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ISOC-PEERING SESSIONS

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>> My name is Lindsay and I work for the marketing team. I'll be introducing the event today. Firstly, we are going to say thank you to all the event sponsors. Thanks to Darwin and Carolyn. Ben and Andrew from Facebook and the team here at linx who is supporting the active event once again. Thank you for your support. We also have a series sponsor. Thank you to Nap Africa, thank you everyone.

(audio going in and out)

>> They will providing and supporting the interpretation service throughout the events in this series. There is an interpretation support service at the bottom of your Zoom bar. You can switch between English and French in that function. So have a go and make use of that so you can understand sessions to the best effect.

We have a chat room function as well. Please get involved in the chat function. Any questions for the presenters, please post them in the Q&A function and we will be asking these at the end of each presentation session as we go.

If you are on social media watching this, watching the live streams, please use the hashtag to share that you are here. It would be great to share that you are getting involved. This session as I mentioned is being live streamed on multiple platforms and also it's being recorded so it can be watched back after this event on demand.

After the main content today we will be handing back to the event organizers for the peering personal sessions. Stay on the line if you opted in to hear those. It will be a different organization introducing their network, it's a great chance to network with other peering, potential peering contacts.

Here is what you can expect to get out of today's session. We want you to be able to learn more about good peering economics. From why peering is never free, how to develop a peering strategy. What role to IXs play (lost audio)

Learn more about programmable telecom. How it's evolved and how it's driving forward new products. Also insight to how it's I involving. We will be finishing with the demonstration of the new universal IX API solution and why it's beneficial and how easy it can be used to adopt. Here is our lineup for today. We will be starting with Susa Forney. Moving onto Nico. Then to Mark and finishing with Mike Hellers with Linx before we come back and let Mike and Mark run the demonstration.

My colleague Esther will be moderating the sessions. She will be asking the presenters the questions that you'll be dropping into the Q&A function. Lookout for her after each sessions. Without furtherer delay, here is your first presenter. I'll be handing over Susan Forney who is our network engineer at hurricane electric and will be talking about economics.

>> Hi. Let me share my screen.

>> I'm here today to talk to you about peering economics. The topics I'm going to talk about today is why peer something never free. When peer something worth the investment and how to develop a peering strategy and how to be a good neighbor.

The reason why peering is never free because it actually costs money, you just don't think about how much. Peer something a connection between two network devices and they require money. People are required to configure and maintain network devices. People are not free. People are the most important cost in any of your networks.

>> Something wrong? Sorry. What should I do? I'm sorry, I'm being told I have feedback and I'm not sure how to accommodate that.

>> I can hear you so carry on. You can pop your camera on if you want.

>> Back to our story. Then network devices need electrical power and places to specify. They are not free. They cost money. These are things to consider when you think about joining an internet exchange.

while peering has a cost, you have to determine the value on investment. To determine the value, determine how much support costs. Besides the actual port on your equipment, the optics, the power the support costs for having something in a facility. How much a cross‑connect costs at the data facility and don't forget the setup fees? You would have to have most of these things if you were to connect to an ISP in a data center. This will help you when your accounting guy comes along and asks you for your budget next year.

So make it easier to understand, we came up with this chart to show the difference between an internet service provider and internet exchange. I use broad numbers to make the math easy. Your mileage may vary. But this is for purposes of illustration. During the ISP, the one-time cost for device are in 200‑dollar for the support. The setup fee for cross connection is $500. I notice the ISP tends to be less than the IXP. I put $250 for the ISP and $500 for the internet exchange.

Then once you get those costs out of the way, you think about the recurring costs you are going to pay every month. I'm assuming a 10 gigabyte port. I'm going to say that commit price is $2,000. If you exceed above the megabytes ‑‑ above the 2 gigs I'm going to say it's one dollar per Mb then we have price per port and cross connect. Over on the side for the IX, we have the ‑‑ we don't have a commit level and the commit price and price because you are prefills because 90% billing. Because you have the cross text and device port.

If we take all those numbers, then we have the information on what it's costing us, then we need to see if it makes good business sense based on cost. If we take a look at that, I have this little graph that shows you, okay, this is graphed from 500Mbps to 5 gigs. I tried going to ten but it's long and an eye chart. It's bad as it is right now. The ISP obviously is more expensive. It starts out relatively high compared to the internet exchange. As they both converge a little bit. The internet exchange stays competitive. Ends up 20‑cents a megabyte at eight gigs while we are attenuating towards a dollar a megabyte on the ISP. We are clearly saving money on the internet exchange. We are just looking at it on the flat rate.

But does it really work that way? Because you have to have some transit. Not even hurricane electric could get all its connectivity from peers. We have to have some tracking go to ISP and some traffic going to the exchange. For the sake of easy math that I have done on this chart, is put 50% of the traffic on the internet exchange and 50% on IX. We have the original lines on the last chart for ISP for exchange. The center line is actual cost per megabyte if 50% of the traffic were on both exchanges. It still looks good.

There is one more thing you need to take into consideration when considering these costs. That is that pesty commit price. You have 50% of our traffic on internet exchange and 50% on IX, you are going to have to have 4 gigs of traffic before you meet that commit. That falls on the floor if you don't use it. It's important to keep this in mind if you are trying to figure out if joining an internet exchange is a good idea.

Then in addition to our monthly recurring cost, don't forget to factor in operational support costs. Save by streamlining or automating them. People are going to be your most expensive investment for these. Create peer groups for your neighbors so it takes less time. Consider the support priority. You may not want to wake up your expensive engineers to reconnect a peer on an exchange if it's not important. So monitor your port capacity on your IX connections and increase it before you get into trouble. That port fills up faster than you know it so you should keep an eye on it to make sure you don't throw pacts on the floor.

