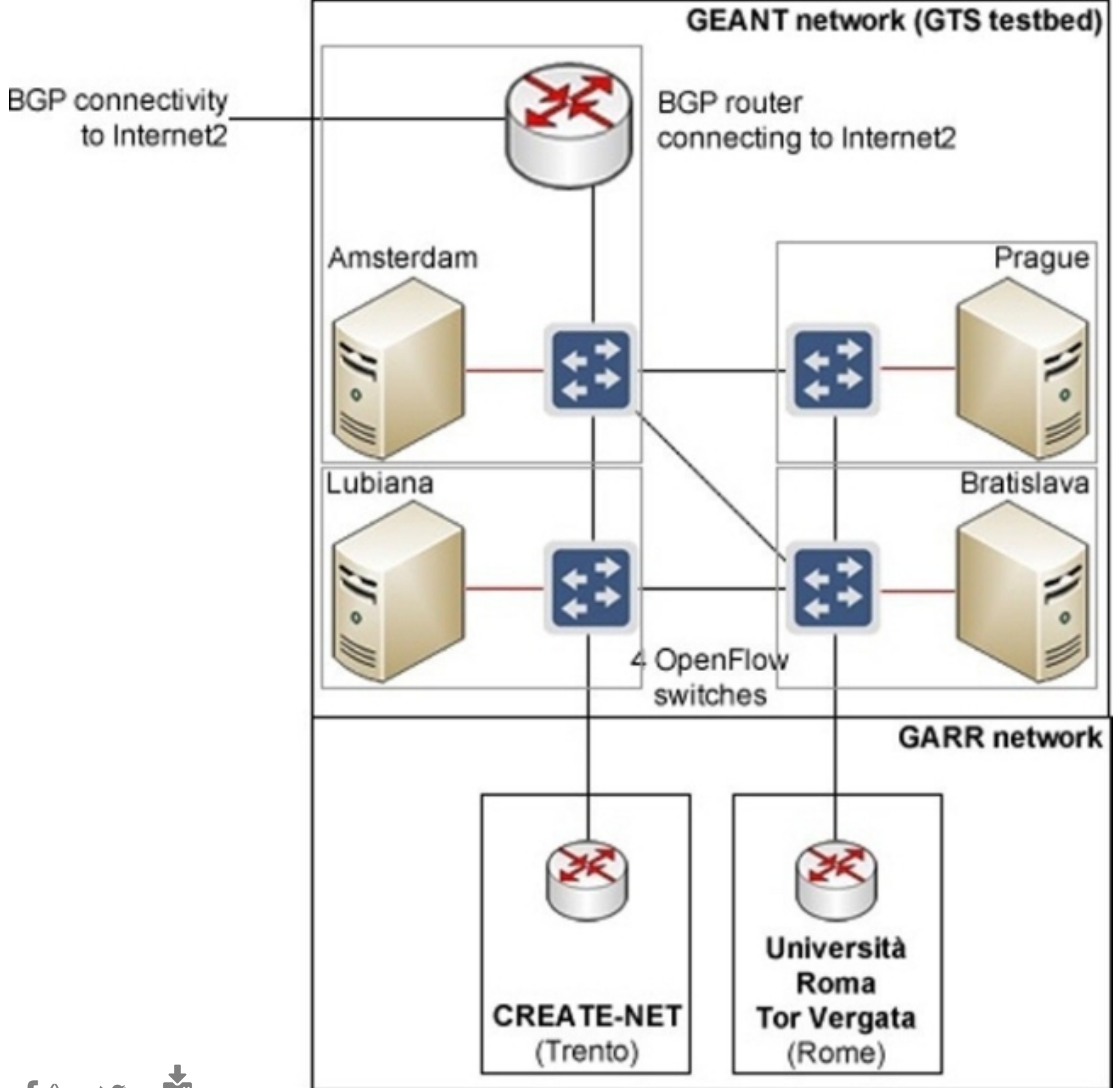
Map of the ONOS/ICONA OpenFlow network, running on a slice of the GTS testbed facility offered by GEANT.

