Open GOLEs

Open Lightpath Exchanges Why?....

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- What is the problem that Exchange Points solve?

- In order to strategize about any near term or long term issues of Exchange Points, it is necessary to have a clear understanding of what a Exchange Point is (or is not) and how it functions in the larger [global] ecosystem of advanced networking architectural constructs, objectives, and policy…

**What is unique about the Exchange Point?**

And why does this matter?

- What is an "exchange point"?
- What is an "*open* exchange"?
- What is an exchange "point"? vs a "distributed" exchange?
- How does the function of these OXPs differ from conventional networking constructs?
- How do/will Exchange Points affect the "rest of the network"?

- Simply recognizing the existence of handfull of OXPs, or even a "gut feel" that there is value here, does not provide sufficient understanding or clarity to guide long term strategic planning.

- A clear definition of these OXP network constructs and their architectural roles in the global network will reveal the essential functional characteristics that must be preserved and nurtured for the future.

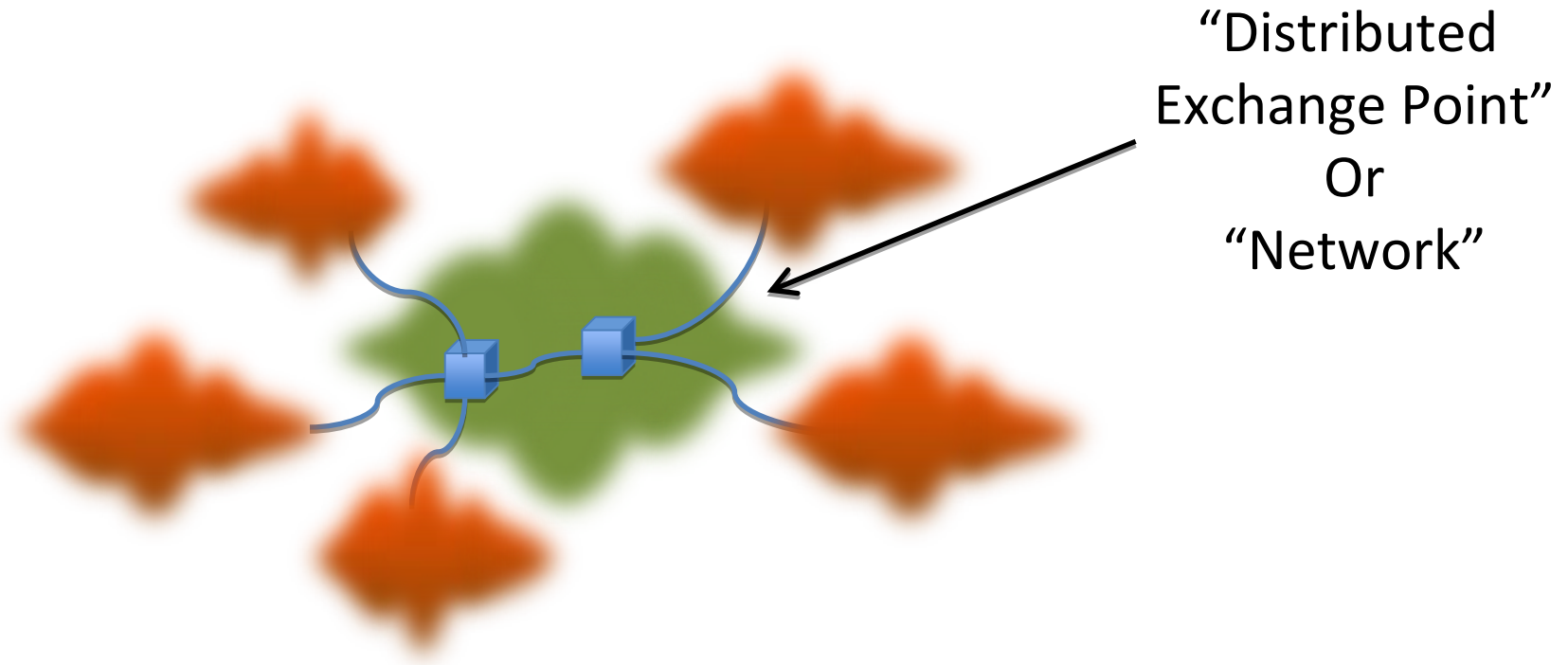# Fundamental Functional Role of an Exchange Point

