Networking Basics: IP Addresses – 00:00

so we're starting with some networking basics. So first off, IP address is the label that each computer has. So that is each computer's like name, I suppose, or just how each computer knows who it is. It's an identifier. Each computer that is also it can be part of a subnet. So a subnet is all the different computers or devices that can talk to each other.

So example being in our office, we have our printers, the printers and your laptops when you're signed into the main network are all in the same subnet, so they're all able to talk to each other, which is why you can print things on one of the office printers if you're on OE main, but you can't print on a OE guest when you go to on OE guess you're now on a different subnet you're on a different network so now your computer doesn't know where the printers are.

Then a default gateway is the address that the computer uses to start sending out its traffic. That's generally like a router, and that is how your computer gets out to the internet. We're really just diving right in here. IP addresses can be local or public. So if you've seen IT stuff before, a local IP is usually a 192.168. whatever dot whatever address.

That's typically the format of a local IP. Public IPs have different numbers up in the front. So like 12.230 or like 74.86 or whatever different network, those are on. The difference between a local IP and a public IP is that local IPs can only talk to IPs on their own network. Public Ips can be seen by anybody on the Internet.

So again, using our office as the example, our Internet service, we have a public IP from AT&T that when you send a request out like go to Google or whatever, it goes through our office firewall, through our office network, and then as it sends out to the Internet, the AT&T IP is what's going to go out that way.

And then when you get your response back, it's going to come to that AT&T IP that will then, you know, get it filtered all the way down to your computer again, usually for our projects, the firewall, which we should get to a little bit later on, the firewall has a public IP, but then everything else on site that is a computer or device that uses the Internet, those are all on local IPS.

So only the firewall has a public address so that it can actually hit the internet. Everything else has to talk to the firewall before it can talk to the internet. This is more on how you get to Ips and why they look the way that they do. IPs are set up in the manner that they are because of binary and how all computers use binary as like their primary like language communication type thing to, you know, talk to each other.

So, there are four octets, so one, two, three, four and each one is made up of an eight digit binary number. So eight zeros or ones, those are all then converted into like a decimal number the way that we're used to working with numbers. So you take this big long string and turn it into a nice short string.

You can then also the same thing happens for subnets, so subnets you'll also often see a slash that tells you the size of the subnet and that will make more sense here in a second. same thing. It tells you how many ones there are available, which then gives you how many IP addresses are available questions as you all are just kind of staring at me.

Okay. Like I said, subnet example. The way I like to think of a subnet like I explained it earlier as what does your computer know how to talk to and the size of your subnet will tell you how many different things you can put on that network that can all talk to each other. So this first example is if we have a

slash 24 as our main network so 192.168.1.0 slash 24, that shows you the slash 24 tells you that your subnet mask is going to be 2552552550 and you're going to have the IPS from .1 to .255 available for use or I guess available that you can assign something to them.

Typically your gateway is 1.1, so you don't typically use 1.1 to put like your computer on and you also don't typically use the last IP in that list that is usually the broadcast. So when you actually put all that together, you have 255 addresses to start with. I mean, it's 256, math is hard. But then once you remove your subnet identifier, your gateway and your broadcast, you now have 253 addresses that you can assign out things.

So you're going to have 253 computers or, you know, 200 computers and whole a whole bunch of printers and whatever the hell else you want to put on your network. Alternatively, if you have a slash 29 that makes your subnet smaller, since now you have 29 ones out there. And so now if we go through the whole thing, if we save our gateway, we save our broadcast, we save our subnet identifier.

Now we only have five addresses that we can use to put devices on. So now we can only put five things on that network and only have five things that talk to each other. And I try. I'm so sorry. So why are subnets important? the way that our firewalls are set up. So CentraComm is our third party IT service people and they will set up different groups of devices that can talk to each other on our firewall.

You can have, you know, these four things can talk to each other, these other four things to talk to each other. But the two sets of four things cannot talk to each other. And by setting up your subnet in different sizes, you can limit or expand what all you have that can communicate with each other, other networking things that might be helpful for you.

Static vs Dynamic IPs – 06:27

So these are a couple of little tidbits that we found useful. A static IP is an IP address that does not change. So you've told your computer, you've told your device, this is your IP address. That is the end. There's also a dynamic IP which changes based on when your computer or your device talks to whoever. Whatever device is assigning IPS.

