Model Driven Protocol/Platform for ICN

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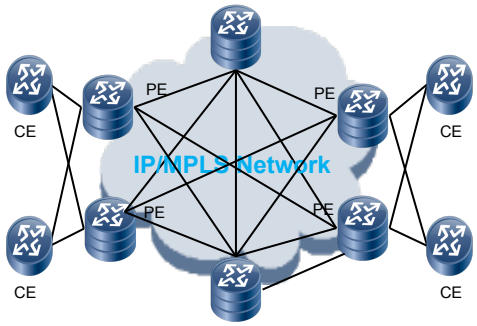
Contents

- **Problems with Current Network Protocols**
- **Model Driven Protocol/Platform**

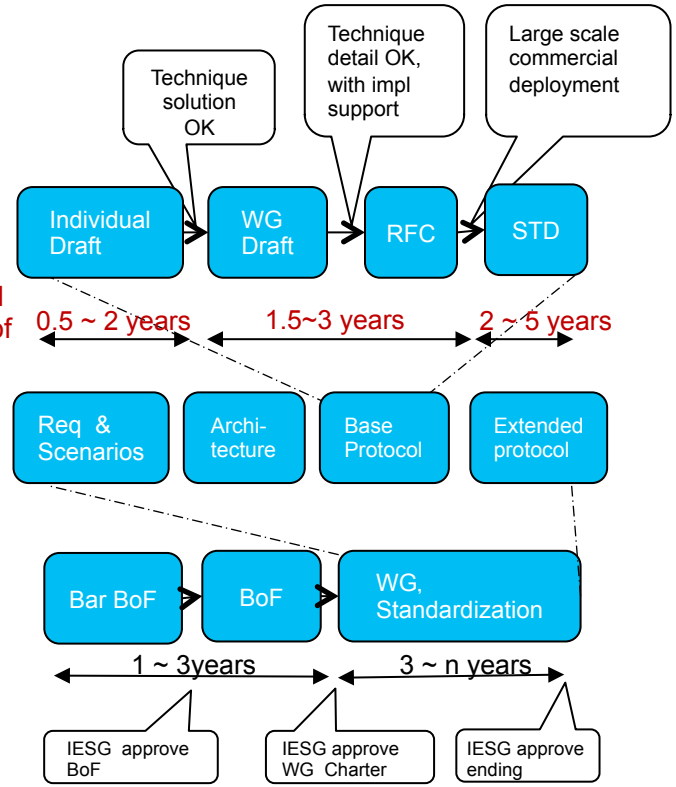
Various Protocols, Long Process to Market



Multi-vendors and multi-operator networks need standardized protocols to cover every aspects of network functions

- RIP/ISIS/OSPF/BGP/PIM
- LDP/RSVP-TE/PCE
- L2VPN/L3VPN/E-VPN
- STP/TRILL
- BFD/FRR
- …

7000+ RFCs



Each RFC takes 2-5 years

BGP Protocol History

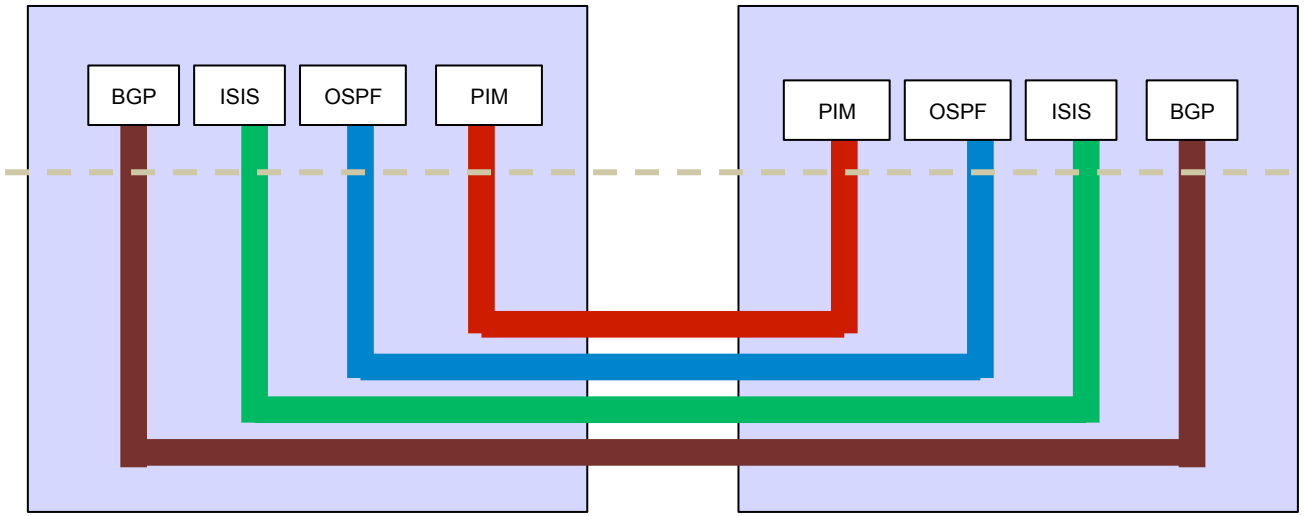
RFC 1771, A Border Gateway Protocol 4 (BGP-4)
RFC 1772, Application of the Border Gateway Protocol in the Internet
RFC 1965, Autonomous System Confederations for BGP
RFC 1966, BGP Route Reflection: An Alternative to Full-Mesh IBGP
RFC 1997, BGP Communities Attribute
RFC 2270, Using a Dedicated AS for Sites Homed to a Single Provider
RFC 2283, Multiprotocol Extensions for BGP-4
RFC 2385, Protection of BGP Sessions via the TCP MD5 Signature Option
RFC 2439, BGP Route Flap Damping
RFC 2842, Capabilities Advertisement with BGP-4
RFC 4271, A Border Gateway Protocol 4 (BGP-4)
RFC 4360, BGP Extended Communities Attribute
RFC 4456, BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP)
RFC 4760, Multiprotocol Extensions for BGP-4
RFC 5492, Capabilities Advertisement with BGP-4
。。。
RFC 7196, Making Route Flap Damping Usable
。。。