GEANT network (GTS testbed)

BGP connectivity to Internet2

BGP router connecting to Internet2

Amsterdam

Prague

Lubiana

Bratislava

4 OpenFlow switches

GARR network

CREATE-NET
(Trento)

Università
Roma
Tor Vergata
(Rome)

Architectural diagram for the ONOS ICONA deployment on GEANT (GTS) / GARR

South America — USA — Europe
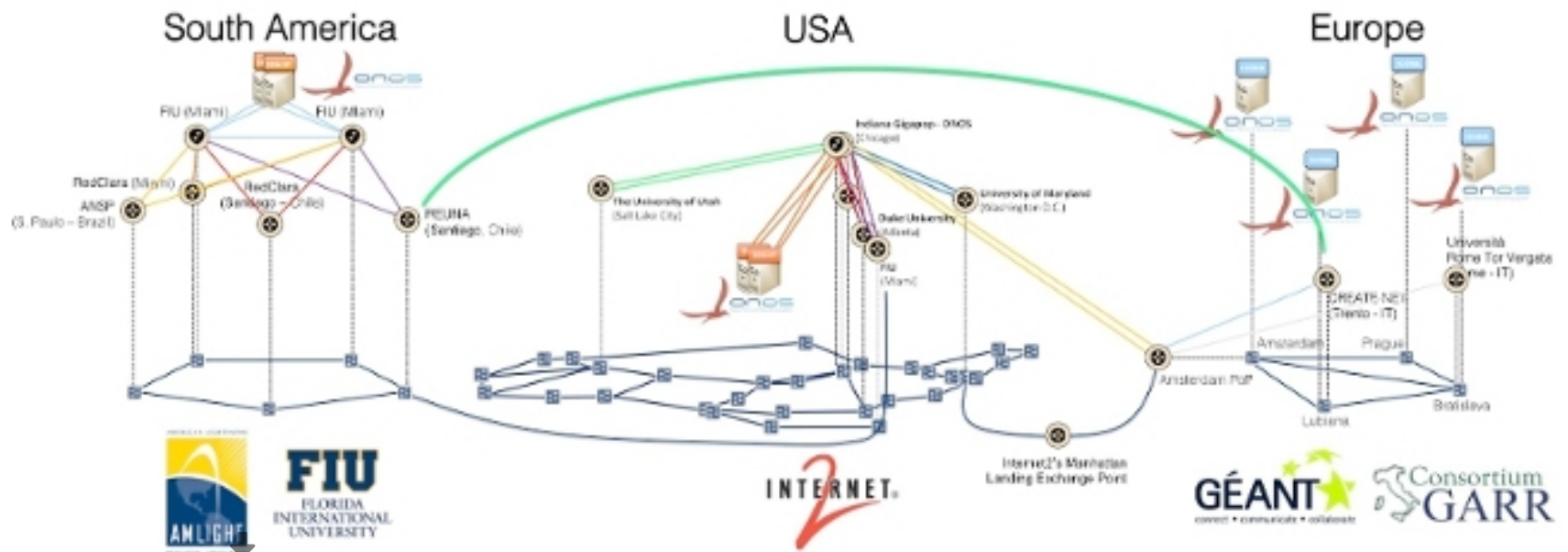
Global ONOS SDN deployment linking 3 continents

"ON.Lab and its ONOS network operating systems are a great example of emergent network paradigms that would be difficult or impossible to test or evaluate at full European scale without the infrastructure provided by the GEANT network and the virtualization capabilities provided by the GEANT Testbeds Service," said Jerry Sobieski, GTS Activity Leader. "We are excited to work with ON.Lab to deploy ONOS across our GTS facilities as this allows us to showcase both the advanced capabilities ONOS delivers as well as the advanced capabilities of our testbed. GEANT's mission is to facilitate this type of leading edge global network research to help deliver the next generation of networking."

The GEANT network is the panEuropean research and education network that interconnects Europe's national research and education networks. It connects over 50 million users at 10,000 institutions across Europe, supporting research in areas such as energy, environment, space and medicine. Through extensive links with networks around the world, GEANT also reaches 65 countries beyond Europe. Thanks to collaboration with the DREAMER project and a set of Layer 2 (L2) circuits offered by the Italian Academic and Research Network (GARR (http://www.garr.it/eng)), CREATE-NET and the University of Rome Tor Vergata in Italy joined the testbed on May 2015 and more entities are expected in the upcoming quarters.

