

A network diagram on a dark blue background. It features a cluster of blue circular nodes on the left, interconnected by red lines. Four red lines extend from this cluster towards a larger blue circle on the right. This larger circle contains the white text 'ECI'.

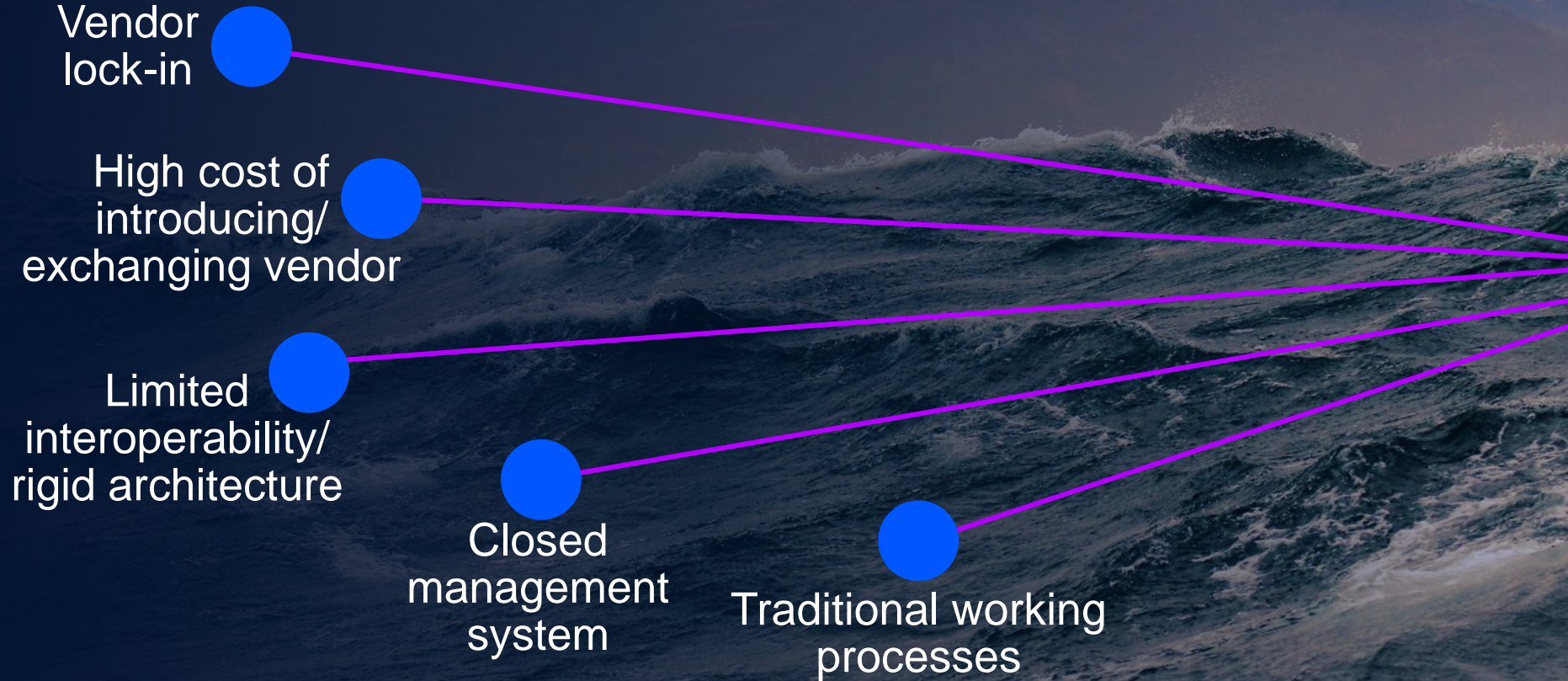
ECI

THE ELASTIC NETWORK

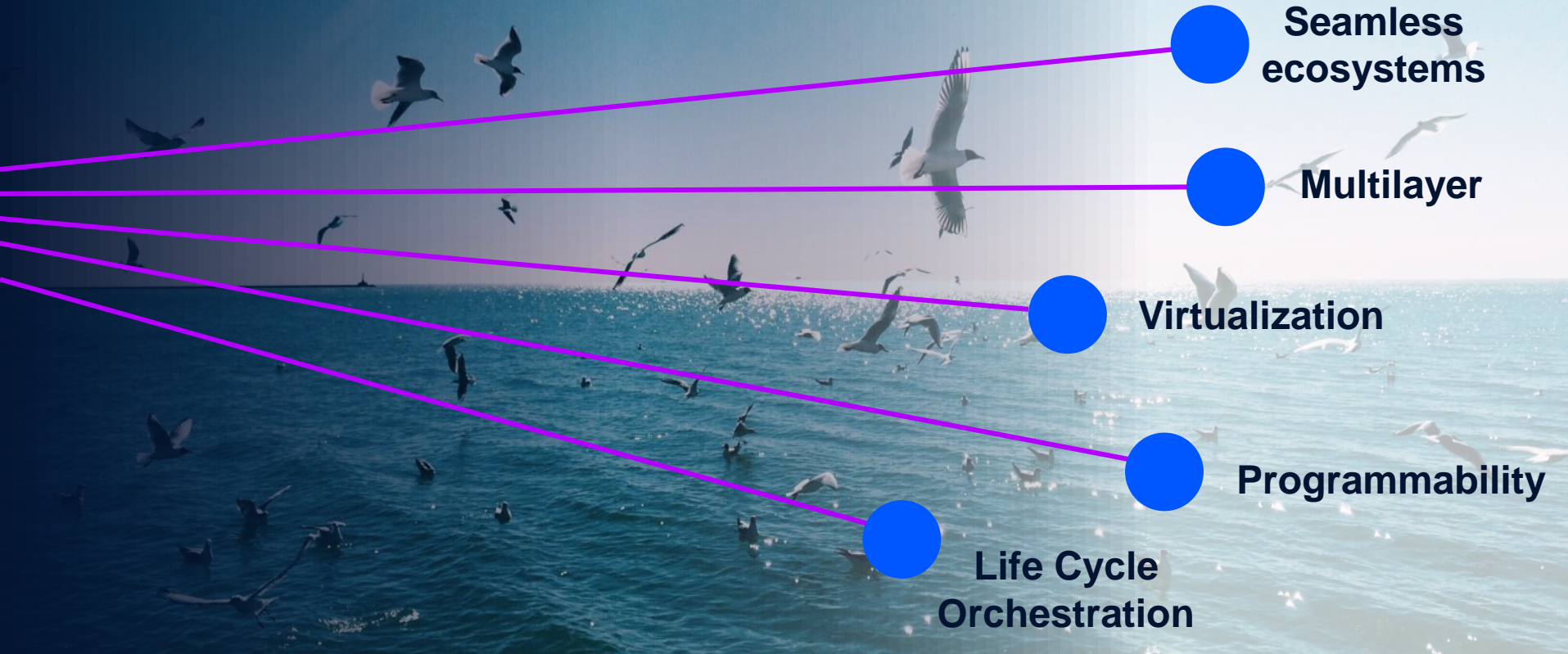
DRIVING STANDARDS FROM CODE – ECI'S WORK WITH ONOS

Hayim Porat, CTO
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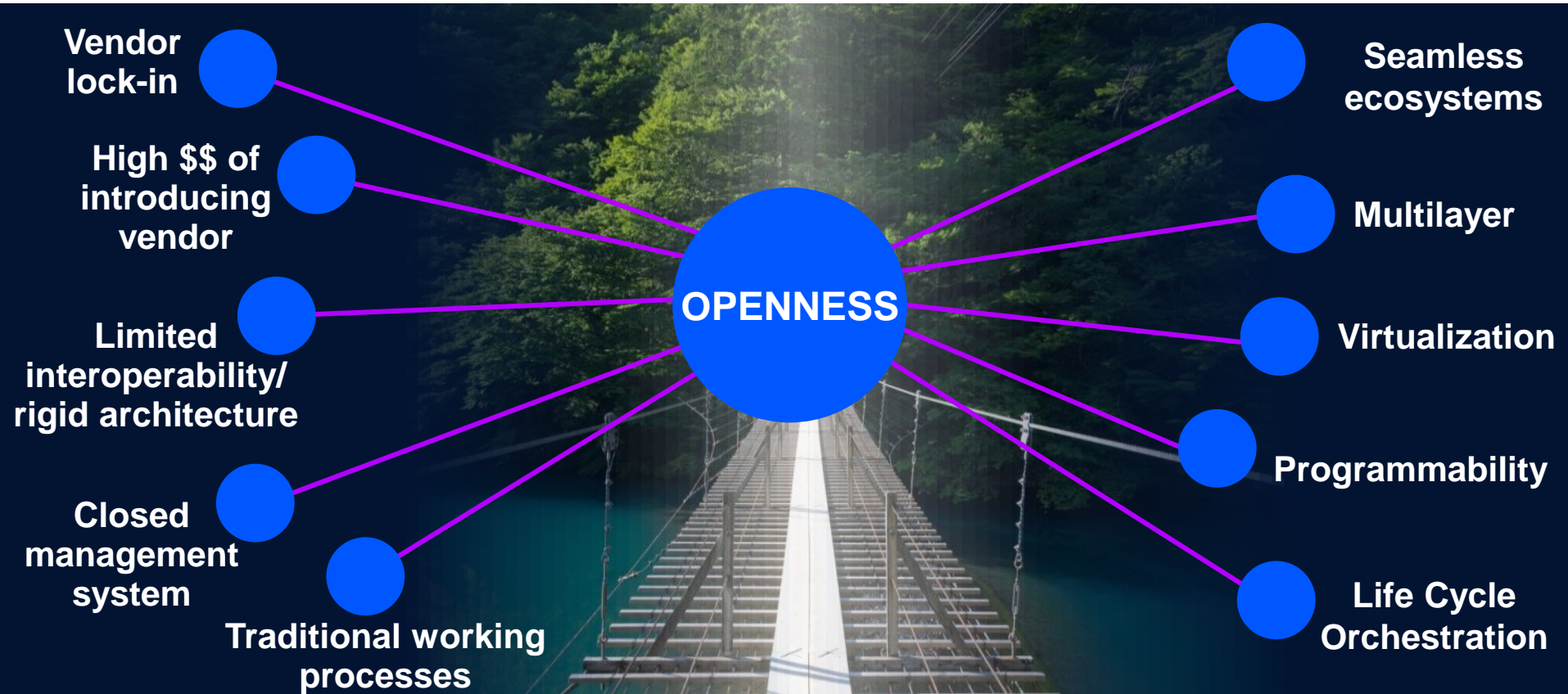
WHERE IS THE INDUSTRY TODAY?



