NANOG Presentation

June - 2023

How to Prepare for a Network Engineering Job Interview with a Tech Giant

June-2023

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Some Background

- Let's go back to October 2019, NANOG 77 in Austin, TX

Some Background

- Some boring network engineering interview questions and how to replace them with smarter ones

Some Background

- Main Topics:
  - The Main Skillsets
  - (THE) Great Expectations
    - TCP/UDP/IP
    - IGP: ISIS/OSPF
    - BGP
    - Misc. including MPLS, coding etc.

Some More Background

- The Anatomy of the Most Challenging Network Engineering Interview Question

Some Background

- Browse a random website, tell me what happens behind the scene?

So Now…

- Your feedback:
  - Prep plans
  - More sample scenarios
  - More insider tips

✂️ **Especially when we are interviewing with tech giants**

What This Session IS and IS NOT?

- **IS** an overview of what you must know
  - A lot of clues and ideas
  - Helps you develop a preparation plan
  - An advanced session
    - But also a good refresher

What This Session IS and IS NOT?

- Is **NOT:**
  - A full list of topics
  - Networking course
  - Covering all the answers

How is This Session Structured?

- Why people fail?
- Who fails?
- Key areas:
  - TCP/UDP/IP
  - IGP
  - BGP
- Multiple tiers of each

How is This Session Structured?

- Simulating a long interview day
  - Hence the amount of details

What to Do?

- No need to memorize
  - In-person or virtual
  - Watching later YouTube
  - Do not mute
- Quiz yourself as we go
- Take photos if you wish

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Why People Fail Such Interviews?

- No recent (ever?) knowledge of technical **theories**
- No understanding of the corporation's core values
- Poor "presentation" style
- No preparation; the "It's my job I'm good" approach
- And a few more that we'll see…

Who Is More Likely to Fail Such Interviews?

- Recently certified
  - The main issue with many networking certs
- Long tenure in the previous job
  - But not every job
  - Enterprise vs SP vs vendor
- Some personality types
  - Remember the mission, focus on the mission
    - "Get in, get the job done and get out"
- The unprepared

Some of the Key NE Interview Areas

- TCP/UDP/IP
- IGP
- BGP
- *MPLS, automation, cloud etc. (Out of scope)*
  - Maybe a future NANOG

Basics of TCP/IP

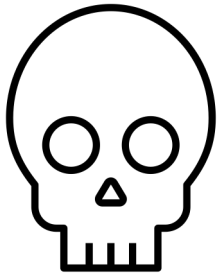
- Different flavors (implementations) of TCP
  - E.g., Different congestion control
- Safe assumption: College TCP unless specified
  - Tahoe
  - Reno and New Reno
  - Cubic
  - Compound
  - FAST
  - Vegas
- Even Wikipedia is not a bad resource for the NBI*

TCP/UDP/IP in Tech Giant Interviews

- Candidate must master the theories
- May go beyond the basics
  - 3-way handshake is not enough anymore
- Might go after different implementations
- Might cover troubleshooting
- Might include PCAP analysis

Beware of the feedback

TCP/UDP/IP Tier 1



90% of candidates stop here

- TCP, IP and UDP Headers
  - Header size
  - Well-known fields and ALL the flags
- 3-way handshake
  - Do you also know the teardown process?
- TCP vs. UDP
  - Common and custom use cases
- Data offset

TCP/UDP/IP Tier 2

- TCP Slow Start (again go classic)
  - Clear diff between RWND and CWND
- Fast Retransmit
  - Duplicate ACK
- Explicit Notification
- Selective ACK (SACK)

TCP/UDP/IP Tier 3

- Silly Window Syndrome and Nagle algorithm
- Detailed window scaling option
- TCP tuning for Long Fat Networks
  - Come up with your own scenarios
- Analyze PCAP files and their graphs

TCP/UDP/IP Tier 3

- The tools
  - Ping and pathping
    - Could get more complex in MPLS environments
  - Traceroute (Linux, Windows etc.)
    - Details, details, details…
      - What if the port is open?!