Sometimes for the internet peering is provide tangible benefits in terms of reduced latency and improved throughput. You will gain for diversity. It will improve traffic management and help your routers rebuild your tables faster when tables go or a link goes down. Improves the scale of your network and prepares you for future growth. This results in internal and external customers being happier. That is worth something.

Now that we have talked about how much it's going to help you and your business case. Let's look at developing peering strategies so you can get a better value of your investment.

The next thing to do is target the exchange as they are going to have the most to offer and figure out who you would really like to peer with when you get to an exchange.

So, to determine if the port is a good investment, you should consider who your potential peering partners are on the exchange. Exchanges where you can reach content networks or cloud providers can be advantageous. If you are amazon, Microsoft or Google customer on the clouds and you peer with them on an exchange this will make a dent in your transit bill.

Don't forget to peer with catching networks like Akamai and lime light.

Net flow or S flow can give you information about your traffic sources and destinations. It may not be what you expect. At one point I was helping a University trying to figure out who to peer with. They sent an S flow so they can figure out which research organizations may be the most advantageous and they were thinking about Microsoft and Google might be great for thinking about free flow of information on a college campus.

They discovered 75% of our traffic was going to streaming services like Netflix and Hulu. They were providing the internet service for the college dormitories and that is where the bulk of the traffic was going and the bulk of transit costs were. The first persons we hooked them up with were Netflix to save them money. You might want to take a look where your traffic is going even if you think you know.

So armed with this information, you should investigate some exchanges. We have a list of all the peering exchanges. You can browse through them and see which ones are close to where you are or might be advantageous to join at relatively close proximity and in some cases countries or geography may be better for you.

Since we are doing APIC I'm going to look the NAP Africa. It shows you the exchange and all the people on the exchange as well as links to handy things that the exchange has to offer like Nap Africa has a link to peering traffic so you can get an idea of the traffic going across there. You can see what it looks like and if it would be good for you.

The solution to get your feet wet is peer with the internet exchange route server. You'll only have a couple peering exchanges with the route server. It's a quick way to access many networks on the exchange. Even if you decide you want to peer individually with people on the exchange, you can still peer with the route server but you may prefer any connected peers over the route server routes.

The disadvantage of using a route server is you do have less control. You may not get all of the available routes because not all networks advertise all of their routes. Some advertise a subset. It may be advantageous to do it directly. Not all exchanges have route serves, although now a days it's pretty common.

A peering strategy will help you get the most value from your exchange port. You can evaluate these attributes first as we mentioned before. Are you releasing transit cost on that port? Can you send traffic to this peer that you otherwise would have to send on your transit connection? Are you going to get a lower latency? For example, cloud providers in addition to saving money on your internet connection, it will probably improve your performance. Do you have excess band width on your IX interface and on the ingress and egress interfaces on your router? This is a big question. You may discover you are out of room. It's always a good idea to do these things in maintenance window and make sure you have enough capacity.

So, a peering strategy helps you look at the big picture as well as the small one. And I'm going to give you an example as to why you need to think carefully about your network architecture and traffic patterns.

So in this diagram, I have a green network. The green network has a sat light office which is a building in another country. It has a connection to the satellite office. They like to do a lot of communication with the partner which is blue network. Green network has good connectivity. The office has good latency. Then the green network discovers there is an internet exchange that allow it to peer directly with the blue network and save a lot on transit costs.

What it fails to take into account, once it prioritizes that route for everything on the network, now the sat light office in another country instead of going through the lower latency route to the blue network is now going all the way back to the country for the mother ship, across the internet exchange back to blue network and then back the long way. That is causing a performance problem. That is the thing you need to keep when you do internet exchange ‑‑ when you connect with a peer on internet exchange. You need to think about how it's going to affect your traffic pattern internally and do the thing that is best for your network.

You may need to do geographic communities to help yourself out. A lot of peers will advertise those to make them easier. Especially ones located in many places. So those are all things to keep in mind.

Now, we are going to talk about our last topic which is why you should be a good neighbor. Peering works when it's a good experience for both parties because it's voluntary. So, first, cleanup your advertisements. You should not be leaking your private IP space around routes that don't originate from public AS. Be easy to keep in contact with by updating routes and contact information in peering db or on your local RIR data base. Keep your IRR records up to date and create RPKI ROAs for all of your prefixes.

And, then, while the other network you are peering with is probably a fine organization, trust no one. Set maximum prefix limits for your peers. And, the reason why I tell you this is a story that I have from when I was working with Microsoft and I had a colleague that worked in the company and I came into the internet exchange hub for the city of Seattle which is the building one morning. He was crawling out of the elevator half dead. One of my peers advertised the internet to me last night. I said you don't have the maximum limit set on your peers? He said, I do now. Don't let that happen now. Set prefix limits. Accidents happen all the time and people do things they don't intend to. Don't be affected by it.

Filter the routes to accept owned the valid routes from your peers. Again, so you don't accept things you wish you hadn't.

It's easy to create a filter for your peers. You can use a tool like bgpq3 to generate a prefix list. I have an example here. I'm creating an l so I can give it a name. Then bgpq3 pops it out for all the prefixes allowed for that. Simple. You can even automate it.

Also, be responsive when you are notified of an issue. Nobody likes a peer network who ignores them, especially if they experience a DDoS attack or one of your customers is doing something naughty. No one can take advantage of you without your permission. You are the one who can control your advertisements. At the end of the day, not all networks are going to want the peer review. And this is usually more of a problem with their peering policy. A case of it's not you, it's them. Even if they decide not peer with you, it's a good thing to check back later. Maybe people are moving to a different location. If you keep contacting them sooner or later you might be successful. So be persistent.