WHERE THE INDUSTRY IS GOING?



ECI EFFECTIVELY BRIDGING THE GAP



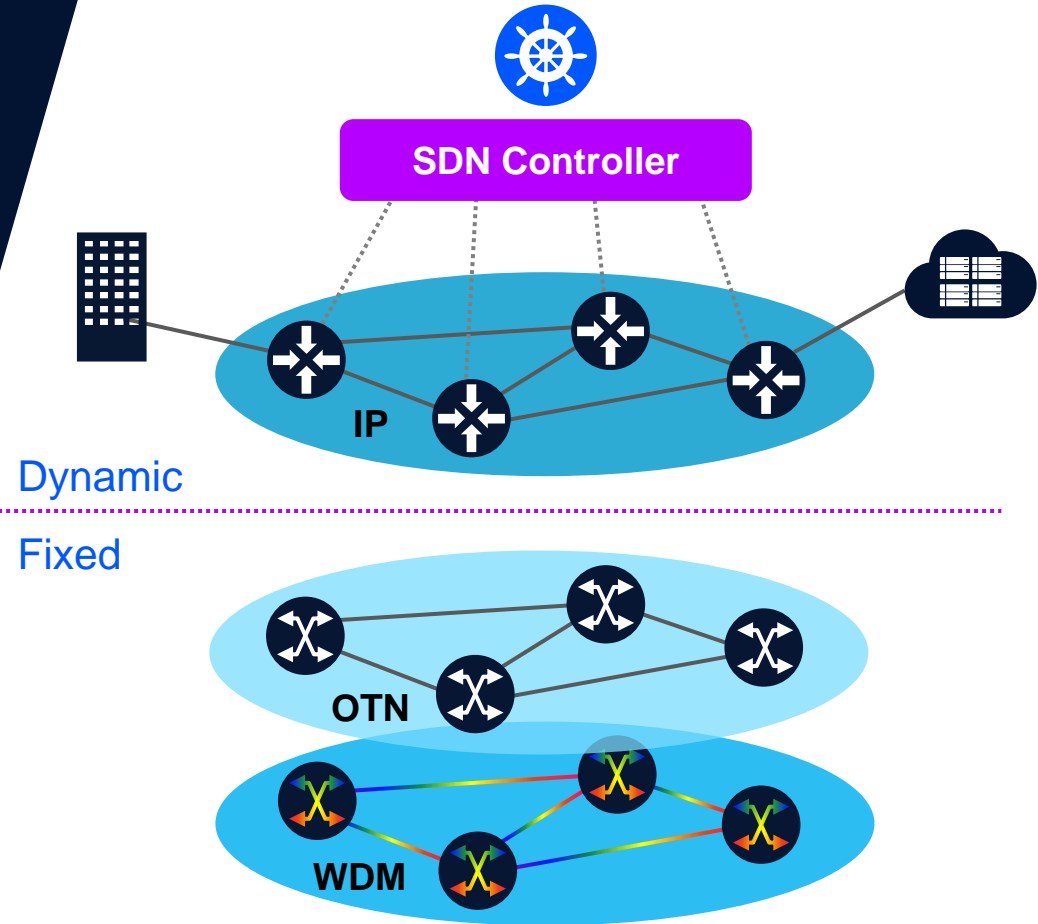
OPEN TELECOMMUNICATIONS STANDARDS

Foster growth of telecommunications markets by enabling **ecosystems** where diverse participants can interoperate with each other to create a whole that is greater than the sum of the parts