TCP/UDP/IP Recap

- Headers
- Control systems including congestion
- Enhancements
- The tools

OSPF in Tech Giant Interviews

- Candidate must master the theories
- Most likely NOT a configuration quiz
  - Certified? Be careful.
  - Maybe route filtering strategies?
- Might cover their particular use cases (e.g., SP?)
- Might cover troubleshooting

Basics of OSPF

- Here we focus on IPv4 (OSPF v2)
  - Must do your research if they use OSPFv3
  - How?
- Here we focus on general OSPF topics
  - See my NANOG 76 (2019) deck for an IPv6/SP/EN application

https://pc.nanog.org/static/published/meetings/NANOG76/1993/20190612_Agahian_Demystifying_Ipv6_Over_v1.pdf

OSPF Tier 1

- Your favorite IGP and why?
  - Be smart; clear, real and well rehearsed
    - Be prepared for ”why not?” beyond “that decision was made before I joined…”
- OSPF interface types
- Single-area design: Area 123

OSPF Tier 1

- Concept of router ID and its selection process
  - Loop13 the RID owner was shutdown by accident
  - Conflicting RIDs

- 224.0.0.5 vs 224.0.0.6
  - OSPF TCP port number? ☺
    - IP Protocol number 89

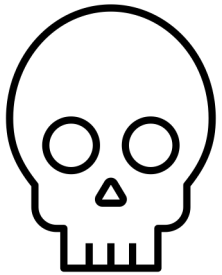
OSPF Tier 1

- Designated Router (DR) election process
  - What if a DR and a BDR exist?
  - Priority 255
  - Priority 0
  - Everyone priority 0
  - ISIS priority 0

OSPF Tier 2

- Backup Designated Router (BDR) election process
- Why is OSPF considered a (fairly) quiet IGP?

OSPF Tier 3



The average candidate stops here

- OSPF neighbor state-machine
  - Down – *Attempt* – Init – 2way – ExStart – Exchange – Loading - Full
    - Details, details
  - DB Description packets, LSR, LSU
  - Might be asked individually or as a state-machine
    - Practice to draw
      - Stand-up and draw

OSPF Tier 3

- Implicit vs Explicit acknowledgement processes
- What if a router receives multiple copies of the same LSA?
  - Seq numbering – Checksums – LSA Ageing

OSPF Tier 3

- OSPF Convergence
  - OSPF default timers
  - Enhanced timers
  - Multiple hellos
  - BFD
- How does BFD work? Details, details. (*Independent…*)

OSPF Tier 3

- OSPF Virtual Link scenarios
  - How about a GRE tunnel?
  - V-bit
- Practice beyond the classic "*partitioned Area 0*"
  - Beyond "once upon a time a junior engineer…"
  - Triggered by a circuit/SP catastrophe

OSPF Tier 3

- OSPF LSA Types
  - Go well beyond the basics
  - Originators, functions and propagation scope
- LSA 3 scope
- LSA 4, 5 and 7
- Stub, totally stubby, NSSA with real-world scenarios

OSPF Tier 3++

- External and NSSA routes: e1 and e2 / n1 and n2
- Routing preference: Intra vs. Inter*
- OSPF exhibiting Distance Vector behavior
  - Topology abstraction vs route summarization
- OSPF P-bit
- Details of the LSA 7->5 translation
  - Single ABR
  - Multiple ABRs

*There is a lot involved check out RFC-2328 for more details.

OSPF Recap

- OSPF State machine
- Routing preferences: Intra/Inter*, e1/e2 etc.
  - Exceptions
- Convergence improvements
- Area types and their common architectures
- LSA types; especially 3,4,5 and 7
  - Originator, functions and scope

*There is a lot involved check out RFC-2328 for more details.

And last but not least: BGP

BGP in Tech Giant Interviews

- The easiest area to fail IF you rely solely on "*Ha! that's my everyday job*"
- On most jobs we **maintain** BGP
- Jobs are mostly either: (1) Repetitive design patterns or (2) Configuration related or (3) Troubleshooting related

- Hence take your interview prep seriously

BGP in Tech Giant Interviews

- Once again the candidate must master the theories
- Could be very classic (boring?!)
- Most likely NOT a configuration quiz (some exceptions still exist)
- Might cover their particular use cases (e.g. DC, Enterprise, SP?)

* https://pc.nanog.org/static/published/meetings/NANOG77/2077/20191028_Agahian_Some_Boring_Network_v1.pdf

Basics of BGP

- We cover BGPv4 for IPv4
- We are focused on classic BGP
  - There are many vendor-related nuances out there

BGP Tier 1

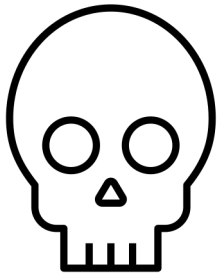
- All the USUAL stuff
  - **Please see my NANOG 77 talk**
  - BGP attributes
  - Classes of each path attribute
  - BGP inbound traffic engineering
  - BGP outbound traffic engineering

https://pc.nanog.org/static/published/meetings/NANOG77/2077/20191028_Agahian_Some_Boring_Network_v1.pdf

BGP Tier 1

- All the USUAL stuff – cont'd
  - The decision process (best path selection)
    - Know "Step Zero"
    - More details than usual
  - BGP messaging system
    - Open – Update – Keepalive – Notification
  - The BGP state machine