The internet turns 50 on October 29 which means it's almost 51 years old. Peering exchanges began in 1993. They weren't gone out of style. During the pandemic, seven of them formed this year. The reason for that is exchanges are the backbone of the internet. They have been able to improve our network in ways that transit providers can't.

communities form around exchanges that are invaluable. You are getting connections and involvement that you wouldn't normally be able to have. You get benefits not available from other sources. Joining an internet exchange will do a lot for you besides just decreasing your transit costs. That is all I had today about how to do peer economics. I'm ready for questions.

>> We don't seem to have any questions at the moment for Susan. So we shall move on onto Nico from CMC networks. If we get any questions for Susan, we will come back. Thank you very much. That was fantastic.

>> Thanks Susan. Appreciate it. We have shown you some of the bits and pieces when I started it would have saved a lot of time, money and effort.

If you want to go to the next slide. I think in the context of beyond peering and what we are trying to achieve here, it's important for us to have a look at the scale of Africa and some of the stats around it at a high level just to understand what we have to work with in our region.

As we can see on the left, the interesting thing we did was to take some of the major countries in the world where a lot of traffic is generated from and compiled them and overlay them on the African map. It ends up being scary to realize what we have to deal with. And if you look at the stats on the right we have 54 countries and cable systems. Currently 46 internet exchange points that service this footprint. It is incredible.

We are basically saying we only have one exchange point per country give or take and we have to service a continent that has very large population. So again, going back to what Susan is saying, internet exchange points truly become the backbone for the answer to subsea cables for the capacity and content we need.

All right. So we go back and we say, we know the content, we know how big and why peering matters? One of the main things we all know and understand it lowers latency. So, it provides us with a direct hub between networks and connection networks and brings them together. In the context of the enterprise, it helps them have networks with better performance and experience for their users or customers.

I think one of the main drivers behind joining these peering internet exchanges and starting to peer is to reduce cost. I think Susan showed it beautifully. The fact when we start joining internet exchanges and getting more members onto these internet exchanges. We rely les on international transit which we know is a costly expense. Adding to the fact we reduce latency and have happier customers and enterprises using these services using service providers to do these things, we also provide an ecosystem that ultimately benefits the end user where we want to be.

So, it's extremely key to choose the right internet exchanges where we have the most members and the most routes. But if we do this in a conscious fashion, we definitely start relying less and lesson international transit. That is where we want to be. We want to keep our traffic local as much as humanly possible or within the region.

Within we look at enterprises, they started moving into the cloud. They wanted to give the flexibility we all know. When we look in the space of peering, when we start having people going to data centers joining internet exchanges we have increased capacity. When looking at maybe a five meg, 10, 20meg. It's expensive. Where we look at it in a different view with internet exchanges and data centers we have the ability to increase our capacity, speed and lower latency. It keeps adding to the reason why peering and internet exchanges are so important even in the enterprise space.

And finally, when we look at why this matters, it ends up being a direct value add for our customers for your users. Lower latency, let's say relies on international transits, overall happy customer and more business for all of us. It's a much better environment than ecosystem to work in.

So now we have looked at why peering matters. Let's look at the value of the internet exchanges. I mean, the first one and the most forefront of mind is bringing metrics together. That is something that internet exchanges and the people working very hard behind the scenes have been extremely good at doing. And that is why it has just grown strength to strength.

It's a neutral environment. It's a platform provided for members to join. As more members join and the experiences improve and the experiences available more join. It's such a nice environment if it's done correctly because there is no pressure. It's neutral. There is no partiality. If you look at traditional IXs and look their value is more in the capacity they provide or the amount of content delivery networks or operators connected to them, I want to highlight we are sometimes missing the point where the other value lies with internet exchanges over and above the discussion of capacity.

What I have experienced over the past few years and what separates a normal internet exchange with a really, really good one is that they act as visors. Not just for service providers, but for all members. We want to get the message out to get enterprises on board and build bigger networks. Larger networks, advertise more routes, rely less on international transit.

Again, when you have an internet exchange involved in your ecosystem, they act as a trusted adviser. They act as a broker to new relationships. One of those things I personally experienced time and time again is the value of an internet exchange as a broker to new relationships. We manage to build out enterprise networks using internet exchanges and the knowledge they have and the people they know and the members that they have to of great effect. Ultimately, the net result is giving the customers the best experience.

And finally, what we find there is a new services. So I think the reliance on ‑‑ again, in the context of peering. Internet exchanges aren't just a place for networks to peer, but there are new services that they constantly bring to the table that service providers and internet providers can work together and do joint things with.

The one thing is the cloud exchange. That has added the most value. Not with standing Covid, but prior to Covid, I feel like services like L2 services available through exchanges. But predominantly the concept of a cloud exchange or cloud onramp has been extremely useful as new services are concerned.

How ‑‑ this is a very high level ‑‑ I'll explain how this diagram contrasts the before and after scenario bringing all these various elements together. So, taking a look at a couple of our enterprise networks from 2016 and prior to that. The two circles indicate a local exchange that we connect to pick up internet or IP transit. That goes to a UK internet exchange. So prior to 2016 and this is avoiding the additional work that again, going to the broker of new relationships conversation I had just now where our internet exchanges have gone to the content delivery networks, to the delivery scalers. Trying to broker these relationships and bringing them locally.

Prior to that we had networks by a local group to a local internet exchange where they can pick up IP transit and in this case we go to London where most cases that is where our content was. So, you can see a net result is we had access to some of the content there that I just put in the bubble but at high latency. There was no other way. What we have done on the right hand side with the evolution and the real inclusion of internet exchanges on the continent of these brokering these relationships and getting the providers to bring the content onto the continent. Adding the concept of a local cloud exchange. You look at what it looks like now where customers will buy access into a local internet exchange where they have access to a cloud exchange.