Exchange Point Switch
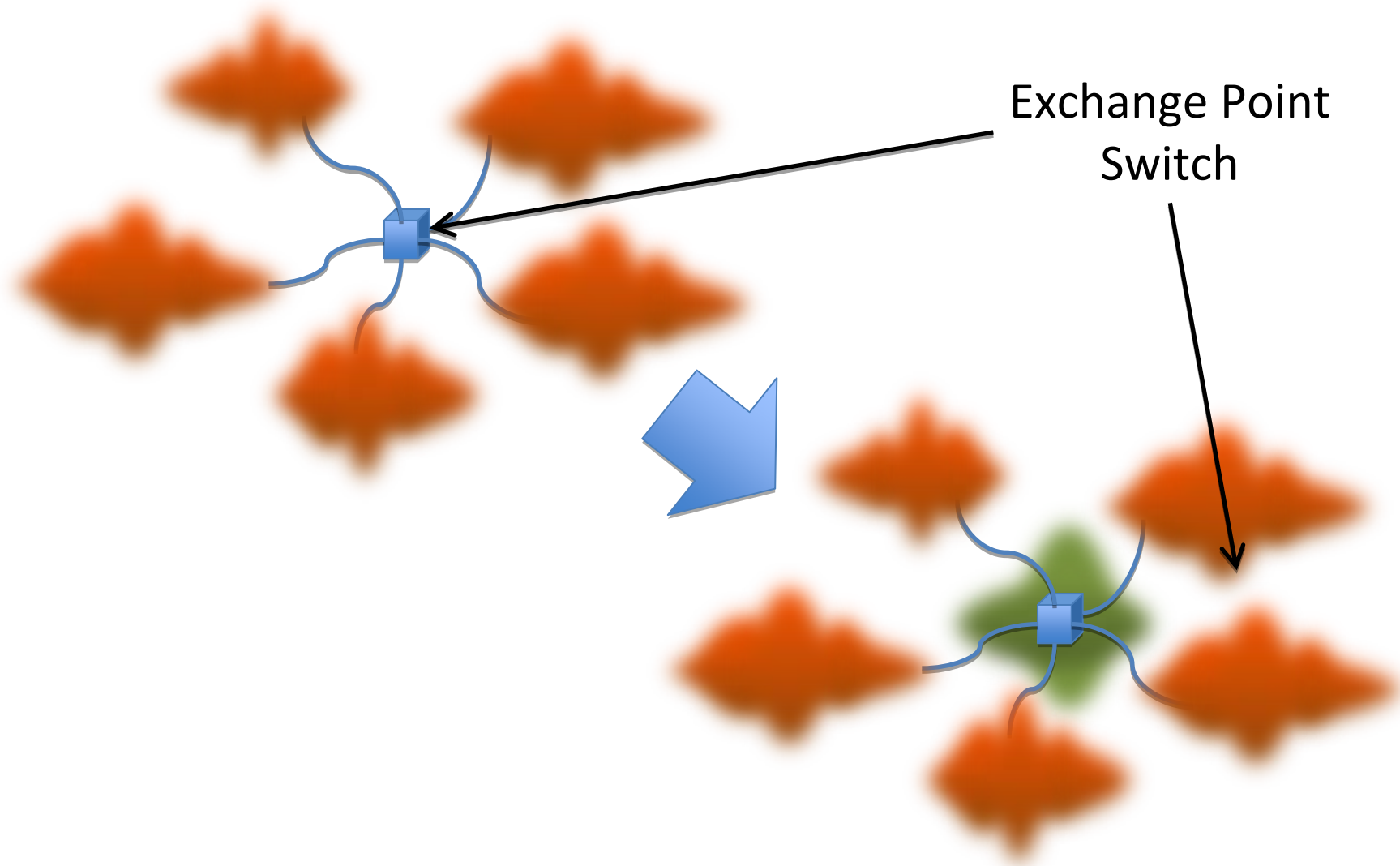
Exchange Point or Network?
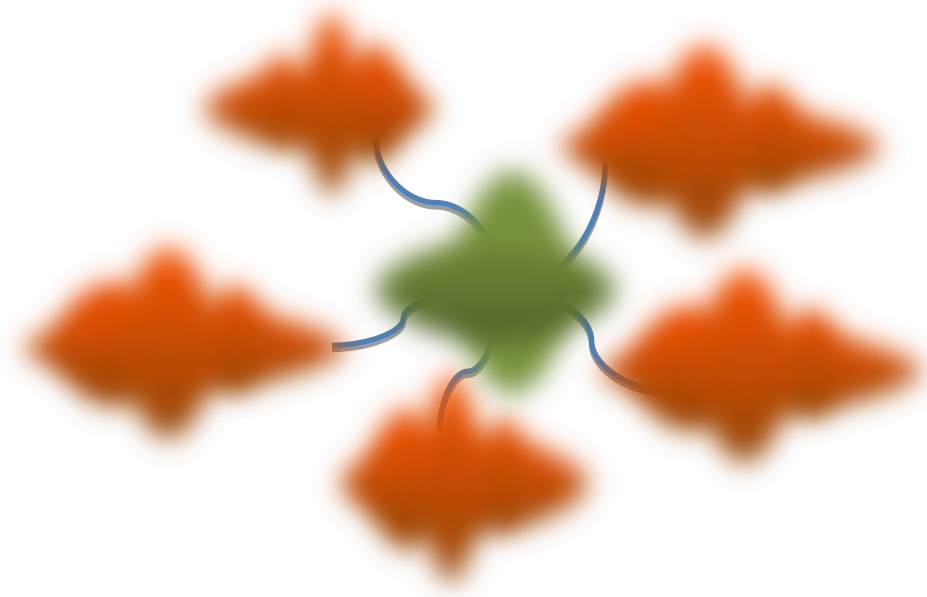
What differentiates an "Exchange" from conventional networks?

