CCN

CCN and Contemporary Network Technologies

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Software Defined Networking (SDN)

- **SDN decouples Control, Management, and Forwarding to enable:**
  - Network control to be directly programmable.
  - Underlying infrastructure to be abstracted for applications and services.
  - OpenFlow is the current foundational block for building SDN solutions.
- **Benefits: More Flexibility and Lower Cost**
  - Programmable control plane makes configuration easier.
  - Better cost structure using virtualized SDN controllers.
  - Efficient traffic optimization using more powerful compute resources.

SDN in Relation to CCN

- CCN is orthogonal to SDN.
- SDN controllers can be implemented using CCN Interest messages and Content Objects.
- CCN Control plane (FIB, PIT, and CS) can be managed with SDN controllers.

Network Function Virtualization (NFV)

- **Definition: Replacing Hardware Functionality with Software**
  - Network Address Translation (NAT)
  - Firewalls
  - Intrusion Detection
  - Domain Name Service (DNS)
  - Dynamic Host Configuration Protocol (DHCP)
- **Benefits: Lower costs, better agility, more flexibility:**
  - Reduces the need to purchase dedicated hardware.
  - Reduces the need for over-provisioning.
  - Reduces physical space, power, and cooling requirements.
  - Reduces the time to deploy network services.
  - Reduces risk by enabling service evolution and experimentation.

NFV in Relation to CCN

- **NFV Functions with CCN Counterparts:**
  - Domain Name Services
    - CCN provides name lookup and translation services.
  - Client Configuration
    - CCN requires no network address management
    - CCN DNCP provides client configuration information (akin to DHCP)

- **NFV Functions without CCN Equivalents:**
  - IP addresses specify network endpoints, CCN does not.
  - CCN Firewalls use names, not addresses.

Self-Organizing Networks (SON)

- **Definition: Automatic configuration and optimization of network equipment**
  - SON reduces workload and complexity for network administrators.
  - Self-* == Configuration, Management, Optimization, and Protection.
  - Self-Configuring streamlines on-site equipment setup and deployment.
  - Self-Managing maintains and updates according to policies and objectives.
  - Self-Optimizing analyzes and adapts to changing network conditions.
  - Self-Protection monitors and corrects from failures and attacks.
- **Benefits: Reduces CAPEX and OPEX by lowering cost and complexity**
  - Self-Configuring saves CAPEX by reducing time and frequency on-site.
  - Self-Managing saves OPEX with smaller workload and energy conservation.
  - Self-Optimizing saves OPEX via offloading to cost-advantaged networks.
  - Self-Protection saves OPEX by reducing admin costs and better uptime.

SON in Relation to CCN

- **SON Benefits are Enabled with CCN:**
  - CCN networks are inherently self-configuring with an intelligent initialization and update mechanism.
  - CCN uses a policy-based management layer for autonomic monitoring and adaptation.
  - CCN's distributed content model ensures interest and content responses are served from optimally located nodes to reduce congestion and extraneous transmission.

Network Coding (NC)

- **Definition: Use linear coding to combine multiple packets for transmission**
  - Nodes send out random linear combinations of packets received.
  - Choose coefficients so receivers get linearly independent combinations.

- **Benefits: Optimizes throughput with a decentralized algorithm**
  - NC makes more efficient use of network resources
  - Improves throughput and scalability.
  - More resilient to attacks and prevents eavesdropping.

NC in Relation to CCN

- **NC can significantly increase CCN network throughput**
  - CCN's in-network caches and support for multi-path routing make linear network coding highly effective.
  - An Interest packet routed on more than one path may bring back different and useful bits to the requestor.
  - Initial simulations show up to 40% throughput improvements using random linear network coding in CCN nodes with caches.