- BGP：1990~ now, 66 RFCs
- MPLS：1999~ now, 122 RFCs

Protocol features expansion makes system complex

Funnel-style Protocols, Duplicated Functions

Current network protocols follow a funnel-style architecture: every protocol has a relatively complete and independent architecture, has its own mechanisms of everything



Different Processing Logic

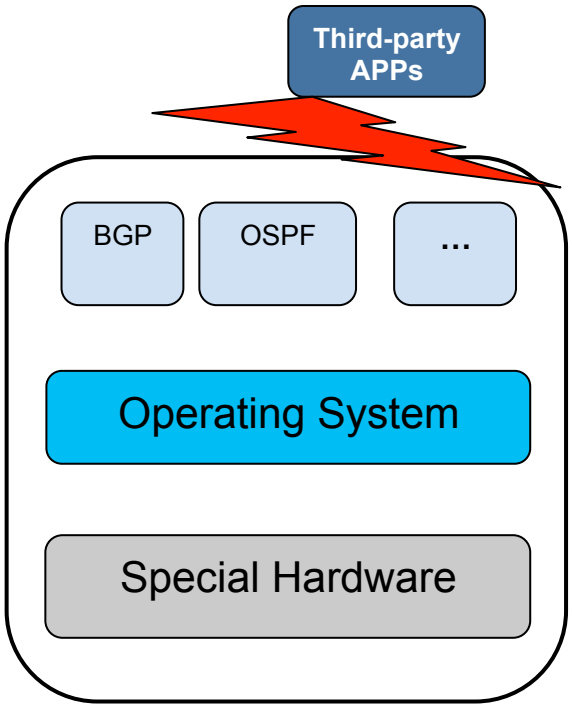
Similar Protocol Mechanisms:

- Neighbor discovery
- Information exchange
- Reliability
- OAM
- Security
- …

- Pros: protocols are decoupled, can operate and evolve independently
- Cons: every protocol has a set of similar but different mechanisms, introduces a lot of duplication and complexity to the device/system

Closed Architecture, Hard for Innovation

- Current routers are closed box, both hardware and software are provided by router vendors, the period of system version update is long
- Existing interfaces (CLI/SNMP/Netconf) only provide limited openness, and lots of differences between different vendors & versions, hard to develop applications based on these interfaces
- Usually do not support integration with third-party applications, cannot support customization or secondary innovation