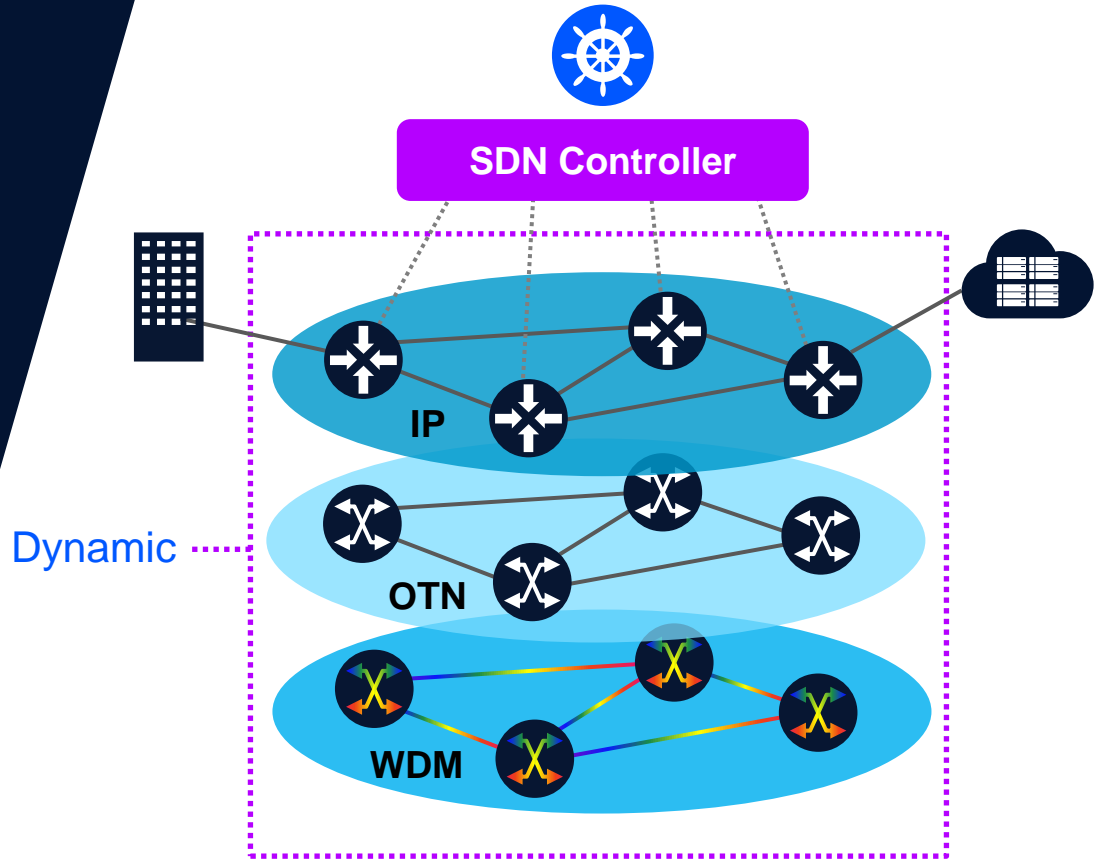
WAN SDN TODAY

- Separation of control plane and forwarding plane at IP layer
- Regard underlying OTN and WDM layers as fixed underlying pipes



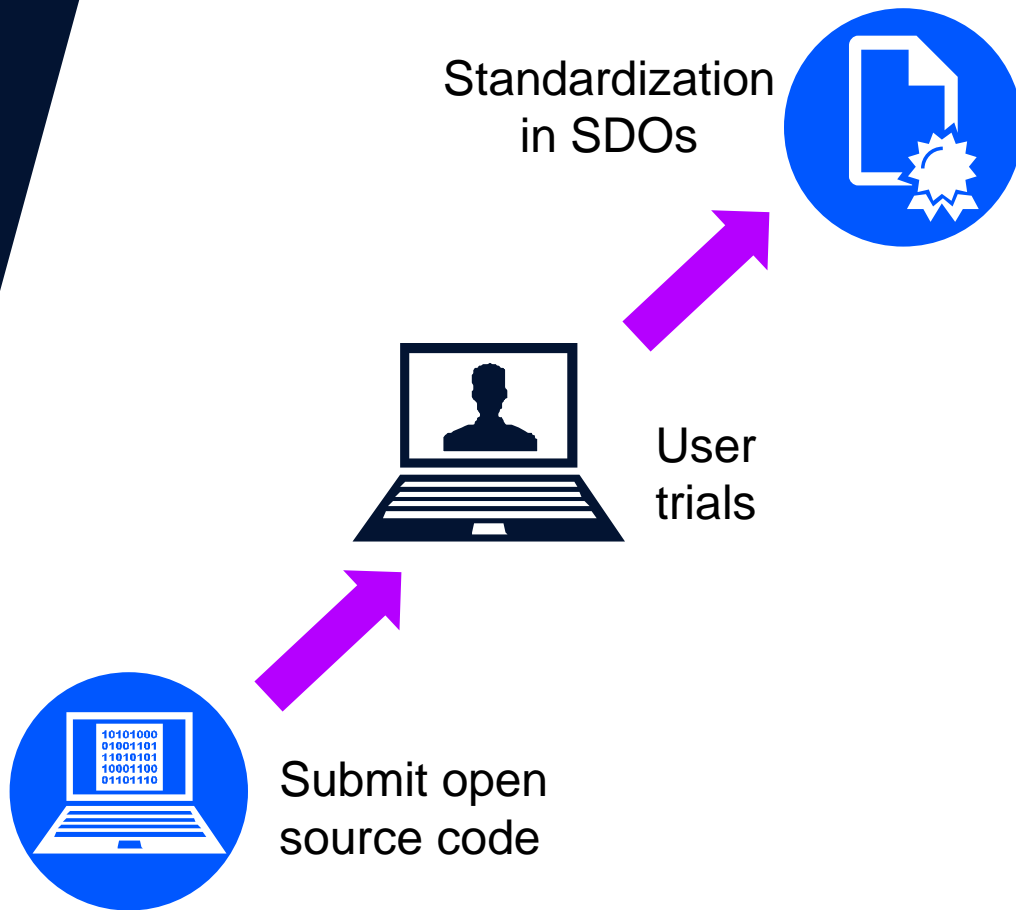
MULTILAYER WAN SDN

- SDN can make these layers interactive and dynamic
- Can exploit untapped OTN and WDM flexibility