So all of your computers right now use dynamic IPs every time you turn them on and you send a request hit parade, go to Google whatever your computer talks to. The firewall gives it an IP address, and if you close your computer, take it home, come back the next day, you're probably going to have a different IP address the next day because our router or our firewall just kind of assigns IP to things as needed. That is the recommended setting for your computers while they're here. By the way, unless someone tells you otherwise.

Command Terminal – 07:22

If you ever need to know what your current IP address is or what any of your IP, your connection details are, and you go to command terminal and you search IP config, it will give you information and if you do IP config dash all you can get all of the details.

So this picture is an example of someone who ran that command on their command terminal. And you can see in here that their IP address was 192.168.1.14. So that was what their computer was using to talk to. I assume it was the firewall is where they were when they took this picture. And you know, they might show the next day and it might be 15, it might be 32.

Who knows? You could also see here that the default gateway they were using is 1.1 and then you also see the subnet that they were on. So 255.255.255.0. Any other questions? I'll keep going. This is not going to be an hour presentation.

Configure an IP on Site – 08:26

All right. So one of the things that our system operators will have to do, they're actually on site and need to talk to a server.

So I'm not sure if you guys would actually need to do this, but I wanted to include it just in case. So you have it and you can pull it back up, Use it as a reference if you need to at any point is walk you guys quick through how to configure your IP so again, if you're on sites and you wanted to talk to a specific server, you would have to make your computer IP something that that server knows how to talk to.

Does anybody actually have Windows ten or you're going to Windows 11, you're probably running 11 with your computers are all new. So we will skip ahead. So if you needed to change your computer's IP Quickstart, Look at settings, you're going to pick network and internet. You can go to the Ethernet section. Again, this is assumed that you are plugging an Ethernet cable into your computer and then plugging that cable into whatever you're trying to communicate with or into a switch that communicates with it or you're trying to communicate with.

And then you will pick your Ethernet and this is where you will then edit your IP assignment. So you can see that my computer is using PHCP, so it has a dynamic IP. I'm just using whatever the firewall gives me, but I could hit edit and then you have to change the dropdown. I think it's automatic and you to turn it to manual.

Then you turn on IPV four and then put in whatever your information is hit okay. And then you should be able to talk to whatever you're trying to talk to.

Project Networking Equipment – 09:59

Okie dokie. So more things that you actually will probably find more useful in your day to day. And this is a list of what we typically have at our project as far as networking goes.

So I've mentioned the firewall a couple of times. The firewall is basically the brains of the whole operation. It has both a primary IP address. So that will be, you know, our, our primary Internet, so AT&T Frontier, something like that. We also put cellular SIM cards in all of them. So the primary ISP goes down. Now they have a cell connection.

So those are Verizon SIM cards. Those are only used if the first one isn’t working. And these firewalls are owned and managed by Centracomm. Like I said, who is our I.T. People. They do all the config on the firewalls. They set up all of the different networks. They are the ones who manage all of that. So if we are having issues that are like firewall specific issues, doesn't happen very often, but it has occurred before.

Centracomm is the one who we talk to about getting that resolved. They also will tell us if they notice that a firewall has gone down, if they've lost connection on the primary. But we have connection on the secondary. They update us on all of that. We also then have servers at all of our sites.

So every project has a SCADA one server. That server is what hosts and runs the SCADA software, which I don't know. I think that is tomorrow is looking at SCADA. Some projects have SCADA 2 that is designed to be a backup for SCADA 1. But we're moving away from that because they don't really do a whole lot, so its like why pay for that.

We also have our operations server, which that is connected to the relay and the meter. So if you're on the Ops server, you can talk to either one of those things. Then we have switches and media converters which are more so backbone. So the switches determine what devices are physically connected together and therefore what things can communicate. Media converters convert between an Ethernet and a fiber signal.

We also have a PLC, which is a Web 600. Those send alerts as well. So most of them are wired so that if the breaker opens in the switch gear, that'll send an alert. If it gets too hot or too cold in the CEE it'll send an alert. I believe that's most of what they can do. And then we also have the stuff so that if you actually walk into the CEE, you'd be able to look at anything on the screen.