And at the same time, the content providers are connecting to the same exchanges. You have the flexibility of going and peering directly ‑‑ in the case of Microsoft with public. Or with using Microsoft as your peering services as an example. But the list is endless. And the opportunity is there. But, you can see the massive reduction in latency is one of the main benefits, plus the capacity. Now we can peer with content provider at a 1gig, 10gig, 100gig. It's a great cost saving on that side and a good scenario to be in. Next one.

I think, in summing everything up and again, with the concept of beyond peering, what is the future value of the African internet exchange point? What are the enterprises that we have discussions with all the time? What are the service providers looking at internet exchanges for that future value? I think one of the things is to keep driving that conversation with enterprises in large peering partners and getting more members on board. Expansion of local routes. The implementation of more cloud exchanges would be something that would add more value. Peering services automation. We see that in other regions and we want to bring that into the African exchange and say, do the same thing. Automate peering services and making it easier to gear with other providers or enterprises.

The SDN services we are talking about end to end point to point. Using the internet exchanges in combination with data centers to greater effect.

Providing more live statistics and analytics. The more you know, the better decisions you can make in terms of strategy. That is ultimately what you see as better value. Any other questions fire them away.

>> Hi. We did have one question which now disappeared, but I'll ask it anyway. It was from Sammy. It was asking, how many African countries do not yet have an IX and do we have any plans of getting them on board?

>> Off the top of my head we are probably sitting with about five or six countries that I can think of easily. Countries like Somalia for instance would be a good example. In the case of Sudan it's an embargo country so it makes it difficult to operate there. Consumers and enterprises try to find long line services. So I think the plan is, again, we look at regional hubs. Getting the message out from there. We are relying on some of the bigger internet exchanges or some of the bigger name in that region to process that message. Barring the embargoes that is more difficult to operate. That has been our experience. We operate in 51 of those countries, so I can tell you it's not always that easy.

>> Then we have another question. What is the experience which you said with the countries that do not yet have IXPs like Nigel republic? People are still working, but don't have the vision for an IXP?

>> So, that is a really good question. I think we have two ways to answer it. One is from the element of a political aspect. It's sometimes we are close‑minds people that are running the regulators and making the decisions. At the same time, there is a cost element where the local country incumbents are trying to keep as much as they can and try to push as much over their expensive IP transits in a way they can control.

Sometimes it's a case of being closed and narrow‑minded and not understanding the true benefit here. They try to profit as much as possible, but that is subjective, I guess.

>> We have another question for you. How cloud exchange is done and in terms of the agreements? Is it made regionally or locally?

>> There are three elements. The cloud exchange itself, the organization that hosts the cloud exchange, you would have an agreement setup with them directly. And the agreement with the cloud exchange is that you peer through are also considered regional. So depending on the location you would set. So I guess high level that is the quick answer there.

>> All right. We have another question. How to get a provider as an IXP member without an operator?

>> That is a very difficult question. We work with these people as well. I can tell you I don't have an answer for it that is not going to cause any issues. It's about speaking to the right people and trying to find one open‑minded person within that organization and getting the message across and trying to drive it from within as opposed to drive it like from the outside is the best way to explain it.

>> Thank you very much. That is all the questions for you. We do have a question for Susan. Susan, we have a question for you. It says, in which circumstances it's about the pros and cons of the root server. In which circumstances would you trem or not because I want to use the root service?

>> If you are new to internet exchange using a route server has some advantages. Usually an internet exchange will have a primary and backup route service and I recommend peering with both of them because they do go down from time to time. If you peered with that, then you would get a lot of routes right away and a lot of benefit for moving traffic on to the exchange. That gets you up and running quickly.

The other advantage is that it does take a lot of time to contact all of the individual peers on the exchange and create peering sessions with them. So, this has a lot of advantage in terms of speed. The disadvantage for a route server, though, like I pointed out in my presentation is you don't have any control over who is peering with you over it. You may not want to listen to some routes from the ‑‑ some peers on the route server because maybe you are peering with them other places or you don't want to listen to routes there. You want to prefer other paths for latency purposes. Lots of reasons why you might not want to. If you are skilled at GPB you can filter them out. Or you could not listen to the route server at all. It depends. That is an example of when maybe peering with the route server may not be a good idea.

The other thing I also mentioned is that a lot of times you will get more routes from a peering over a PNI ‑‑ not a PNI, but a private peering session over the exchange than you will from the route server. Like hurricane electric, we advertise about half the routes we advertise to peers to the route server. If you peer with us directly, you get more routes. Those are all reasons why you might want to do it.

It kind of is an individual thing. It's where you have to take a look at the situation and evaluate it for your own personal experience and what makes the most sense for your network.

>> Very much, Susan. Now, we will move over to Mark from Epsilon for his presentation.

>> Hi, everybody. I'll share my screen so we can get a move on. Hopefully everybody can see that.

All right. So hi, everybody. My name is Mark Dily. I'm the director of dev for Epsilon. I focus on looking at new trends and technologies. Anything that is sort of impacting the world of communications. Today, I'm going to talk about future trending in terms of programmable telecons. So hopefully, I'm presenting a fairly interesting and new topic. What I'm going to talk about is the evolution of telecons as a resource and how exposing telecons in a programmable manner is changing many aspects of our business and industry. It's now starting to impact the internet exchange world.

Today, I'll talk about how we present these telecons functions. It's like a tool set, not just for telecons folks, but other people in have I via use portals by our customers and others. APIs to other are codes using capabilities like SDN and SDN interfaces.

>> We can't see your slides. They vanished, if you could start them again, that would be great.

>> Okay. That is weird. Let's try again. What I'm talking about the trend for programmable telecons for functions like internet changes, telecons functions that are presented by portals, APIs et cetera. Then, what I'm going to do as well is focus on the impact to the business world about what we are doing within this programmable telecom as well. It's an interesting and new topic for all of us.