Distributed Exchange Point?

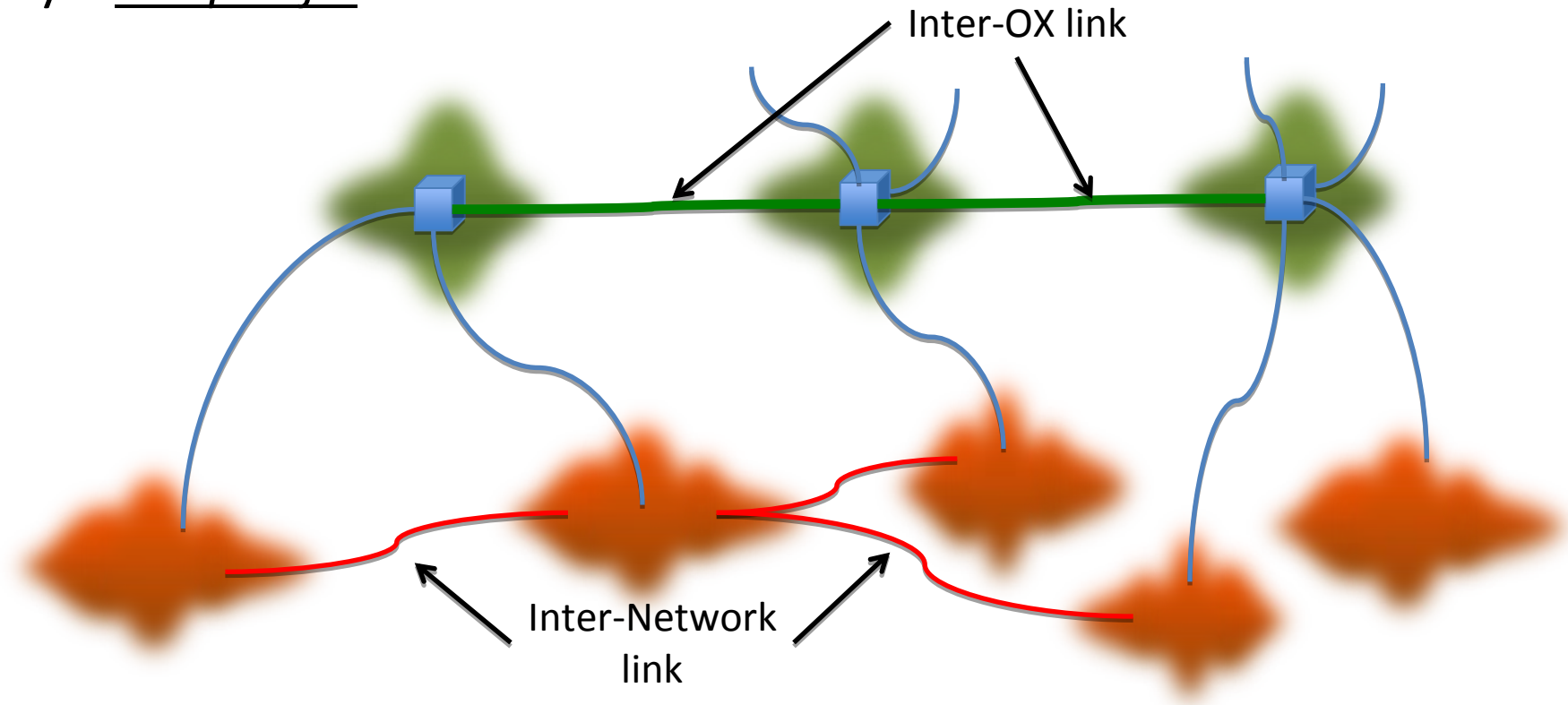"Distributed
Exchange Point"
Or
"Network"