GEANT's GTS network is currently comprised of four points of presence (PoPs) located in Amsterdam, Bratislava, Lubiana and Prague, creating a software-defined network entirely based on OpenFlow. Each external entity (e.g. CREATE-NET and University of Rome)

connected to the testbed exposes a "legacy" Border Gateway Protocol (BGP) router that peers directly with the border router placed in the Amsterdam PoP of the GTS network, thus exchanging IP routes with the rest of the global network IP prefixes. This enables the entities connected to communicate together and with the rest of the universities and the research institutions attached to the global network. In fact, the Amsterdam PoP connects GTS directly with Internet2 in the U.S. Through ONOS' application intent framework, the ONOS clusters are able to provide L2 connectivity between all the "legacy" routers connected at the edge of the network.

ICONA is a tool developed on top of ONOS that is designed to extend ONOS' capabilities in wide-area network (WAN) scenarios where there are stringent requirements in term of control plane responsiveness. ICONA provides an orchestration mechanism to synchronize the status of all the ONOS cluster instances to ensure ONOS delivers the resiliency, scalability and high availability required for production environments. By redounding ONOS clusters in several geographical locations, ICONA decreases event-to-response delays (shortens network response times) in WANs while increasing the overall robustness of the controller to network faults.

"We are very excited to participate in this worldwide SDN testbed deployment," said CREATE-NET Research Director Elio Salvadori. "It gave us the perfect setting to test our ICONA application and it opens up even more opportunities for controlled testing of further SDN apps that we are currently developing on top of ONOS."

"We strongly believe in Open Source technology for SDN," said University of Rome Tor Vergata Professor Stefano Salsano. "We are proud to participate in the efforts of the ONOS community towards the realization of a production-ready platform that meets the operators' requirements while remaining fully open to researchers."

"We are thrilled to support and collaborate directly and through GEANT to the development and research in new networking technologies using the ONOS platform," says GARR Research and Development Coordinator, Mauro Campanella. "A joint international effort greatly facilitates the innovation towards an open source SDN production environment."

"ONOS' deployment on GEANT's GTS is another major milestone for the ONOS project," said Bill Snow, Vice President of Engineering at ON.Lab. "With the GTS connecting to Internet2 in the U.S. and, through them, to South America we now have the best and brightest minds from three continents linked together via pure OpenFlow-based networks running ONOS software. Drawing from a global collaborative community provides us with resources that can't be matched and accelerates the pace of open SDN innovation by providing valuable insight, testing and feedback for ONOS to deliver the benefits of true SDN."

Industry Takeaways

The virtual network environment offered by GTS provides a revolutionary new capability for both network researchers as well as for developers of advanced networked applications. By utilizing the GTS platform, ON.Lab and its European partners at CREATE-NET and University of Rome are able to move the field testing of their advanced ONOS network operating system to the next stage.

ONOS, deployed within GTS' virtual network environment, is now available in four European cities and provides an advanced SDN-based IP network. The virtual network environment was designed and instantiated across Europe by the collaborating team in just a few minutes and then the ONOS network engineers began work hardening, developing and testing its next-generation open source software.

The EU ICONA deployment provides a secure and safe pan-European networking platform that allows researchers to deploy novel network technologies at full scale and to test these – even to the point of failure – while remaining isolated from the live traffic of other production network users or services.

GTS offers the flexibility to build and tear down network structures quickly and enables researchers to directly control their networks, to incrementally refine configurations, topologies and other service attributes without the ensuing costs, logistics, contracting and time required for field hardware engineering or conservative production operational coordination.