So programmable telecons is not a new concept. It started with voice services and something called high end products or intelligent networks back in the 90s. We started discussing voice functions as a programmable element in other applications. Sorry. This is ‑‑ there we go. I'm on the wrong side.

Really, what happened is we had the technology ‑‑ I'm trying to get to the right slide. I do apology for the hiccups. We had a technology we first created called Parley. This was the first major step in how we created functions as programmable elements to telecons developers. The focus was telecons developers. This Parley is now called API. It still exists. We then evolved to full architecture such as JAIN. That is Java API for integrated networks. These were all in the 90s and 2000. Then to provide programmable functions, there was a company on the west coast called IntelePeer. That still exists. They started developing programmable single elements like messaging. These type of programmable single elements started getting more and more of them. Eventually, this type of capability and set of capabilities led to the success of companies like twillo.

Data networking began programming during this period as well. It focused on open standards, a lot of manufacturer involvement as well. The manufacturer started catching up and leading the way as well. This drove to issues as far as programmable telecons I'll talk about later, too.

Where are we at now? We are at a point where we have an evolved set of APIs for different functions. On the next slide what you'll see that basically there are seven sets of APIs that telecons people should recognize or recognize at least some of those APIs. These are become or emerged in our space as really ‑‑ I guess you could loosely call them telco standards. They are industry standards developed by industry standards like TM forum. They have package sets of APIs. Independent ‑‑ telcos developed their own APIs. Others have as well.

I S OES lay interface noose their cloud stacks. They have literally thousands of functions now. AWS, if you go to their events it's mind blowing. They develop their own application stack programmable interfaces. Then finally, and maybe even more interesting for this community, community APIs where developers and engineers specifically from telecons have created interesting tool sets. There is an interesting one to Google called napalm which is about network connectivity. Really interesting topics. And I'm sure there is many others that the audience is familiar with as well.

So we now have these sets and standards of APIs that are very applicable for us, at least in the telco space.

The type and complexity of the service functions being presented through programmable telecons is continuing to evolve as well. This is also driving change in what we have come to know as SDN. As SDN is maturing the functions presented as controllable and programmable capabilities, they are increasing as well. You can see the graph on the right hand side, the stack you get in the SDN environment keeps growing and growing. Micro functions such as policy control, identity management, security elements, they are all now being presented as a mini resources even within the SDN environment.

So, even the SDN stack is continuing to evolve. So, then, if we look at ‑‑ okay. Talking about programmable stuff all the time. If you think about this, programmable telecons functions are enabling the monetization of telecom in multiple ways. We are not always taking advantage of that as providers. Our platform as a service companies they present telecons as resources to developers as tool sets for new and innovative ways to enhance their customer applications. A good example would be a calling function within a taxi app so the taxi driver can find where you are. It's the CPAAS guys that created and monetized this new approach to enabling business applications. They have been successful in this monetizing capability. They are usually doing it with services that we provide and monetizing functions that we never were able to in the past.

You can see on the slide here there is like a couple revenue estimates. They are wildly different. Here is an interesting example. Of this company Twillio. If you haven't heard of them Google them later. They are revenues are like 1.134 billion US dollars. They sell our services. They are not a telecom. They present telecom functions to use in other functions. These companies have done well through programmable telecons to monetize new services. Probably far better than we have unfortunately.

Interesting three enough, I'm very involved. As telco, we had our chance at a lot of this and missed it. Even programmable service functions have been available to use for a long time. We tended to keep it a secret and used to use it for ourselves for our own engineers, our own service creation. The example in this slide is a flow engine from an I platform just after the year 200. On the left hand side, this is what telco used and we also used it internally. It's for voice service for example. This is for trellio they launched in 2018. They allow others to create their own all flows just presented out as a graphical interface. You can go and create our own call flow as a developer or even as an admin person. The genius of companies like Trillio is to expose the functions to the developer community who create interesting and innovative uses for their own companies. This is thing trend which continues to impact and drive us today.

So, telecons is a resource and its solution components have become tool sets for others. Where I'm leading now is starting to talk about as an industry, we are working on how to take the next step to support functions such as digital product threading. That is a big one for us. Threading products together in a programmable way to deliver solutions to create service tools to enable that and building every more so the interworking and interconnecting business and ecosystems.

As an example, systems integrators are out there now looking for tool sets that enable them to build bigger and better and easier to deploy end to end integrated service solutions for their enterprise customers. And, using these tool sets to work not just functions and services, but also the business ecosystems itself becomes interesting from the SI and ultimately for the customers for systems integrated.

So, I have an interesting example here. Many industries are seeing digital and online capabilities changing. Banking is a great example where certain segments such as younger demographic are being targeted with agile on the move solutions with more visibility that than traditional bankers. This company Monzo is a UK company. Don't have high street branches. They are fully online. They are wildly successful. In the UK they are the most recommended bank. Banking in Africa has had a digital move in years.

We see a lot of digital change in this segment. That is led by the ability for people like telecons companies through functions like programmable networking and functions.

All this change has impacted us in the telco world. For incumbent telco had non‑traditional challenges particularly to market segments like the SME for services like voice and contact solutions and it's now moving into the data world and we see non‑traditional challenges even in telecon. Programmability in telecons is good, but it's a challenge for some of us telcos that have been around for more than a couple of years.

You were thinking what does the digitization mean to a company and if I want to present these services in a more e‑commerce or digital model, what I have done is create a list of six key functions if you were going to present a portal this is where you would start. From my perspective this is where I would recommend you start. The first step is thinking about visibility. How do you make your products visible? And if it's like me where you buy a new shirt. I go online to Amazon and I'm looking for shirts. So presenting that category. And then once I found it, I need to configure the shirts. So, I want a white shirt, I want size large. For us in terms of services, that is like I want a 1gig service and I want it for 12 months from here to here. Once we configure that service we get a price. We present the price. I like the price. I can order it. So online ordering has become really big certainly in some sectors of the marketplace right now.