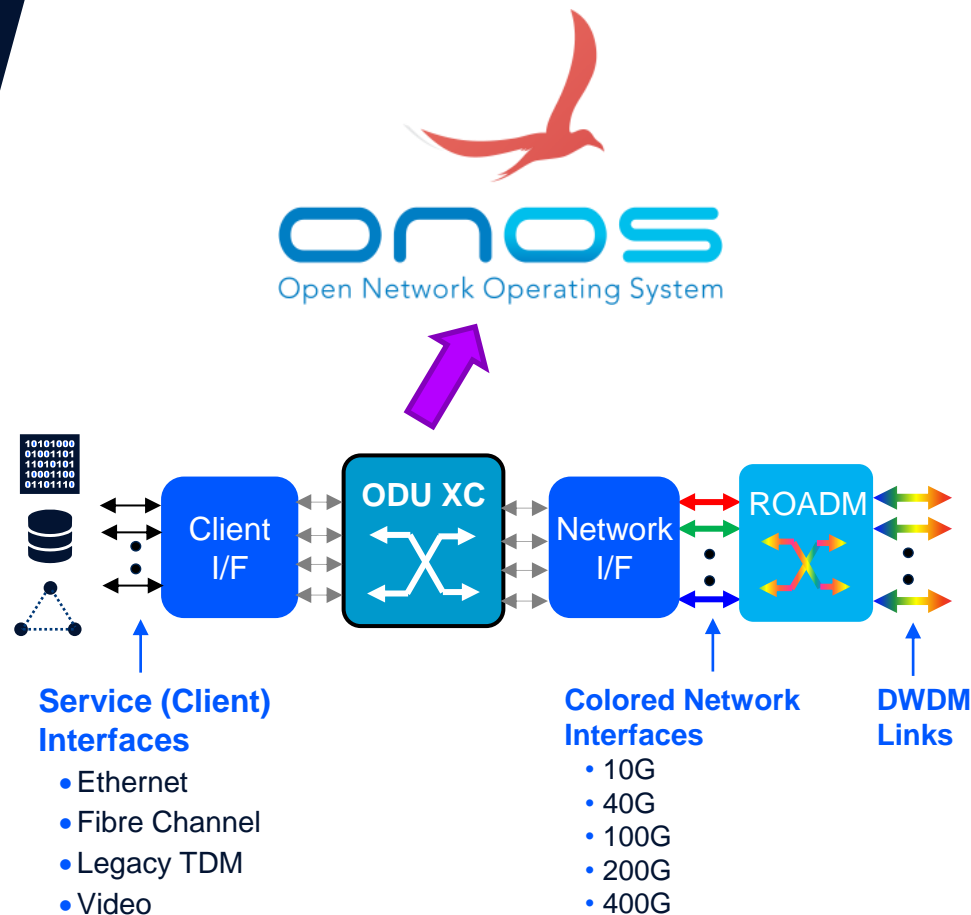
ECI APPROACH

- Code is king
- Let users play and refine
- Successful use drives standardization



OUR STARTING POINTS

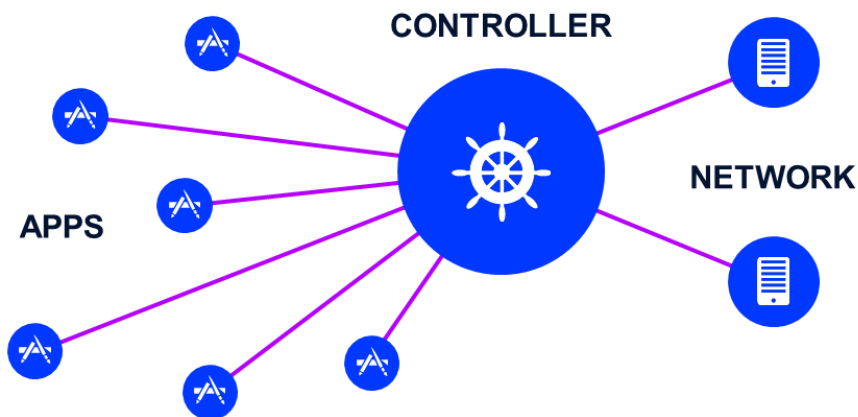
- ONOS SDN Controller
 - WAN oriented
 - Carrier grade
 - Truly programmable networks
- Address gap at ODU layer



A savanna landscape at sunset with a network diagram overlay. The background shows a dirt road winding through tall grass and acacia trees under a blue and orange sky. Overlaid on the right side is a network diagram consisting of blue circular nodes connected by white lines, forming a complex web of connections.