Technical Details

The GTS service offered by GEANT delivers integrated virtual environments as "testbeds" for the network research community and the network testbed resources are dynamically allocated from real e-infrastructure distributed throughout the GEANT core service area. The image in the network diagram shows a slice on the GTS testbed offered by GEANT that hosts the four PoPs located in Amsterdam, Bratislava, Lubiana and Prague. The black lines represent the data plane connections between the switches and from the switches to the external BGP routers. Each PoP hosts an OpenFlow HP 5900 switch, each connected (red lines) to a dedicated ONOS cluster.

Though not represented in the diagram, the ONOS clusters are then all connected together through the out-of-band network in order to let the ICONA applications synchronize together. Through dedicated L2 circuits offered by GARR the nodes of Lubiana and Bratislava respectively connect to the BGP routers running in CREATE-NET (Trento – Italy), and the University of Rome Tor Vergata (Rome-Italy).

The Amsterdam PoP has been connected through another L2 circuit to a legacy router in Amsterdam that is peering with the one running on the Internet2 AL2S network in the U.S. at its Manhattan Landing Exchange Point, creating intercontinental communication between the two testbed facilities.

Intra-domain BGP sessions have been established between the router in Amsterdam and the two end-points in Italy; and the ONOS clusters take care of provisioning the L2 tunnels between the routers. Each university or research center acts as a separate AS and connects into the OpenFlow data plane through a dedicated "legacy" campus router (either physical or virtual), that is able to exchange routes with the rest of the entities connected to the facility.

The Internet2 network also exposes an extra router (appearing from the ONOS and SDN-IP point of views as any other university router) that enables the communication with a second SDN facility running in Europe. The two SDN islands – both running ONOS – can communicate together through a legacy BGP peering session between two legacy routers. The Internet2 network has been also connected to the AmLight network, running in LATAM and the U.S.

About the ONOS project

ONOS is the open source SDN networking operating system for Service Provider networks architected for high performance, scale and availability. ONOS' ecosystem comprises of ON.Lab and organizations that are funding and contributing to the ONOS initiative. These include AT&T, NTT Communications, SK Telecom, China Unicom, Ciena, Cisco, Ericsson, Fujitsu, Huawei, Intel and NEC; members who are collaborating and contributing to ONOS include ONF, Infoblox, SRI, Internet2, Happiest Minds, KISTI, KAIST, Kreonet, NAIM, CNIT, Black Duck, CREATE-NET, Criterion Networks and the broader ONOS community. Learn how you can get involved with ONOS at onosproject.org (http://onosproject.org/).

About GEANT

GEANT is Europe's leading collaboration on network and related infrastructure and services for the benefit of research and education, contributing to Europe's economic growth and competitiveness. The organisation develops, delivers and promotes advanced network and associated e-infrastructure services, and supports innovation and knowledge-sharing amongst its members, partners and the wider research and education networking community. GEANT has 41 member countries and is owned by its core NREN membership, and also has Associate members including commercial organisations and multi-national research infrastructures and projects.

GEANT was formed on 7 October 2014, when TERENA and DANTE joined forces and adopted the GEANT name from the GEANT Project (co-funded by the European Commission and currently in phase GN4-1), which continues to be a major area of the organisation's work. http://www.geant.org (http://www.geant.org/)

About GARR

GARR is the Italian Research & Education Network (NREN). It plans and operates the national high-speed telecommunication network for University and Scientific Research. Its shareholders are four major Research and Academic organizations in Italy, CNR, ENEA, INFN and Fondazione CRUI, representing the Conference of Italian University Rectors. For more information about GARR please visit http://www.garr.it/eng (http://www.garr.it/eng).

About CNIT and University of Rome Tor Vergata

CNIT is a non-profit consortium of 37 Italian Universities, coordinating and fostering research activities in the area of telecommunications. A team from the Research Unit of University of Rome Tor Vergata coordinated the DREAMER project funded by GEANT and participated by CREATE-NET and GARR which supported the deployment of the EU side of the world-wide SDN testbed as well as several research activities on software-defined networking. For more information about the DREAMER project please visit http://netgroup.uniroma2.it/DREAMER (http://netgroup.uniroma2.it/DREAMER) and for information about CNIT go to http://www.cnit.it/node/103 (http://www.cnit.it/node/103).