So I'm placing the order. This is where we kind of transition into something called orchestration or part of the SDN function. I have the spec through the configuration. I can push that down into the network lab and speed that network up through SDN. We call it deployability. The final one is now I have the service running. I can see that in the value of the service. It's green. Everything is great or not. Visibility is control. If I can see that service and how it's behaving, I can do something about it if it's not behaving in the manner that I want it to behave.

So, where is all this leading to? It's relating to the IX. Analyzing where the next generation of networking is heading with all this stuff going on. I just want you to think about this. It's all about the app. It's all about the business application or the consumer application now. That is exactly the thing that ICT people focus on. High enabled applications and creation of remote data and data and apps that are all over the place means there is more and more need to provide good mission working entity. This is good for telecom companies. ICT people face more challenges to improve the application accessibility perceived performance of the application through networking.

I have a challenge to integrate not just the integrations, but the networks that enable the applications and create a user experience and system to system experience as well. So system classified as mission critical so is the connectivity they depend on. Thinking of connectivity as mission critical. That makes it a start to talk to ICT people about what the problems are they are trying to solve. The next step is presenting next internet and connectivity as a manageable enterprise network focusing or enabling process to and from different network applications using the different network tools available. The internet is a big part of that.

So the coming together of the need to access more and more varied applications and more efficiencies and better performance means the internet exchange is going to directly become part of the enterprise networking. We are seeing trends for that to happen right now in western Europe. It has already happened in a couple exchanges. You can see a couple logos behind me where they are experiencing this right now. We all know what enterprise needs are from a coms perspective. You probably hear it all the time, you need this and this.

To help with these drivers is there. From IX perspective, there are probably three elements that will become a focus in order to support enterprises. That is to support the continued verticalization of the IX community. More and more layers of types of companies to enable IX functions to be programmable and to enable the cause and effect another business rule functions to be built and deployed for automation.

So, it's a challenge but I think they can deliver it.

In the future, it's my belief that through programmability and AI, applications will start to be able to drive the network as well. We already have the pieces in place. They are only now starting to be presented as into working functions at the different network levels. But SD1 is a very good example. It's a good example of how application is becomes visible or applications. And they can have their own policies and end views with just a few key strokes. If that data is delivered and presented down and pushed down into the physical network, then, it could be that the applications is, I'm the CRM system, I'm mission critical. I'm going to take preference over Netflix as an example. I don't want to pick on them. But the application is telling the network needs for bandwidth. The network needs to expand. The pieces are just about there to happen all the way through the layers.

We have had a lot of these functions available before. The magic is exposing it to others where it's other network layers or other technologies or other companies.

Finally, I think the summary needs and drivers for evolution within the IX and its community include improving the ecosystem integration and developing multi-function and multipurpose APIs. Enabling more visual control and federation of services. Driving automation of peering function itself definitely. Giving external access to companies like Epsilon perhaps. So we can control and enable things like remote hearing and integrate SDN. Present more statistical data. Linking so we get more access to more defined sets of network fabrics and communities. So presenting communities.

Perhaps creating different commercial models or maybe not. And bringing out interesting serves as a server. I see the internet exchange becoming more than a community exchange port, but how we can manage companies to configure and enable to function better.

That is it. I hope you enjoyed the presentation. I thank you for your attention. I'm not sure if there is any time left for questions, but there you go.

>> Thank you, very much. We have one question for you. The question is what would the perfect IXP legal state us in line with service evolution can we convert an IXP? Association or commercial?

>> I think it's a combination of both, actually. So from my perspective, there is an ability in the future to monetize enterprise‑type enablement within the environment, but I think both. I think as an association, we already see right now that banks can keen to join up with what you might call commercial IXs. So that seems very acceptable to the banks. The only question that sort of large enterprises might have is the package of an SLA. I think the type of entity that is managing the IXPs and business isn't as big of consideration as the end to end SLA and those big guys are traditionally minded when it comes to service levels and guarantees in particular.

From a commercial perspective managing IXPs I'm seeing right now, in my opinion at least, there is very little difference in terms of success and addressing the newer segments between what I would call more membership orientated IXs like linx and more commercial orientated IXs or full‑profit type IXs out there as well.

I think they both have equal success. I think it's going to be more about the service bundle and the guarantees. I hope that answers your question.

>> Thank you very much, Mark. And now, we will move over to Mike from Linx for our next presentation. Thank you very much.

>> Hello, everybody. Good afternoon. Let me find my screen. So, my presentation fits in with what you have seen over the last couple of presentations. Presenting how internet exchanges have evolved really over the last 20 years and where we see them going in the future and what we see the demand is.

I use linx as an example, but you will see similar developments in all the internet exchanges. Just a couple words about linx who don't know us. We have been around for 26 years now. We have been doing this for quite a while. I have been at linx for the last ten years. We are fully membership owned. We are not for profit. We are neutral. It's one fee. Every member has one vote. And we have also been known for leading in the way in the engineering solutions we provide just as an example, two years ago we made the decision to go for desegregated model for one of our peering in London. We use the hardware kind of white box switches and overlying software from the different supplier.

These are just a couple of numbers to give you a bit of an idea of the size. We are actually running multiple exchanges which are all run independently. They are not interconnected. We have our two main exchanges in London. They are by far the largest. You have three regional exchanges in the UK. Manchester, Scotland and wales. We run an exchange in USA. Last but not least, together with STC, we are rating Jeddah X which is located in Jeddah Saudi Arabia. The operating exchange combined is about 35Tb and 5 second.

