Dr. Rephael Benhamo

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Education

Ph.D. Computer Science and Mathematics – Hebrew University 2007
MBA Marketing and Management – Hebrew University 2009
M.Sc. Computer Science NYU Polytechnic Institute of New York, 2002
B.Sc. Electrical Engineering, NYU Polytechnic Institute of New York, 2000

Awards and Patents

U.S Patent Application No. 16/176,580 "System and Method for Content Integrity using Blockchain", 2021
U.S Patent Application No. 98/987.776 "SDN Load Balancing NF & Scalable L7 Visibility", 2017
U.S Patent No.: 6,301,267 B1: "Optical Smart Switch", 2010
DARPA Grant, Ph.D. Thesis award**, "**Optoelectronic Semiconductor Design and Fabrication", 2008
AT&T Labs: Received the Distinguished Member of Technical Staff (DMTS) Fellowship award 2009

Profile

With more than 26 years of extensive experience in the telecom industry, talented in network performance, automation, and digital transformation. My expertise spans various technologies, including O-RAN, 5GC, MEC, network infrastructure, IoT planning, and provisioning, as well as AI/ML-based BSS/OSS and cloud-native microservices architecture.

Presently, I lead Barnet Communications Intelligence in the development of frameworks for autonomous network operations, and the implementation of AI/ML-driven closed-loop automation, evolving the digital transformation in the telecom and enterprises landscape.

Key accomplishments

i. **Develop and implemented PoC for O-RAN and 5G Core for Privet network** using Metaswitch (Azure), Altiostar (Rakuten) and VMWare NSX for Verizon. PoC involved the design, implementation, and testing of a 5G network using AI based automated slice allocation. PoC demonstrated the feasibility of using open-source software and hardware to build O-RAN and 5G network. using VNFs/CNFs with dynamic micro-segmentation and service chaining leveraging big data, security, network, Cloud, SDN, 5G-C, O-RAN, IMS, MEC, NFV, IoT, AI/ML.

ii. **Developed architectural framework for OSS/BSS cloud native transformation** for various customers, including AT&T, Verizon, and T-Mobile Telenor, TeliaSonera, Tele2, VF-Group, T-Mobile, Etisalat Group, VF-Idea, BT, Orange, Jio, SingTel, Globes, Smart, STC, Mobily, Avea, and Turk cell.

iii. **Telco Cloud transformation:** (I) digitization, converting information into digital (e.g., machine-readable), (II) digitalization, automating the CSP's processes (III) applying digital tools to the CSP's operations such as digital twin, ontologies, knowledge graphs model (RDF graph linked by schema, e-map, physical environment, network coverage, delay, load, topology, etc.), closed loop automation, integration, unification, analytics, deployed on AWS, Azure, and hybrid cloud environment.

iv. **Led Open-API development** for zero trust partnering and service activation. Contributed to the development of industry standards through work with the TMF: eTOM/SID/FF, Open-API, autonomous network, and operation, AIOps practices, maturity model and data governance, including 3GPP, ETSI, MEF, BBF, and O-RAN alliance.

v. **Assessment of new services** such as digital gaming, online video, messaging apps, smart home services, digital music, e-health, financial services, and location-based services.

Expertise in the following areas

i. **Telecommunications Expertise**: Proficient in O-RAN and 5GC, MEC compute and network infrastructure planning, AI-based BSS/OSS transformation, ERP, distributed AI, Open APIs, VNF Virtualization and Cloudification: Developed PoCs using Matplotlib for visualizing VNFs chaining. Explored 5G network topology discovery, (QraphQL, Resnet), graph neural networks (GNN) analytics, data transfers, mobility control, session management, and more.

ii. **Information Security Framework**: Developed an information security framework addressing data breaches, identity, and access management (IDAM), governance, regulatory compliance, and GDPR. Implemented federated identity, access management, and content integrity using DLT for zero trust.

iii. **Implemented Distributed Ledger Technology (DLT):** Patented and deployed DLT to protect communication channels from adversary attacks. Utilized VNF and SDN to reroute malicious traffic. Applied radio analytics for adjusting TCP congestion control and worked on various applications like social analytics, video surveillance, etc.

iv. **Data Governance:** Proficient in data collection, storage, clustering, and analysis using *R* and *Python*. Implemented video content segmentation, distributed CDN caching, MEC video distribution stream analysis, advertising insertion algorithm, CCTV surveillance and analytics, ADC, DDoS, URL filtering, and performance optimization.

v. **AR/VR and Metaverse**: Created blueprints for AR/VR and metaverse using digital twins of cell sites. Enabled remote maintenance and operations tasks and utilized AI/ML decision models, anomaly detection, pattern discovery, and data insights.

vi. **Smart City Surveillance**: Designed a smart city surveillance model using IoT sensors, video cameras, and drones interconnected through LTE-M, NB-IoT, LoRaWAN, and 5G technologies.