FUTURE DIRECTIONS

CARRIER GRADE CONTROLLER



- Multi instance for scale and resiliency – improve on current designs
- Distributed infrastructure for SDN applications
- Agile large scale reactive controller



How Did We Do It?

Warning – Real Deep Dive 😊

OPTICAL USE CASE – ODU MULTIPLEXING

Why

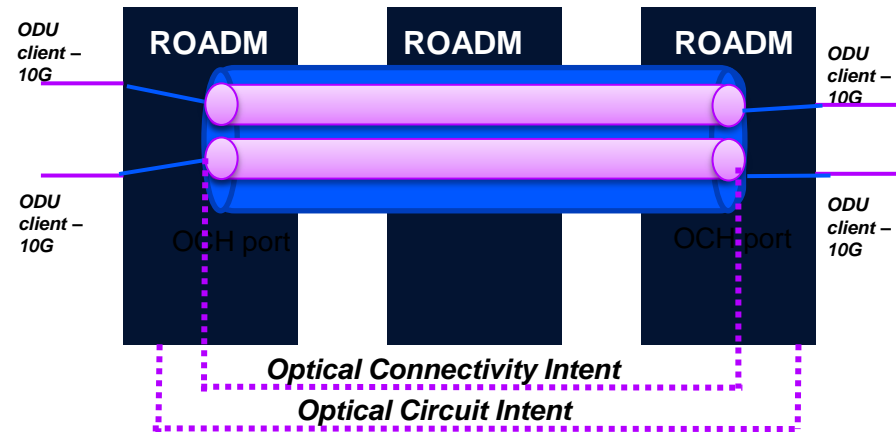
- Add multiplexing points for optical layers (similar to VLANs but ODU clients to OCH)
- Enable flexibility in mapping multiple ports to same optical channel
- Utilize each OCH port to contain several services

What

- Add Multiplexing of several OduCLT to single OCH trail (Lambda)

How

- The work was done based on ONOS Optical Intents (mapping client port to OCH port)
- Optical Circuit Intent – Modified to include ODU Tributary Slots
- Supported through Optical Connectivity Intent
- Tested with ECI Optical Equipment (supporting OpenFlow 1.3)



OPTICAL USE CASE – ODU CROSS CONNECT

Why

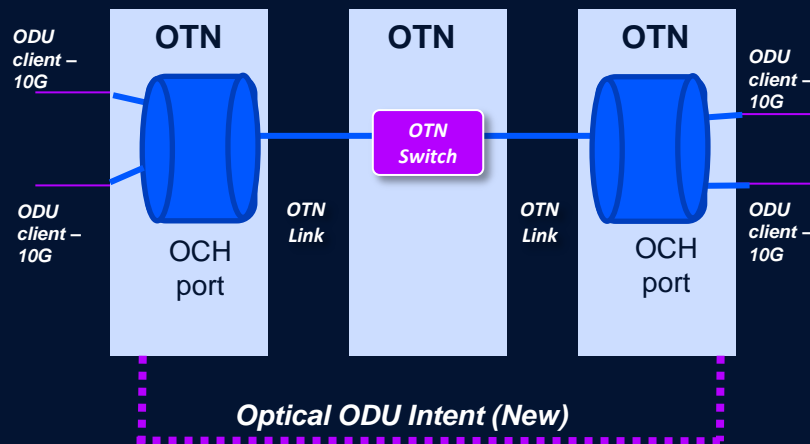
- ODU cross connect enhance the flexibility of forwarding | within optical network (the cross connect can be done in ODU level rather than OCH level)

What

- The option to perform ODU cross connect didn't exist in ONOS, hence prevented from creating connections via ODU switches
- Create ODU trail over topology based on OTN Devices

How

- Introduced
 - *New Intent – Optical ODU intent*
 - *New Port – OTU Port*
- Tested with ECI Optical Equipment (supporting OpenFlow 1.3)



