NANOG Presentation

June - 2023
How to Prepare for a Network Engineering Job Interview with a Tech Giant

June-2023
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
  • Do not mute
• Quiz yourself as we go
• Take photos if you wish
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

- 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

90% of candidates stop here
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

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

- 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

The average candidate stops here
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...)

NANOG
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

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

- 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

Here is where the average candidate stops
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
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
Thank you

June 2023