AI/ML algorithms and applications development: Tested and implemented various ML algorithms (e.g., TensorFlow, LightGBM, XGBoost, DBSCAN, PyTorch) for improving business processes and operations.

vii. **Broad Expertise:** Skilled in enterprise architecture, cybersecurity, product management, wireless engineering, solution architecture, cloud computing, network architecture, integration, and telecommunications deployment, performance, and operations management.

Work Experience

Barnet Communications Intelligence Lead Scientist 2004 – Present
- **Technical advisor for leading CSPs worldwide** adapting Open-APIs and AI/ML for ZTP partnerships, considering autonomous operations and network optimization, amending OSS/BSS for mobility and locality services, 3G/4G/5G transformation, IoT enablement and analytics, Smart Cities, 5G Private Networks, MEC and distributed localized services

HCL Technologies 2020-2023: Chief Architect 5G Innovations and Integration
- Design and Build O-RAN and 5G core domains for Verizon based on MS Azure and Altiostar/Rakuten, Metaswitch (Azure), VMWare NSX platform for E2E configuration and troubleshooting across O-RAN domains.

- Defined industry standards such as: CLA, DLT, Digital-Twin, AIOps, NaaS, CaaS, ZTP, Data Governance, information and data models, Open Digital Architecture (ODA) components, Autonomous Network (AN) leveraging Open-API's. Contributed to TM Forum and liaison with 3GPP, ETSI and MEF several articles on "Enterprise Partnership Enablement", AI Closed Loop Automation and Digital Twin, etc. See Publications.

- Led the development of industry standards at TM Forum and liaison with 3GPP, ETSI and MEF, this includes: CLA, Digital-Twin, AIOps, NaaS, CaaS, ZTP, Data Governance, information and data models, Open Digital Architecture (ODA) components, Autonomous Network (AN) leveraging Open-API's

Director SD-WAN Automated Network solutions - Comcast 2019-2020

- Versa - SASE SD-WAN platform, Palo-Alto and Fortinet security VNFs, Amdocs - active & available inventory, order delivery & orchestration, automated service management

Huawei, Shenzhen, ROC 2016-2019, VP Led Technical Solution to Huawei's Customer

- Served as technical solution architect on 5G and NGOS cloud native transformation for various customers, including Telenor, TeliaSonera, Tele2, VF-Group, T-Mobile, Etisalat Group, VF-Idea, Globes, Smart, STC, Mobily, Avea, and Turk cell, Etisalat Group, VF-Idea,: Avea, Turk cell, SingTel, INWI, etc.

- Implemented 5G core network-based services and cloud native transformation. Design and deploy PoCs for vIMS, vSBC, vTAS, VoLTE, VoNR, ViLTE, FWA WWC, eMBB, mMTC, and MIoT.

- Assessed and addressed challenges in 5G network operations, including slice lifecycle management and "zero touch" operations. Experience with integration in multi-vendor ecosystems and development and deployment of hosted services programs: VIM/NFVI and PNFs, data models, on-boarding, resilience applications decompose into smaller functionalities that runs on PaaS APIs services.

- MSP cloud transformation planning using M/R/E- CORD, ONOS, and ONAP for wireless, terrestrial, and optical access and transport networks. Implement EN-DC interworking based on microservices NF packaged in containerized image, orchestrated by Openstack helm, Kubernetes, Airship on network slice instance to automate provisioning & management. Assess operation challenges in 5G network: slice lifecycle management, "Zero touch" operations: creation, provisioning, service enablement, closed-loop assurance, self-healing, predictive, and pro-active network/service 5G and NGOS cloud native transformation

- Design network 5G slices performance analysis: create, activate, & manage network slice instances and services in real-time. Network slice instance CNFs are monitored & integrated using KPIs automated data analytics AI/ML, SBA & MEC for IoT & URLLC. Develop and deploy hosted services program: technical architecture governance and E2E operational model and remote help desk (NOC in India), APIs exposure program for 3ed party vendors, feasibility, design, analysis and E2E deployment, SDP/SOA

Amdocs- 2014–2016 Director BSS/OSS Strategic Planning and Development

- Lead technical advisor to Amdocs' customers, including BSNL, Vodafone Essar, ICE VertICE, and SingTel.
- Designed and developed solutions aimed at automating operations processes, specifically focusing on achieving zero-touch functionality by using data analytics and quantitative modeling techniques to enhance device performance, QoE, and QoS.
- Performance Measurement and Statistical Modeling: developed methodologies to measure and model wireless network and device Key Performance KPI/KQI as well as user behaviors.
- Data Visualization and ML Algorithms: data visualization tools to effectively present analytical results. Additionally, applied various machine learning algorithms such as forecasting, clustering, classification, reinforcement learning, and deep learning to extract valuable insights from data.
- Data Extraction and Analysis: performed data extraction, transformation, and loading (ETL) tasks, along with text mining and statistical analysis by using a range of tools and languages such as Python, R, MATLAB, VBA, Java Scripts, Spark, Hadoop, MySQL, MS Excel, VBA, Teradata SQL, and MS SQL.
- Policy Enforcement and Integration: conducted testing and integration of policy enforcement and integration points using Amdocs A&AI (Artificial Intelligence and Automation) with Versa edge and Palo-Alto technologies to enable the convergence of Network-as-a-Service (NaaS) and Secure Access Service Edge (SASE) by integrating Next-Generation Firewalls (NGFW).