The evolution. What have we seen in regards who is using exchanges and what kind of traffic do we see across exchanges? The early days when the exchanges got established, at the time it was simply a couple service providers who knew they want to improve how they interconnected to each other and wanted to simplify the way and have a neutral place where they can interconnect all of their networks.

The focus ‑‑ at that time, we call tier two networks. The tier one networks weren't really peer. But all of the tier networks and below would join. The main goal was cost savings, efficiency and having a neutral place where they can do all of that.

We saw the growing of streaming on the internet was the arrival of CDNs. In the early days it was you have your service providers. Most of them had a combination of content they host or where they provide connectivity to. This changes to CDN when we had the clear split between content networks versus eyeball networks on the internet. That was clearly one of the main reasons why we saw them doing a pretty massive increase on a daily basis with internet and amount of traffic evolved across the internet.

The next stuff done was CDNs realized they want to move closer to the edge user. They started to implement caching servers which was within the provider networks. So the eyeball networks much closer to the end user. And that shifted a lot of the high volume traffic to a certain degree shifted it away from exchanges. It doesn't mean that traffic at the exchange has dropped. It did slow a little bit as a lot of the traffic doesn't really pass as the caching. The main goal is to keep it close to the action and use the traffic to be carried around.

That is where we were. What is changing now and it got mentioned in the previous two presentations from Mark and Nico is there are new market segments which are discovered over the last couple years. We clearly see an increase there. We see a benefit of internet exchanges that is to a large degree corporate enterprise type customers. Solve really, more the end users. They want to improve their connectivity. They rely on day to day basis for activity for their staff. A lot of ‑‑ well, at the time the activity department had ‑‑ that has all moved away they use data centers or have applications on services hosted in one of the cloud networks.

They also realized if they are rely on a single access provider they have all their eggs in one basket and don't have any control or influence themselves on how they reach certain parts of the internet. They want to have more control and better visibility of how traffic flows and how the traffic gets to the destination and back to them.

So all of these things together mean that a lot of companies weren't too worried about it. Now, looking at what of options are out there. The other thing we have seen in the past and we have seen again is the demand to having closed user groups. So a dedicated layer to environments that get used for specific use cases or specific applications or specific setups between a smaller set of companies who want to exchange data directly between them without using a public peering point or public infrastructure to do that.

A big and important part of that is of course cloud connectivity. Even though there is certainly no lack in options of how any company can reach or improve their connectivity to different cloud providers and using all different technologies starting from very basic non‑encrypted of VPNs or depending on the importance for them and the amount of traffic and how much they rely on the availability to have layer two separates. We see a lot of demand from existing member that connected to links but also demand from companies that approach us and are interested in joining an internet exchange and asking if it is something that an exchange can ‑‑ having local on ramps directly connected to the fabric so they can use their existing ports and get it directly a connection to cloud providers. There are a number of things that are working there.

Again, it's the fact of having the internet exchange as a well‑known, trusted entity sitting there providing that functionality is clearly something that the market is looking for. And other exchanges are now doing it themselves directly or working with partners to provide that connectivity.

Is Covid‑19 impact willing any of this? The simple answer is yes, of course it does. So, what is changing? It's clearly increased amount of traffic generated by people working from home, not sitting in an office and even though we all expect to go back to offices, we also think that the new normal is going to be that a much larger percentage of people are probably going to continue to work from home.

And that drives ‑‑ that changes the traffic and changes the way companies look at connectivity. There is something that we call the long tail. The long tail is the large set of small networks that provide connectivity for certain areas in a country or for specific use cases. Even the large networks see our need to improve their connectivity to reach all of those networks where cache server works for delivery. The cache networks don't have a lot of the services that need real time interaction. A lot of the chat functions or even Zoom calls. a caching server doesn't have that. They are trying to see they can reach as many servers out there as well.

We talked about this. The reliability to have connective and increasing faster and it further drives the cloud services for a whole number of reasons and whole number of criteria.

The next part clearly an important part for internet exchange is we know a lot of them are looking into improving on this. You saw the presentation from Mark. It's the drive for information. It's clearly the demand. Initially, the demand came from partners that we worked with who sell connectivity to connect. We also see it directly from members to have a problematic way of ordering services, making changes to their servers. It could be something basic like changing an e‑mail address or updating. For members, getting them direct access to statistics, metrics that the exchange has for member services and making those available through an API to those members and partners is clearly a lot of demand and similar to working on a lot of exchanges are involving into that direction.

For us, the automation part, whenever we look at developing a new product, the information part is from the beginning is an important factor of any new product that we develop in making sure it can be used in a problematic way for everybody who wants to use it.

And there is clearly an industry‑wide effort and a certain drive to standards and we are going to see a little bit in the demo after this session. One of the use cases. So IX API is a product that is a cooperation between the three providers that you see in the background to create a common API that can be used for all of our exchanges. And it's developed in a completely open and transparent way and clearly the interest is to adopt the same API to help move us towards a standard way of making our services and our data available through APIs.

As a summary, and I tried to keep it a little bit short so we can catch up a little bit on time. The summary really, we all know it and we have seen it in all of the previous presentations. There is clearly an increasing demand to have diversity in the different needs that enterprise, service providers and everybody has for the connectivity and providing a commonplace and trusted platforms. Clearly IXP or sometime of exchanges are clearly a good starting point to offer all kinds of connectivity and interconnection methods to existing networks and new companies interested in connectivity.

Doing that in a simplified, automated and cost‑efficient way is clearly where the focus is. And most of the exchanging now cover not only peering, private VLANs. Closed user groups, cloud connectivity that we see all of the exchanges evolving over the common years.

That pretty much covers everything I have.