- What is the fundamental difference between an "Exchange Point" and a "Network"?
  - Is it simply a physical capability? Or is it an abstracted concept, _a service_, distinct from specific hardware or software?
  - Is it simply a _Policy_ difference?
  - Is it how we assemble our networks? (peering relationships?) Again, how does it differ from current practice?

- What is unique about the _service offering or policy_ of an Exchange Point vs a Network?
  - Edge-to-Edge connectivity is insufficient: both are capable of this...
  - Do both *offer* (allow) Edge to Edge connectivity? Typically, networks do not offer connectivity to all connectors... (e.g. transit _policies_ of a network often preclude peer networks from transiting that network

- What is an _Open_ Exchange Point (OXP)?
  - How is this different from any other Exchange Point?
  - ...Or different from a network?

- The difference between a Network and an Open Exchange (OX) is the "Service" offered – not the hardware or engineering per se.
  - The OX service asserts no constraints on the exchange of edge-to-edge traffic:
  - All policy governing exchange of traffic is exclusively and explicitly a client function.
  - The OX itself is non-blocking, i.e. the quantity of traffic carried by the exchange is a function of the client port(s), not of any physicallimitations or policy constraints imposed by the core XP due to resource management.

Is an OX architecture useful?

Do Inter-OX links provide "better" connectivity
service than inter-Network links?
Why? *Be specific*…

Inter-OX link

Inter-Network
link

- OX Links can be modeled as simple Open Exchanges as well – they are non-blocking from end [port] to end [port].

- But a set of concatenated OXPs and OXLs do not equate to a single "distributed" OX:

  - There is not a "non-blocking any-to-any" service capability.

  - And they the OXLs have no means to assert policy

What are the pitfalls of a global OX architecture?