ECI CONTRIBUTION

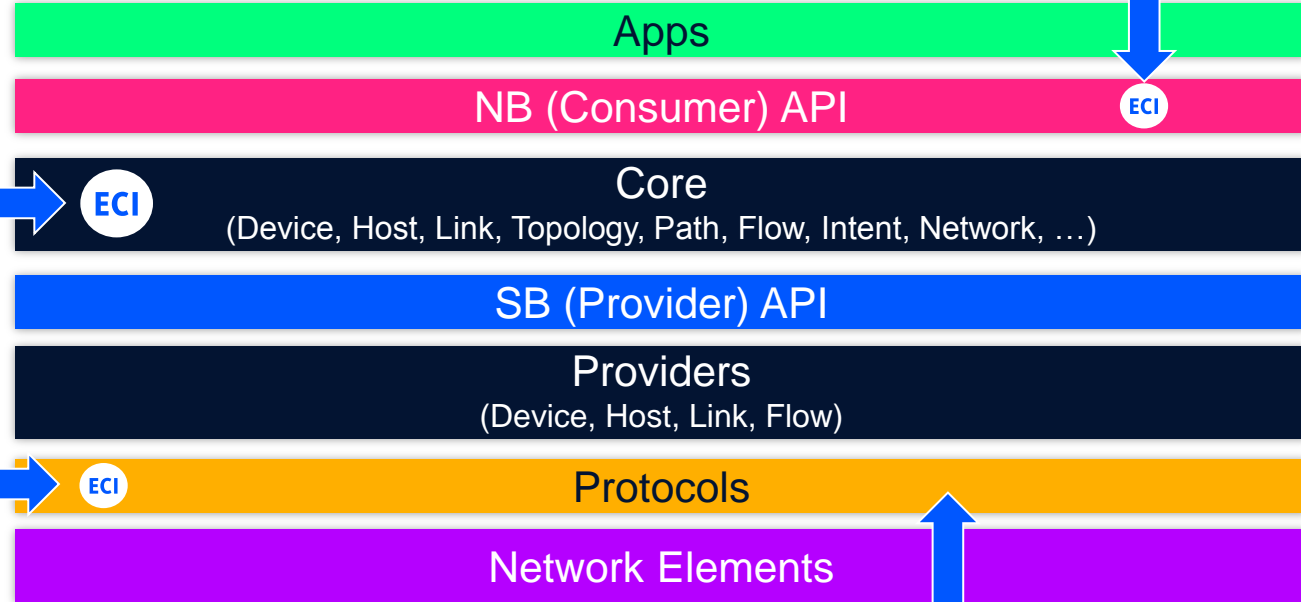
Core changes :

- ONOS Core Information Model
 - Add support for OTU port
- ONOS Intent
 - Enhance Optical Circuit Intent to support ODU Multiplexing
- New Optical ODU Intent
 - Add Resource Management for ODU Tributary slots
 - Several ODU tributary slots on same OCH port
 - Several ODU tributary slots on same OTU port

Protocols:

- Enhance Open Flow 1.3 (ONOS Loxi Project) - Add support for OF Optical Extensions based on ONF Optical Transport Protocol Extensions 1.0
 - Add Flow Match and Actions: OXM TLV (ODU_SIGTYPE, ODU_SIGID, OCH_SIGTYPE, OCH_SIGID)
 - Port Description using Multipart Experimenter Message

CLI to create ODU intent



Protocols:

- **Introduced optical 1.3 switch driver**
 - Retrieve Optical Ports using Multipart Experimenter Message as described in ONF Optical Transport Protocol Extensions 1.0

CONTRIBUTING TO OPEN SOURCE – OUR EXPERIENCE

- 
- We are learning from industry leaders
 - We are adopting state of the art development methodologies
 - We are exposed to new ideas and new trends
 - We are part of large project with different developers and part of global target

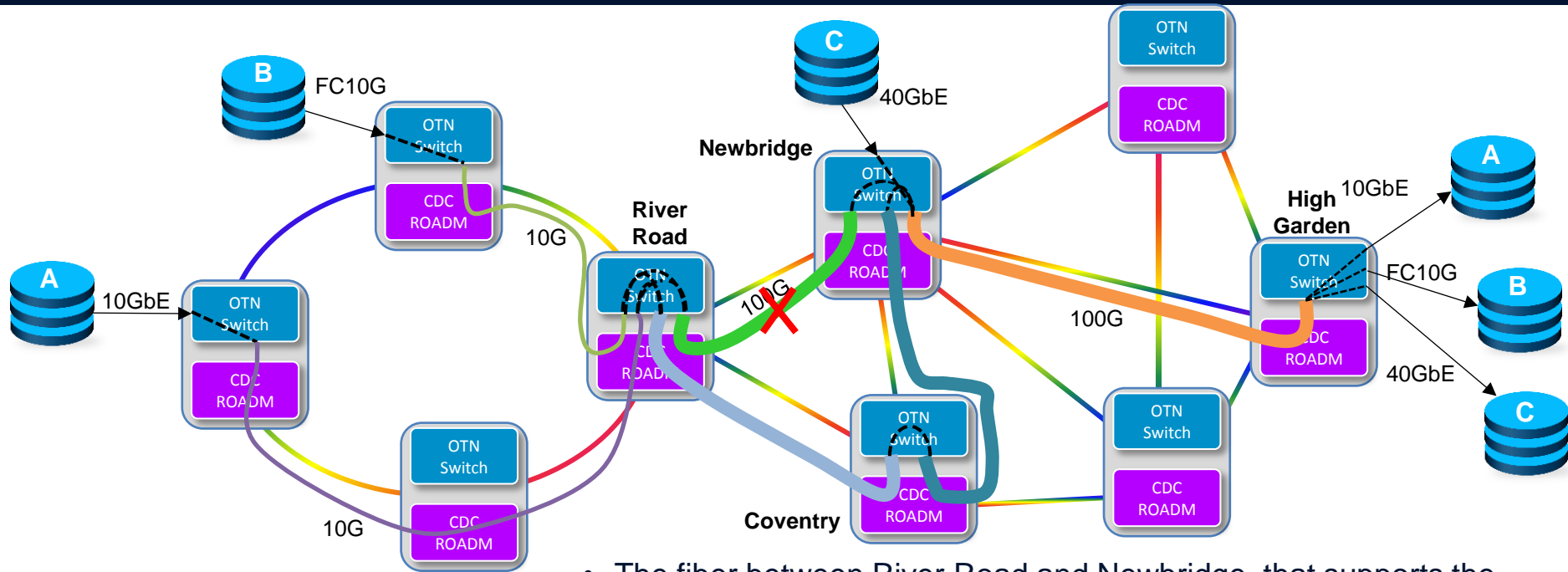
The background image shows three brown horses galloping across a dirt field under a cloudy sky. A network of white lines connects blue circular nodes, creating a geometric pattern over the scene. The text is centered over the horses.

