# AmLight Consortium Research & Education Network Helps Transmit FIFA World Cup in 8K from Brazil to Japan

PRESS RELEASE

Media Contact: Heidi Alvarez, Director Center for Internet Augmented Research and Assessment (CIARA) Florida International University
305-348-2006 heidi@fiu.edu

Miami, Florida, July 22, 2014 While the ball was rolling in the Brazilian stadiums between June 14th and July 13th, the Research & Education (R&E) networks played an important role in helping Japanese television to transmit the FIFA World Cup in 8K resolution (7.680 x 4.320 pixels) to Japan. The huge distance between Brazil and Japan set new challenges for streaming digital images spanning multiple domains over long-distance networks.

The project was led by the Japanese public television company, NHK, which has been experimenting and improving its new 8K streaming technology (branded "Super Hi-Vision" or SHV) since the 2012 London Olympic Games. NHK technology is currently able to compress SHV video flows to 300Mbps -- the same video would require almost 24 Gbps to be streamed if it were uncompressed. The current state of the art of digital television prevents 8K signals from being transmitted over long distances; therefore, this project relies on the technological support of Nippon Telegraph and Telephone Corp. (NTT) Network Innovation Labs, RNP (the National Education and Research Network of Brazil) , ANSP (The Academic Network of Sao Paulo) and other research networks worldwide.

This undertaking was enabled by the Americas Lightpaths (Amlight) Consortium supported by the National Science Foundation[1], Brazil's RNP, the Academic Network of São Paulo and AmericasPATHWAY (AMPATH) International Exchange Point, an initiative by Florida International University's Center for Internet Augmented Research and Assessment (CIARA) in Miami, Florida. Through the advanced network provided by the AmLight consortium, an ultra high-definition live stream was able to traverse half of the world.
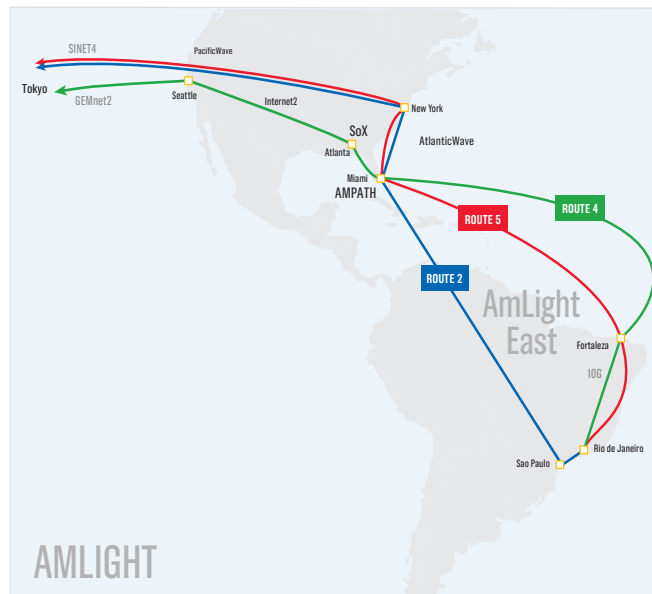
Altogether, nine matches were selected by NHK to be streamed live in 8K at 60 frames per second, starting with Japan vs. Ivory Coast in Recife on June 14th (the first Japan game) and concluding the show with the World Cup final in Rio de Janeiro on July 13th. The selection of games took into consideration the logistics of moving the NHK outside broadcast vehicle

containing the 8K capture and editing equipment between the hosting cities in Brazil. "It's my pleasure to report to you that all nine SHV (8K) transmission for the FIFA World Cup were successfully finished yesterday. On behalf of the networking team for this project, I would like to express our deepest gratitude for all your support," said Hisao Uose, the Director of GEMnet2, the NTT's research network.

"Nothing could surely match the thrill of being there, but the 8k transmission brought together teams across the Americas and Asia for a win of their own," said Chip Cox, Chief Operating Officer of AMPATH. "This demonstrates unprecedented technology, and unparalleled cooperation…a stellar team performance".
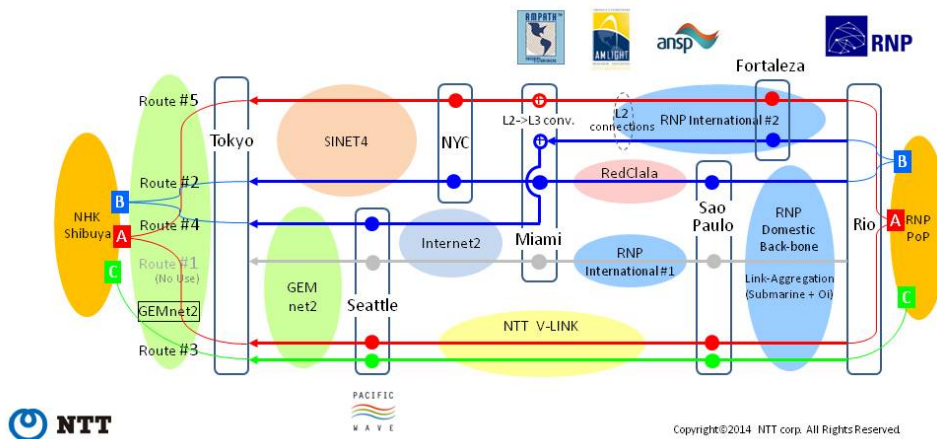
All matches were first streamed to FIFA´s International Broadcast Center (IBC), regardless of the stadium's location. The IBC was located in the Riocentro, an exposition center in Rio de Janeiro, with the FIFA communications network that interconnected all stadiums to the IBC provided by Telebras, a Brazilian telecommunications company. From Riocentro, the 8K signal was streamed to RNP's Point of Presence (PoP) in Rio, using RNP´s local metropolitan network. From there, the 8K video was streamed to Tokyo using the five international routes, with several routes passing through FIU's AMPATH:

Route 1: Rio → São Paulo → Miami → Seattle → Tokyo (via RNP, Internet2, NTT GEMnet2)
Route 2: Rio → São Paulo → Miami → Seattle → Tokyo (via RNP, RedCLARA, SINET4, NTT GEMnet2)
Route 3: Rio → São Paulo → Seattle → Tokyo (via RNP, NTT VLink, NTT GEMnet2)
Route 4: Rio → Fortaleza → Miami → Seattle → Tokyo (via RNP, Internet2, NTT GEMnet2)
Route 5: Rio → Fortaleza → Miami → New York → Tokyo (via RNP, SINET4, NTT GEMnet2)

To create a secure communications path suitable for 8K video transmissions over multiple IP networks, NTT applied a very powerful forward error correction (LDGM-FEC)[2] technology together with the multi-path transmission scheme. Those added redundancies both in

information and space domain greatly enhance the reliability of this very long distance transmission with smaller cost.

The games were streamed in 8K to seven viewing sites, four of them to Japan, in the cities of Tokyo, Yokohama, Osaka and Tokushima; and three of them in Rio at the IBC, the Sofitel hotel (FIFA's main hotel), and the auditorium of the Brazilian Center for Physics Research (CBPF). The latter venue hosted viewing sessions organized in cooperation with the Brazilian broadcaster TV Globo. A selected audience of students, researchers, professors, authorities and representatives from press and industry were invited to attend the live sessions. In addition to the ultra high definition video, the invited audience enjoyed the Super High Vision's 22.2 channel 3D sound system.

"I would like to thank my colleagues at RNP and our collaborators for helping to make possible what has been an excellent example of multinational collaboration on a global scale.," said Michael Stanton, Director of Research and Development at RNP. "It has been great to watch the action in 8K here in Rio. I sincerely hope that this technology becomes widely adopted in the near future".

The collaboration between the research networks of Brazil and Japan on SHV streaming will continue after this World Cup event utilizing AmLight as well as the network monitoring equipment at AMPATH as a joint project between FIU and NTT.

ABOUT:

CIARA Florida International University's Center for Internet Augmented Research and Assessment (CIARA), in the Division of IT, has developed an international, high-performance research connection point in Miami, Florida, called AMPATH (AMericasPATH; www.ampath.fiu.edu).

Academic Network of Sao Paulo (ANSP, Brazil), **ANSP** provides connectivity to the top R&E institutions, facilities and researchers in the State of São Paulo,, including Kyatera, a 9-city dark-fiber-based optical network infrastructure that links 20 research institutions in the State of Sao Paulo in Brazil [KYATERA]; and GridUNESP, one of the largest computational clusters in Latin America, supporting interdisciplinary grid-based science.

AMPATH, at Florida International University, supports AmLight East connectors at Miami and Sao Paulo, operating as an international exchange point for the southeast U.S. and Latin America.

CLARA is the Latin American Cooperation of Advanced Networks (Cooperación Latino Americana de Redes Avanzadas), a non profit organization whose members are the NRENs of Latin America, and which is in charge of the management, development and operation of RedCLARA as well as the coordination of Latin America's research networking activities. RedCLARA directly connects to AmLight links in Sao Paulo, Miami and Tijuana.

Rede Nacional de Ensino e Pesquisa (RNP, Brazil): RNP operates the national research and education network and several networks in Brazil, providing access to around 900 sites of institutions in the fields of Higher Education, Research, Health and Culture throughout the country.

AtlanticWave, provides a distributed exchange and peering fabric along the Atlantic coast of North and South America for national and international networks that interconnect at open exchange points at **MANLAN** in NYC (Internet2), MAX in Washington DC (University of Maryland), SoX in Atlanta (Georgia Institute of Technology), AMPATH in Miami (FIU), and *Southern Light in São Paulo*, Brazil. *Florida LambdaRail:* FLR is the regional optical network of Florida, formed as a consortium of the Florida's research universities, to support their research and education mission including AtlanticWave. *Internet2*, Internet2 is a consortium of leading US research universities working in partnership with industry and

government to develop and deploy advanced network applications and technologies. Internet2 is the representative for MAN LAN, participating in the AtlanticWave project.

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[1] Award# ACI-0963053, $7,744,790.00, 2010-2015, IRNC-ProNet: Americas Lightpaths: Increasing the Rate of Discovery and Enhancing Education across the Americas
http://www.nsf.gov/awardsearch/showAward?AWD_ID=0963053

[2] R. M. Gutierrez and G. Seco-Granados, "Efficiency comparison of LDPC-LDGM and Raptor codes for PL-FEC with very large block sizes," in Proc. Wireless Telecommun. Symp., Prague, Czech Republic, Apr. 2009, pp. 1244–1245