Who owns, and therefore asserts policy over, the inter-OX links?
(Should these be green or orange?)
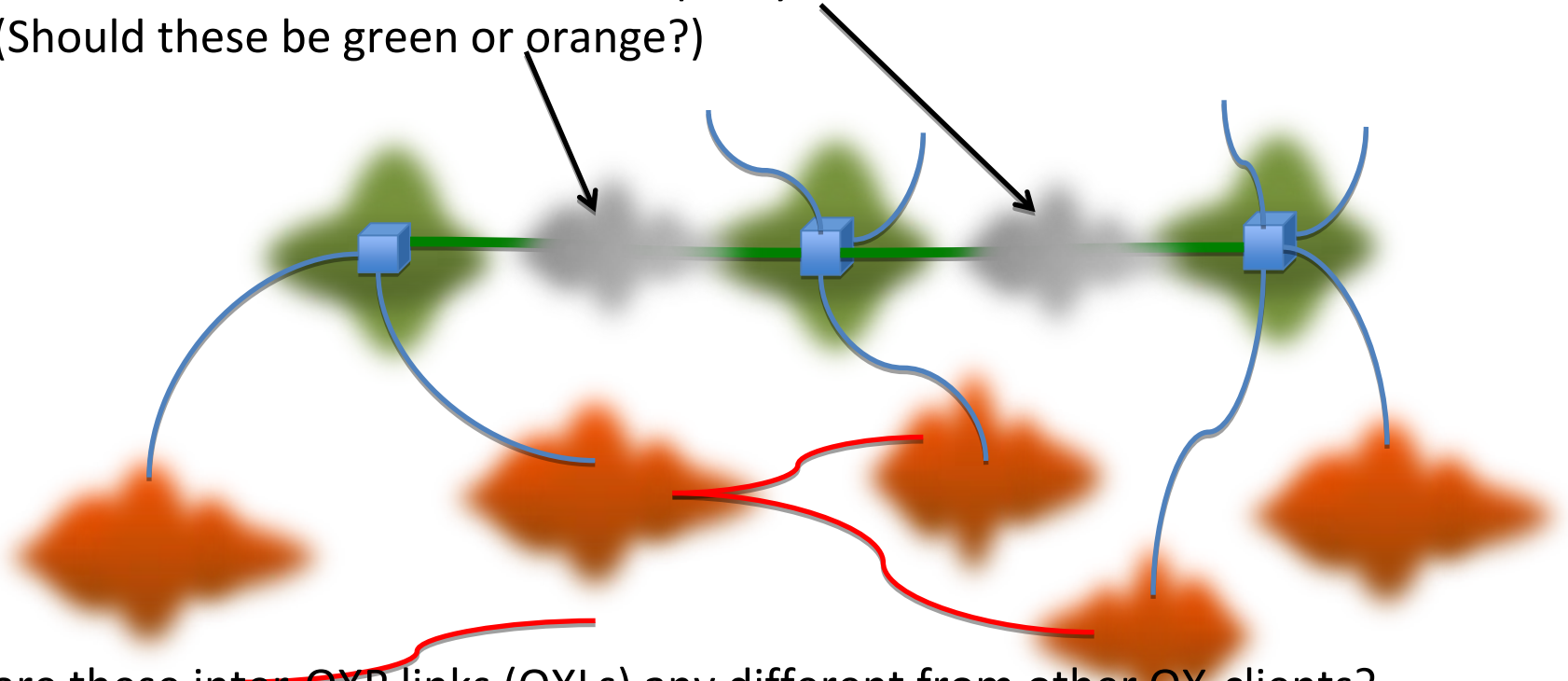
How are these inter-OXP links (OXLs) any different from other OX-clients?
- If inter-OX links form "just another network", then the architecture is dependent upon the inter-OX policy for global reach.

-*We need to address the inter-OX link policy for the architecture to be useful!*

OXP global reach…
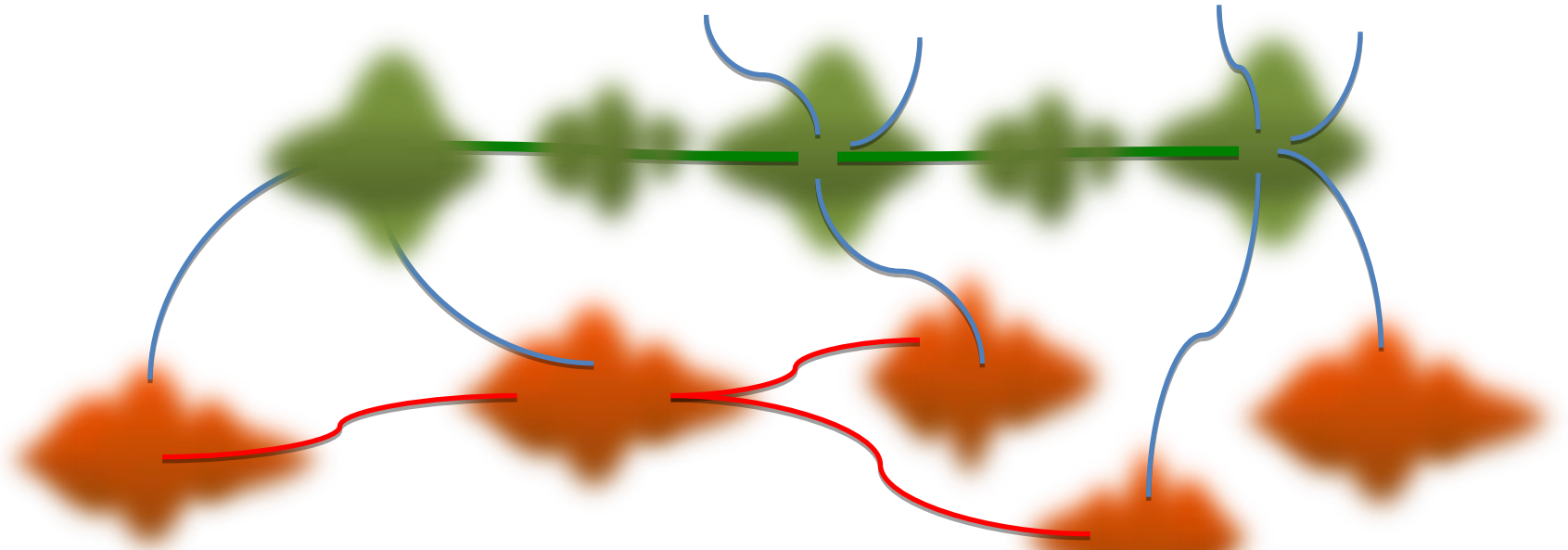
How does this improve our performance or flexibility?
..or have we simply re-created the same architecture with new policy?