About CREATE-NET

Headquartered in Trento, Italy, CREATE-NET is an international research center recognized as one of Europe's leading institutions in ICT and telecommunications technologies. A team of experts on software-defined networking technologies has developed ICONA application on top of ONOS as part of its contribution to the DREAMER project. For more information about CREATE-NET please visit http://www.create-net.org/ (http://www.create-net.org/).

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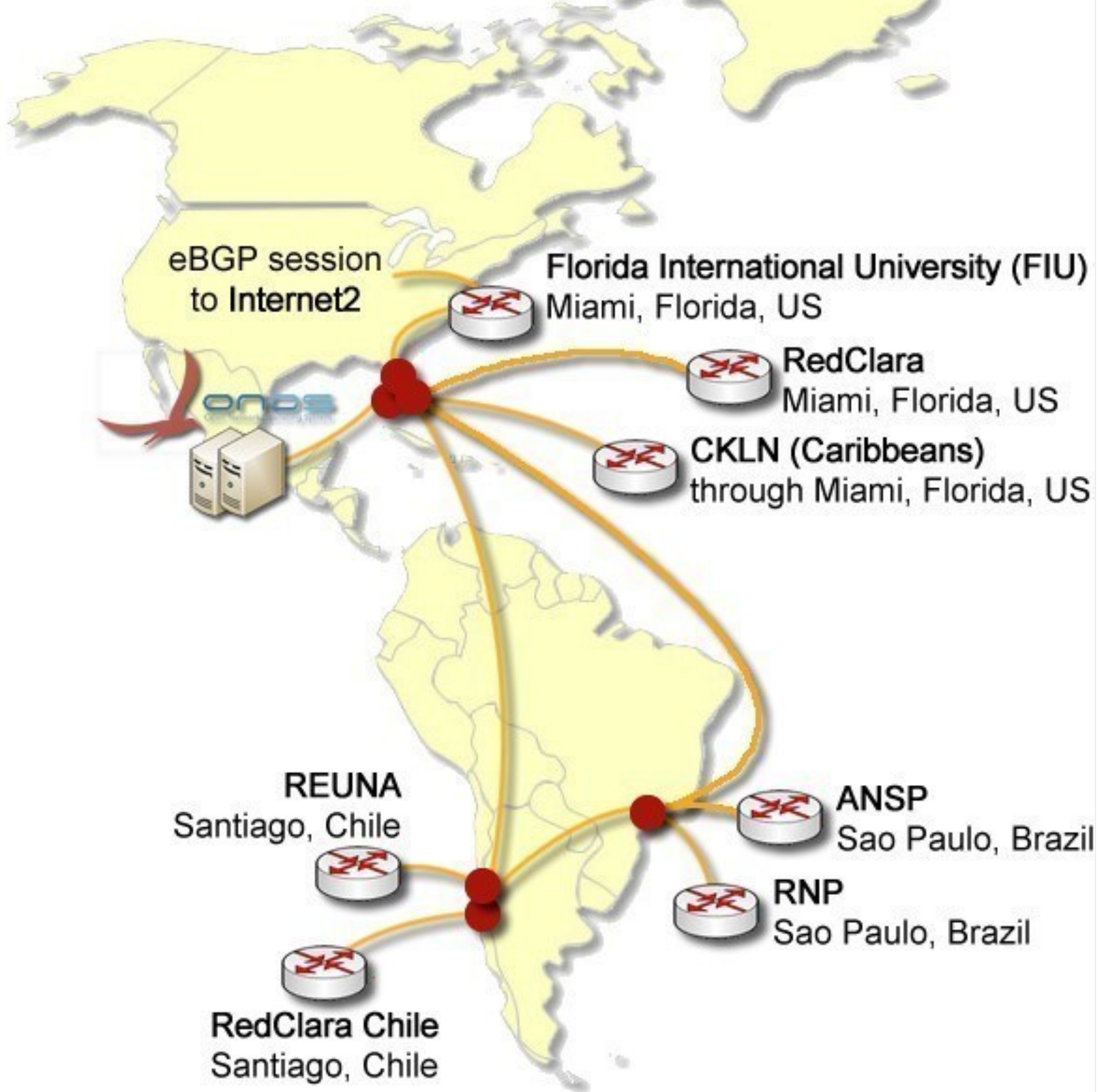
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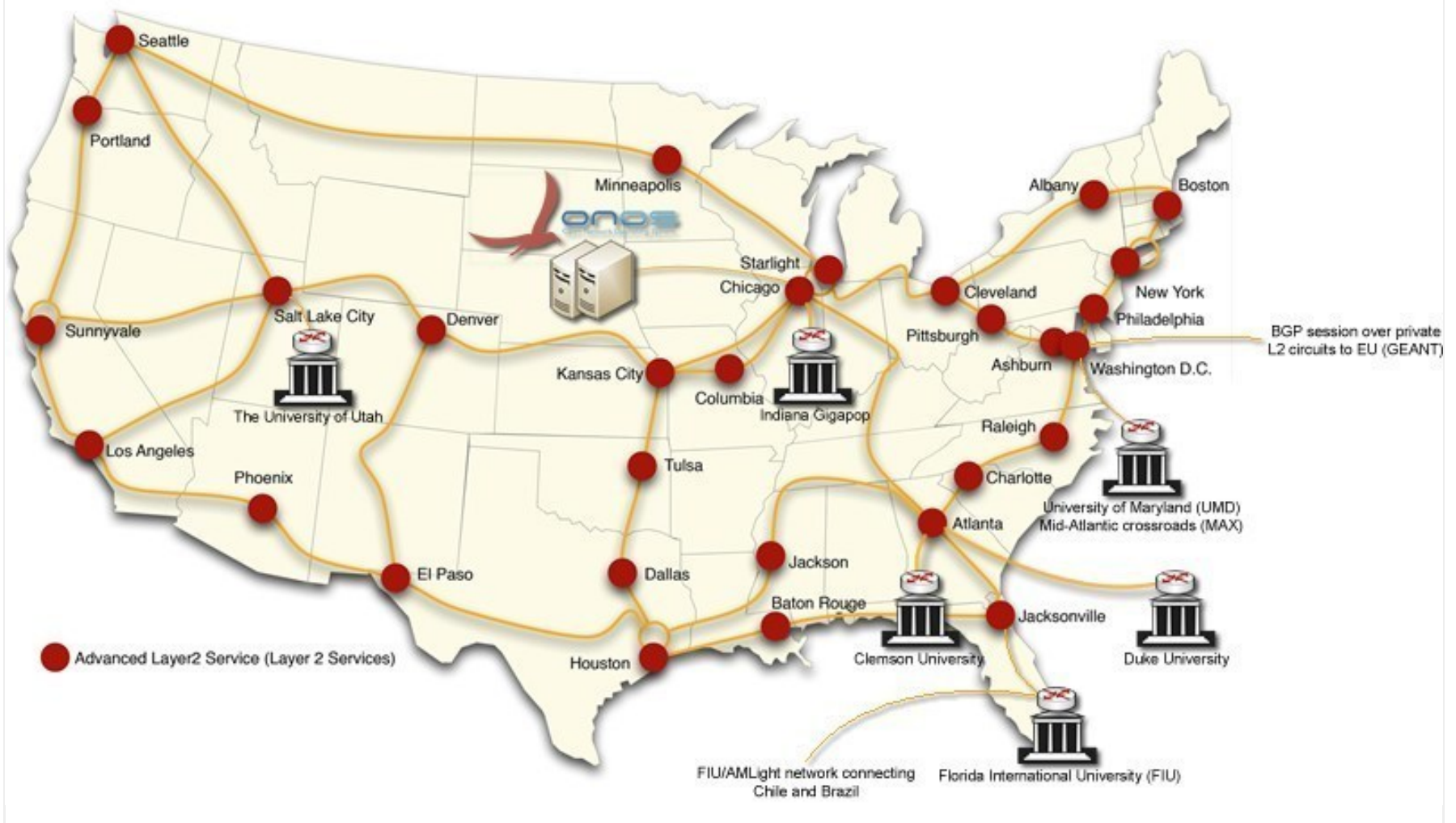
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