Network Maps – 12:42

So what does it always actually look like? So each product has a network map. This is Whirlpool Ottawa. This is one of our most basic cut and dry network maps. So each of the black boxes is a physical location. So we have the control equipment, closure, the switchgear, and then the turbine or turbines. If we have multiple, you can see that we have Internet that comes in.

You have to use our VPN, which again I believe is tomorrow as far as getting you guys information on how to get into that. But once you are signed in the VPN, you can see all of these things. The firewall gets internet access and the firewall. You can see it has two IP addresses, one for if it is using CenturyLink and one for if it's using the 4G.

So again, know that these are public IP addresses. You know that because they don't start with the 192168. This also then tells you what is actually plugged in to where. So you can see we have LAN one. So this is a switch that is plugged into the ethernet into port one on the firewall and this is how Centracomm configures things to be able to talk to each other is that port one has a set of settings that allows traffic, certain traffic to go certain places.

Port three has a different set of settings that allow traffic to go different places. And because this switch and this switch are not directly connected, nothing down here can cross over. So lan one is always turbines and SCADA. So you can see SCADA one and SCADA two. Then there is a media converter and then there is fiber that runs from the CEE, which was control equipment enclosure out to the turbine, the turbine then also has a media converter, and that is connected to the turbines controller.

Then we have lan three, which is our operations LAN and the lans are set up the same way across all the products. So I should have said that a LAN is a local area network, so that's all the things locally that can talk to each other. There also is WAN as a term which is a wide area network. So that's how you get out to the Internet Office network has our operations server and then the relay and the meter and the switchgear.

And then there is the Web 600. You also have IP information over the top, so that tells you what IP is CenturyLink gave us for this site and then so these are all the public IP we have and these are the things that public IPs assigned to them. So the site, the firewall and the Web 600 have a public IP.

questions on this? no, but can we get this information? Yes. Yes, yes. Okay. And so then this is an example of one of the more complicated network maps. And this is Zephyr two. So Ball 2.0 this one is a bit more intense because of the way that Ball two and ball one are connected and that all six turbines end up going through the same switchgear to get to the facility.

So we also ran the communications a little bit differently than we would for a standalone project. And you can see that all of the Internet comes from the storm shelter, which then goes to the ball 1 CEE it ends up over the Ball 2 CEE, and then also that LAN three and ball two doesn't actually go up to that firewall.

It goes over to the ball one LAN 3 So all of those things are together. There's not an ops server here. since it's a little bit more complicated. And then I also should have said when I brought the first one, so all these network maps, which I believe I've seen, or if they're not already printed, are going to be in the room for you guys will end up printed to the room for you guys.

All the different IP addresses for each different thing are in the box with that thing. So the turbine IP addresses the server IP addresses, relay meter. we also have the little batteries symbol, so that tells you what is or is not on the battery backup. So all of the CEEs have a battery backup. Not everything in there is on the battery backup.

So if we were to lose power a CEE you would expect to have like the firewall, the switches, the server, but you wouldn't expect to have like these two servers because they don’t have the little battery symbol.

Command Terminal Practice: IP Config and Ping – 17:30

okay. That is what I put in the presentation. So questions, comments, concerns…

Yes. It's absolutely a lot of information to just gently toss at everybody. So why don't we. Why don't we step through? I'll have you guys pull up a command terminal just so you guys can see that. And then we'll also step through changing IP addresses. Okay, so let's start actually with command terminal.

So you go to the start menu where you can search and search CMD that should pull up command and you'll get a nice little black screen. Yeah, beautiful. You can go to your search bar and just search or type CMD. Yep. That one. Beautiful. you've already IP configed and then you type IP config and hit enter.

Should give you a nice little list of information. Yeah. Just like that beautiful! the other thing that I just thought of that is helpful is the ping command. So if you type ping P-I-N-G and then space, then an IP address, it will send requests to that IP address, see if it can communicate with that IP address, and then it will tell you either I've sent four packets and gotten four responses or I've sent four packets and gotten no responses.

And if you don't get a response, it means your computer can't find that IP address or can't communicate with that IP address. So if its something you expect to be able to ping you kind of have a problem. So what we can try is ping and I will find an IP for you guys. Yes you have question. P-I-N-G space then you put an IP address in.