Nokia 2011-2014 Lead Solutions Architect

- Principal Technical lead to Nokia's Customers: served as the principal consultant to several prominent customers, including BT, EE, 3UK, VF UK (London, UK), DT (Munich DE), Orange (Paris FR), KPN (Amsterdam, NL), VF (NL, IN, ES, GH), and providing expert guidance and support to these customers in their network solutions and professional services.
- Network Solutions & Professional Services: planning, designing, integrating, and deploying network solutions or to Nokia's customers including BT, DT, FT, Vodafone (VF-UK, VF-NL, VF-India, VF-Spain, VF-Ghana). This included project related to enterprise small cells and IoT devices, VoIP services, FTTH ODN Optical Distribution System, IP networks transformation, and network services migration planning.
- Integration of Enterprise Small Cells and IoT Devices: led the integration efforts for an enterprise small cell and IoT devices solution, focusing on providing intelligence control and management for the production chain. Designing and implementing the necessary infrastructure and protocols to enable seamless integration.
- VoIP Services in Multi-Vendor Network: planning, design, integration, and deployment of VoIP services in a multi-vendor network environment. Working with different vendors and ensuring interoperability and optimal performance of the VoIP infrastructure.
- Design and deployment of FTTH ODN Optical Distribution System and IP Networks Transformation, delivering high-speed broadband to homes and businesses and migrating services to IP-based solutions.
- Designing 21CN IP Transport Network for BT: separating control and user plane applications such as DNS, DHCP, Radius, Diameter, NTP, LRSI. The aim would have been to optimize network performance, scalability, and efficiency.

SeRIQA Network, 2006-2011, Founder/CEO/CTO

- Network Optimization Tools Development, Customers: AT&T, SingTel, Level3, BT, HOT, Belgacom, Israel-Cellular. Developed and deployed software components to optimize traffic, prevent network congestion, traffic engineering, developed and patented data analytics tools for IP-Optical synergy
- SERIQA's customer includes AT&T, Verizon, BT, Orange, Proximus, INWI, MTC, Bezeq, Partner, Cellcom, ect.

AT&T Labs NJ, USA. 2005-2010.DMTS – Optical and Packet Network Research

- Algorithms Design, Simulations, and development for the global AT&T USA network
- Led study to derive performance measure for data transport, engineering rules to enable error freed communication channel for private lines using mixed technologies (mobile, fiber, satellite, cupper, coax)
- Algorithm design and deployment: IP Broadcast, radio planning and coverages, network optimization, autonomous service activation and provisioning, and cross-domain network optimization
- Dark-fiber SDH/SONET/IP, 40G/100G/200G/400G coherent optical transmission technologies, Ethernet, Switching, Routing, Data Networks, DCN, optical mesh redundant routes and wavelength routing, DSL, MSAN/MSAG, OAM&P and EMS/NMS

Proficiencies

- AWS - Cloud9, Azure, Telco private clouds and Heroic, Docker, Kubernetes, Openstack, Chef and PuppetScripting and Programming: Linux, GitHub, TCL, Perl, Ruby, Go, RESTful APIs, gRTP, Kafka, C/C++, JavaScript, Java/J2EE, Servlets, OpenvSwitch, PHP, R, SOA, Spring MVC, SQL and No-SQL. HTML5, JS, CSS, XML, Openshift, Apache Spark
- Cloud Foundry, LF Networking, ONAP, OPNFV, tungsten fabric, panda, Open Switch, FD.io, SANS.io, CNCF, Akraino Edge Stack, LF Edge, LF Deep Learning, Acumos AI, Ansible, Helm, Terraform, Prometheus,
- Openstack, VMware NSX, VirtualBox, Docker Engine, Kubernetes, Hypervisors (ESXi, KVM, OVM, Xen), Linux (RedHat/Ubuntu), Apache, YANG, (Python, Groovy, YAML, Perl), JSON, vSwitches/vNics, VMFS, SAN/NAS, MEF and LSO project, OPNFV, IO Visor, OpenContrail
- Openflow, Opendaylight, NETCONF, P4, TCP/IP, UDP, EIRGP, OSPF, BGP, RRC, NAS, GTP, VoIP/SIP, IN, TL1, HTTPS/SOAP, CMTS, SMSC/MMSC/CPM/EVVM/WAP, PDCP, RLC, MAC, SSL/TLS, MSF, NGN, LMDS, MMDS, SIP, ISIS, RIP, SMNP, CLI, XML, AMQP, CORBA, TOGAF.
- Diameter, SS7, ISUP, PRI, MGCP, TGCP, NCS, INAP/TCAP Network Programming Tools: sFlow/NetFlow, Arieso/JDSU, Wireshark, ATPG, Scapy, NetSonar (trace route and ping), Libra, etc., Tools and Common Services: VNF SDK, Microservices Bus, Logs, Auth, OpenID Connect.