>> Thank you, very much, Mike. That was fantastic. We don't seem to have any questions for you at this time. So we will now move swiftly over to the final part which is the IX API demonstration which will be Mark and Mike.

>> Thank you, everybody. I will get the demo ready. I'm going to do an introduction of the case we are talking about. This is about remote peering in an ‑‑ the establishment of a VLAN from a third party network sup as Epsilon all the way through internet exchange. At the same time, what this process is doing is utilizing the common gateway or port in this case. Establishing the fact that the peering or remote peering customer has a name, they have an AS, they want to establish a relationship within the internet exchange. And then have the physical layer two connection setup so that everything can be configured.

I'm over here. I want to connect to the internet exchange that is over there. Linx and other IXs through remote hearing allow other companies to participate and appear in that internet exchange even without physical equipment. The process of the demo is we have a port established already in of this bubble in the Epsilon network. The customer or network already has a port there. We are going to establish a service and show the type in. While I'm kind of getting this logged in so to speak, it's a graphic demo.

Basically ‑‑ let's start again. Basically, this is a portal of an SDN environment. This is the Epsilon one. There are a number of SDN functions out there right now. It landed so the SDN environment layer two connectivity is called cloud LX. I'm jumping into the environment that is going to allow the establishment of the connection. I'm going to connect on a connection point. SDN now generally show three types of connectivity that drive in programmable connectivity. Clouds. Mike in his presentation spoke about clouds is an interesting point for the IXers. They are driving billions of dollars of connectivity in the world right now. Internet exchanges of course. And then, just other networks, other data centers.

In this case, we are going to connect to linx. So we are going to click on ‑‑ I'm going to connect to an internet exchange. Obviously linx. I'm not going to worry about an area. I can see things down here as well.

I'll click on add service to linx. Linx is in the US as well. We are going to connect to linx in London as well. We are going to connect from in Africa. We will choose Cape Town in the Teraco environment. We have a port connected to linx. We are going to use that. There are other ports there and it will show the SDN is in use. This one is running at 5% but we are going to connect using the linx port we preallocated. Take network service for a year. We are going to select 50mbps. We can see a price. Remember my six points? We are going through the six point process right now. So I'm going to put a service name in. Call it linx service name. I can see the available Vlan and choose three. Put AS number. I'll put Epsilon's number. And MAC address. We are filling out the linx application form, but it's now embedded into the portal.

We are not inventing new data. You have all the normal contacts you would expect to fill out on your form. Make sure this is the service I want. It's in London. You see all the details. Most partials have to agree to the Ts and Cs which can be clicked on and read.

Essentially what is happening is we are buying that service. This configuration process is now the call out where the API is being invoked. It's the linx version of the API is being invoked and we are sending that data to linx. That process is occurring. From Epsilon's perspective, we have to. The services are being brought up. It takes a few seconds. If you are configuring lots and lots of different end points it takes a couple minutes.

But now you can see the service is being established. It's still down because we haven't had the confirmation and response yet from. If we are looking at the API, this is an API interface defined by the internet exchanges and linx has been a huge participant. I want to go through the context of the API. But the IX API website sends the confirmation.

So that, heads over to Mike and then it's Mike and his team who actually have to go through and check all this information and I'll hand it over to you Mike.

>> MIKE: It's a new member up on the top left you see the membership status as applied. As we are a membership organization. The API, there is a matter of process involved to improve that membership. It's through the API we have the details of the different accounts and contents created for this one. If we go to the next one we see the contacts being created. This is the first one which was the billing contact which was created here. And on the next one will be the technical contact and the implementation contact. Last, but not least, there is the entrance for the service.

Again, in this stage, this is a completely new service. You can see at the bottom of that page, the services are reserved status, but all the details are there. We see ‑‑ it pasted to us through the API call. In this case, this would now get picked up by one of our provisioning exposing nears who would validate and push it out from the automation platform if the network. If we were using an example of a change connecting service, there would be no unit. The API would come in and straight away if all the information is present, it would go from our systems to our automation platform and push out to the network and the change is applied. But this shows ‑‑ back to Mark.

>> Thanks, Mike. So once Mike's team validates and confirms all of that. The push back is in terms of status before end to end goes live and within the SDN and portal here, you can now see the pull end to end service health. Hopefully, it's always green. But, the service is up and running, start pumping data over that and sending traffic and like any sort of normal portal and service statistical capability, you can now see the traffic and health and how it's performing from end to end from the network all the way through to the IX port, peering port.

So that is basically it. What it does is it just really changed the user experience from a configuration perspective. It saves a lot of time and effort with companies like Epsilon. As Mike and his team build more and more programmable functions over that API, it will expose more and more features that they mentioned. A lot of the features they are thinking about already in the presentation he just did. So thank you.

>> Perfect. Thank you, very much gentlemen. That was great. We don't have any questions for you. I shall hand back to Lindsay for the final part.

>> I think we may have lost ‑‑ thank you. Thanks to all the presenters. Thanks to your sponsors today. We hope you found the presentation and topics interesting today. Just a couple other events coming up. Linx is hosting a women tech connect event with work online communications it's a great initiative which was launched a couple years ago and its valuable network and interaction discussing and promoting positive change for women working in the ITC workplace. I'll drop the links to the information in the chat box about that. The topics will be working from home or living at work, which camp would you put yourself in. And lipstick and leadership. I'll put the links to register in the chat.

The next event in the peering series for the series here is IXP traffic behavior during the pandemic in Africa. This is taking place on the third of November. I'll drop the link in the chat function and lead you to have a look at those as well.

That is it from me. Thank you so much. Thanks to the organizers for giving linx the opportunity to host and moderate this session. We hope you enjoyed the topics and I'll hand back to the event team for the peering personal session.

(Session concluded at 9:41 CT time)