So why don't you guys all do 69.68.54.24. it's very small, and since that one is public, it should give you four for four unless we changed the IP address. Boo. Well, so that tells you that that's not an IP address that it can find. Maybe we've changed that IP address. Okay, how about this one?

It'd be kind of funny if this whole thing just proved me wrong. Oh hey sent four received four. beautiful. Okay, Now, you guys know how to ping things so then as far as, like, actually we're going to do ethernet settings then we'll talk a little bit about troubleshooting. I don't know if that was part of the scope of this presentation, but sorry, Claire, I'm going to add it in.

Ethernet Settings – 22:49

No. Okay. I don't know how to do what I'm doing anymore. Okay. Full screen. Full screen. So if everybody hits the little Windows button, either in the bottom left or towards the center. I think I saw that yours was towards the center and open up your settings beautiful and then find network and internet and then you're going to hit… Yes, beautiful Ethernet. And then where it says IP assignment you can hit edit so you're probably already there. You're good to go. Yeah. So this is how you get to the window up there. Okay. And then you turn on IPV four and then you can put in whatever information you wanted to put in

IPV 4 vs IPV 6 – 23:44

IPV 4, vs IPV six. So IPV 4 is the 192168, blah blah, blah, like a set of four numbers IPV six is what was created when the powers that be that control the internet realized that we were going to run out of IP addresses because there's a finite number that are available. We as a company, none of our stuff uses IPV six.

don't worry about IPV six. You should never need to do that until we get probably many years down the road. But hope.

Troubleshooting – 24:26

All right. So then as I talk about troubleshooting, if I can find a mouse ever. Okay, so if we get a comms issue at a project and I'm starting to troubleshoot. My first question is always, can I ping the firewall?

if I can't hit it on the primary IP, I will try it on the secondary IP. On the 4G. If you can't hit the firewall, odds are good. You have a power problem because the firewalls are all on the battery backup, so they should always be able to respond. So if you cannot hit the firewall, it means either you have a power problem or you have an Internet problem.

In my experience, most of the time it's been a power problem. And when I say power problem, it also typically is the battery backup. Maybe we have had a grid fault and the switch gear tripped and now there's no power to the CEE and the battery backup just like died. Maybe the battery backup, like the inverter on it has decided to die and now we don't have power to anything in there. So if I can't hit the firewall, next step is okay, what else can I talk to? So I will try to hit and I usually just ping things. I will try to ping one of the server's, one of the SCADA servers, one of the Ops servers. If I can hit this server. I know that all of the Ethernet and also that switch are all good to go.

If I could hit the server similarly, I know that everything up to there is good to go. So then if we are having like a turbine comms issue, we can't see the turbine. If you can hit the server, you know that the

problem is now isolated here. If you can ping this PLC, if you can ping the turbine, then you know that you are good all the way up to there and you have some other issue in here.

So that's where I start, is what can I talk to, What can I not talk to? Similarly, you generally should always be able these don't necessarily accept pings, but you should always be able to communicate with them on Quickset. it's very kind of rare that you lose these, the Web 600 is not super helpful as far as diagnosing a comms problem anything else I should mention?

Not that I can think of other comments, questions, concerns. Yay, yay, yay. So IP config, what would we use that for? It's mostly helpful so that you can figure out what your computer currently is so that, you know, like, let me just double check that I did actually do this right and I its what I think it should be, or if you are like, I've used it if I'm working with CentraComm and they're like, what's your computer settings?

So I'm like, here's a nice little screenshot of all my computer settings. It's not the kind of thing like I would expect you guys to use ping more than IP config, but IP config can be helpful in specific scenarios where you need to know like what is my computer's current subnet or what is my computer's current Mac address or whatever?

Yeah. Okay. And so I know tomorrow we are doing two factor and getting into SCADA and I think some of this will also, well there isn't too much we can do with a project at work. I think some of it makes more sense when we actually could just start signing into things like trying things which is tomorrow morning.

I will make sure I imagine that Claire is going to be sending all of the PowerPoints that y'all are going to watch out. But I'll talk to her quick and make sure that if she wants me to I can send this email out right now, or if she's going to do it all in one go, okay. Either way, you will get this.

Okay? Yeah. other any last questions, comments, concerns before I hit end on this here recording. Excellent. Let's see how long it takes me to find the end button. Yeah. Thank you so much for your time.