BGP Tier 2

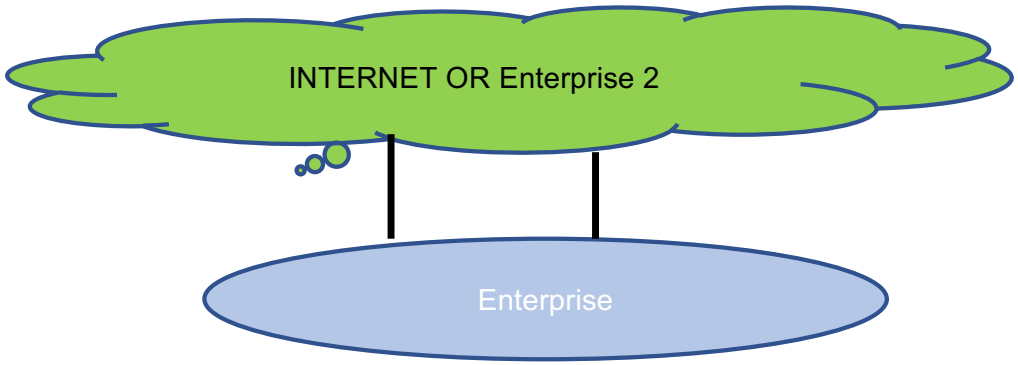


Here is where the average candidate stops

- Attributes and classes expanded
  - Details of AS_PATH
  - AS_CONFED_SEQUENCE and AS_CONFED_SET
  - 16-bit vs 32-bit ASN
  - Atomic aggregate and Aggregator
  - Nitty-gritty of the types
    - Optional, Non-transitive
    - For example: the MED is optional and non-transitive

BGP Tier 2

- Inbound and outbound TE expanded
  - Propose minimum 4 BGP architectures to prefer one circuit over another for inbound traffic.



BGP Tier 2

- 4 or 5 BGP architectures to influence inbound traffic

1- Longer AS_PATH out of the less preferred path (AS_PATH prepending)

2- More specific routes out of the more preferred path or less specific…

3- Use BGP communities to signal your upstream

4- Do not advertise out of the less preferred path at all! Yes – what's stopping you?

5- Higher MED value out of the less preferred path – Maybe?

BGP Tier 2

- Basics of scaling BGP architectures
  - Route Reflector
  - Confederations

BGP Tier 2

- Everybody knows Route Reflectors but
  - Very few can clearly explain how we got there
    - In other words why do we need the RRs?
    - Traffic flow in an RR system – Self?

BGP Tier 2

- RR redundancy and the cluster-id issues
  - RR to RR link failure scenarios
  - Same or different cluster-ids; resources vs. redundancy
- RR advertises the best route…
  - What if you need more than one path advertised?
- Loop prevention mechanism in RR architectures
  - Originator-id
  - Cluster-id

BGP Tier 2

- Everybody knows BGP confederations but
  - Decision process in confederations
  - Confederations vs. Route Reflectors
  - Confederations with Route Reflectors

BGP Tier 3 : BGP “Special” Topics

- AIGP attribute
- BGP-LS
- BGP Monitoring Protocol (BMP) RFC-7854
- BGP FlowSpec
- RR resource considerations
- BGP PIC
- BGP in data centers RFC-7938

BGP Tier 3 : BGP Special Topics

- Make my RR advertise more than the best
  - Simple RR
  - MPLS backbone
- Do some research on the IXP architecture
- Check out the size of the IPv4/6 global tables
  - Not the best gauge but still… ☺

BGP Recap

- Housekeeping such as the state-machine and messaging systems
- Attributes
- Traffic engineering
- Scaling architectures and its details
- Internet architectures
- Modern topics and ideas

Wrapping up but what's left?

- Maybe future NANOGs
  - BGP in MPLS backbones including RRs
  - BGP in data centers
  - BGP optimization
  - RR optimization

Use This Deck

- As a checklist
- Learn to “dig around” it
  - E.g., LSA4’s functionality
  - Think through:
    - How to minimize the number of LSA4s?

The Key Takeaways

- Plan carefully
  - How about tomorrow?
- Study hard, gather intel
  - Books and RFCs
- Score 85% in prep
  - This presentation N88
  - ”Some boring…” N77 talk

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Study Resources

1. TCP/IP Routing vol 1 and vol 2 by Jeff Doyle
2. BGP Design and implementation by Micah Bartell and Randy Zhang
3. Juniper and Cisco official documentation
4. Cisco Live presentations on OSPF and BGP
5. https://www.rfc-editor.org/rfc/rfc2328
6. https://datatracker.ietf.org/doc/html/rfc7854
7. https://datatracker.ietf.org/doc/rfc7938/

Thank you

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