“
**ORGANIZATIONS THAT WILL BE ADAPTIVE
ARE THE ONES INVENTING THE FUTURE.**
– *The Elastic Enterprise*



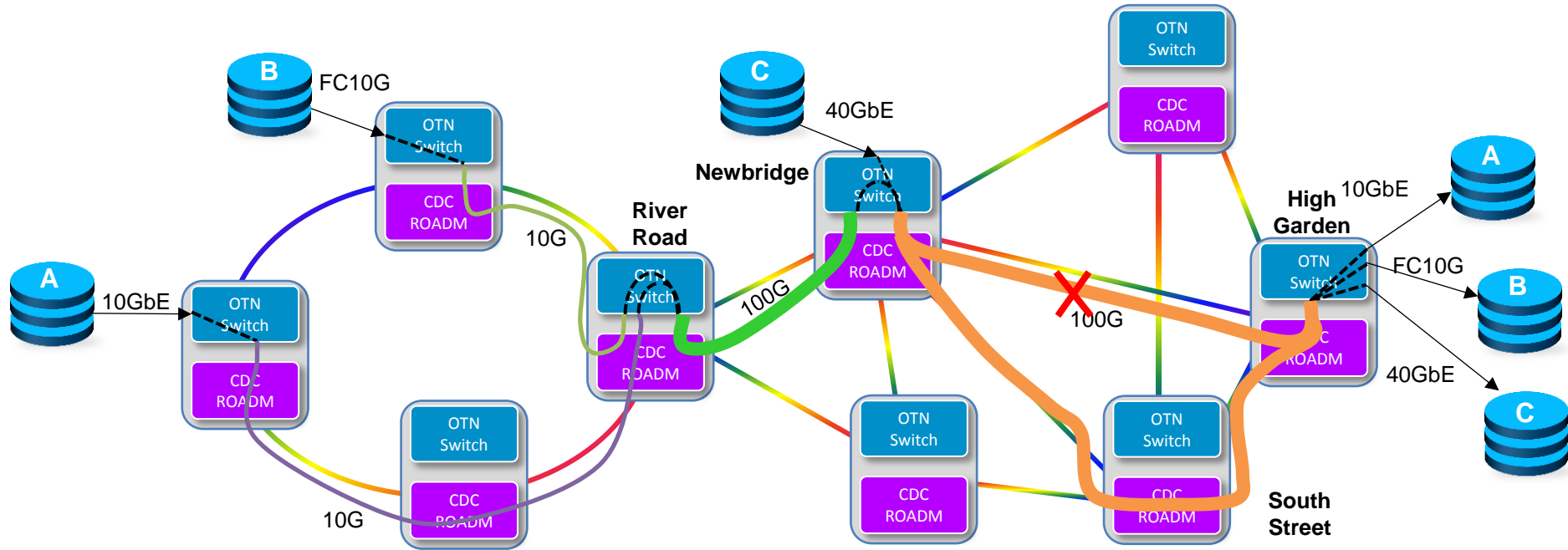
THANK YOU!

OTN RESTORATION APPLICATION



- The fiber between River Road and Newbridge, that supports the 100G channel carrying the 'A' and 'B' 10G service streams, is cut
- The SDN control plane, **uses OTN switching** to re-route these 10G service streams through the Coventry node

ROADM RESTORATION APPLICATION



- The fiber between Newbridge and High Garden, that supports the 100G channel carrying all three 'A', 'B', and 'C' service streams, is cut
- The SDN control plane re-routes the entire 100G purple wavelength, *and all the services it carries*, through the South Street ROADM without any further OTN switching

Abstract

ECI Telecom had traditionally developed proprietary code based on telecom industry standards. With SDN (and NFV) ECI made a strategic decision to move to open source. The first platform was chosen to be the SDN controller. After testing and evaluating several options ECI decided to go with ONOS. Moreover, ECI had decided to take the approach of "code is king" by promoting innovation into industry standards (in this case Openflow) first contributing code to the community, let the community assess its value and only then, try to take it to the SDOs. In this presentation we will present the process ECI went through in adopting open-source and will discuss the work we have done in augmenting OF with optical capabilities as well as our suggestions for a much more agile packet based OF and its impact on the controller architecture.

Audience

Anyone interested in developing SDN software in open source and especially in advanced IP operations in a SDN framework

Experience Level

Intermediate

Benefits to the Ecosystem

For the open source community it will be beneficial to show how the transition to open source can leverage legacy companies For the OF community it will demonstrate the innovations that can be delivered in the SDN framework

Technical Requirements

Good knowledge of OF and its data model