Could we have simply changed our policy?)

Inter Exchange Links

- Inter-OX links are necessary to extending OXPs globally:
  - These links create a global continent from the islands of openness established by OXPs.
  - Without a coherent inter-exchange link policy, the Open Exchanges themselvs are simply local phenomena
  - A link with a "non-Open" policy is just another abstracted network
- But OXLs have several problems:
  - They do not scale easily in terms of extending the "non-blocking" OXP characteristics
    - They potentially pose a "scarce" resource between OXPs – a "policy" is then necessary to allocate the resource "fairly" or "appropriately"...
  - **But the OXLs have no Policy Enforcement Point !**
    - The OXLs are provisioned freely – first come first served
    - For OXLs to function as Open XLs, there must exist a trusted Open PEP at the ends of the OXL

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- Virtualization
  - Over the next few years, virtualized networks will be possible, ... perhaps even common...
  - How do policy-based networks affect the function of policy-free exchanges?
    - Can a PBN join an OX and grab all the capacity from an OXL? (its first come first served after all...)
- Scaling
  - What happens when the OXP+OXL architecture grows to 1000 OXPs? Or 1000 OXLs?
    - Do the principles we assert with today's cost structures and envisioned technologies extend to this scale?
    - Do we *want* this scale? If not, why not?   And how do you constrain it?   Do OXPs create an "urbanization" architecture from the existing "rural" (distributed) network architeture?

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- Cost
  - The Golden Rule: He who has the gold, makes the rules.
  - How do we convince those with gold that an OX architecture without rules should be the rule?
    - E.g. Will the US Dept of Energy be willing to fund X-ATL OXLs that might benefit Nordic collaborations with China? Or Would the Nordics fund X-ATL OXLs that are consumed by LHC traffic?
    - Can we realistically expect a "no policy" position with regard to funding?   And how does that change the OXP premise?
    - Will "no policy" allow connections that are counter to the purpose of the OXP or the sponsor organizations? (legal raminfications)
  - How do we expect OXPs to affect the cost seen by the rest of the community?
    - Will proliferation of OXPs undermine the aggregated cost model of "networks" by encouraging "going your own" to the OXP?   i.e. will OXPs cherry pick geopgraphically nearby organizations thus driving the cost up for more remote organizations?

- A "please enforce my policy" (PEMP) service:
  - Since inter-exchange links cannot enforce policy themselves, and the OXP manages their interface at the exchange point….
  - Could the OXP offer a PEMP service to clients?
  - The OXP itself is not defining the policy – the client defines the policy, the OXP only enforces the client's policy
  - Client policy only has scope for that client's port.

Long term Reliability

- Do Exchange Points pose an inherently different need for reliability, resilience, redundancy – and long term sustainability - than conventional techniques can provide?
  - I.e. If an XP goes out of business or becomes a slug, what is the impact to the network? Can clients go elsewhere?   Should clients rely on any XP that may form a single point of failure for their enterprise?
- Do we need a "special" funding model to make Exchange Points viable?
- Do we need community standards of acceptable practice to bless OXPs?

- A basic non-blocking promise to OXP clients.
- Any organization can be a client.
- All clients treated the same.
- Global resilience through global redundancy.
- Don't try to solve policy problems with a hardware solution.
- How do distributed organizations incorporate OXPs into a robust and long term strategy?

- There is no clarity of the problem space – we need to identify those issues that we believe are now or will impede our vision of global connectivity.

- We need to thoroughly explore the issues and potential solution space to understand the implications of different solution strategies

- A GLIF WG should be established to

  - a) identify and formulate the problem statement

  - b)and to then explore and refine an integrated solution strategy.

  - Report at GLIF Baton Rouge