Closed System

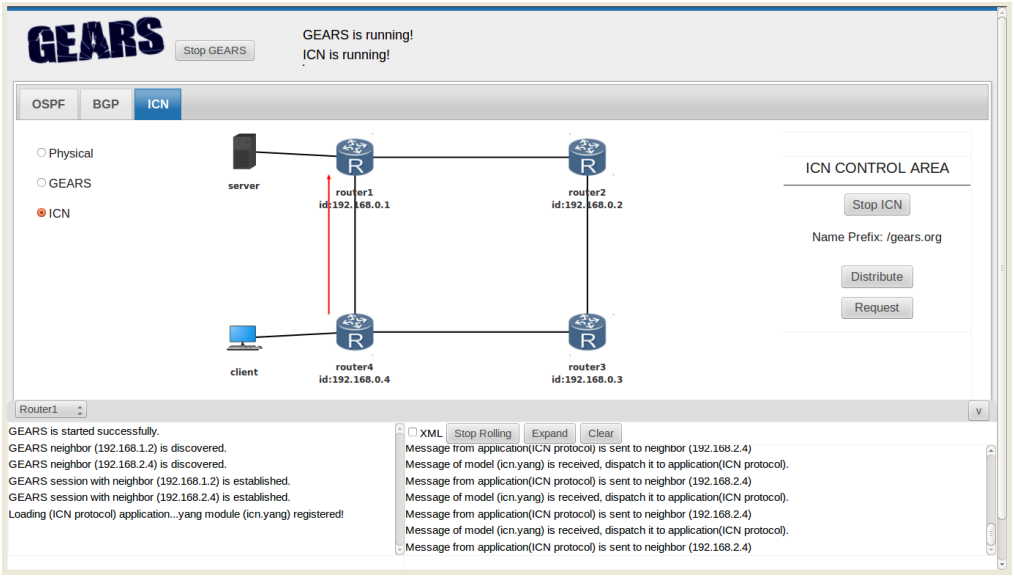
Think in Another Way

- Can we have a “base/generic” protocol/platform with the following characteristics?
  - Open platform, support:
    - Integration with third-party applications
    - Customization
    - Secondary innovation
    - …
  - Easy for introducing new protocols and functions
    - No funnel-style duplications
    - …
  - Incremental deployment
    - No need to update the whole system image
    - Add new service online, without device/system restarting
  - ...

GEARS

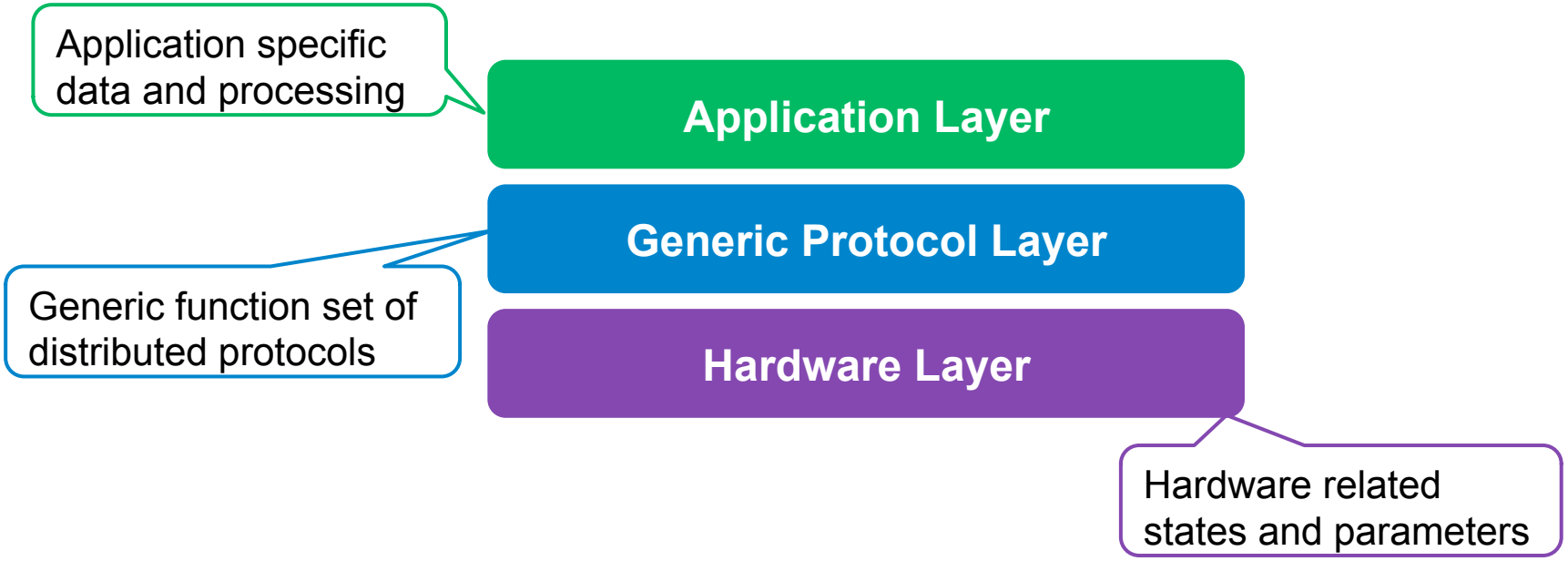
Signaling (**GEARS**)

- A model driven generic protocol/platform
- An initial prototype exists (Thursday evening's Bits-n-Bytes) supports:
  - OSPF
  - BGP
  - ICN



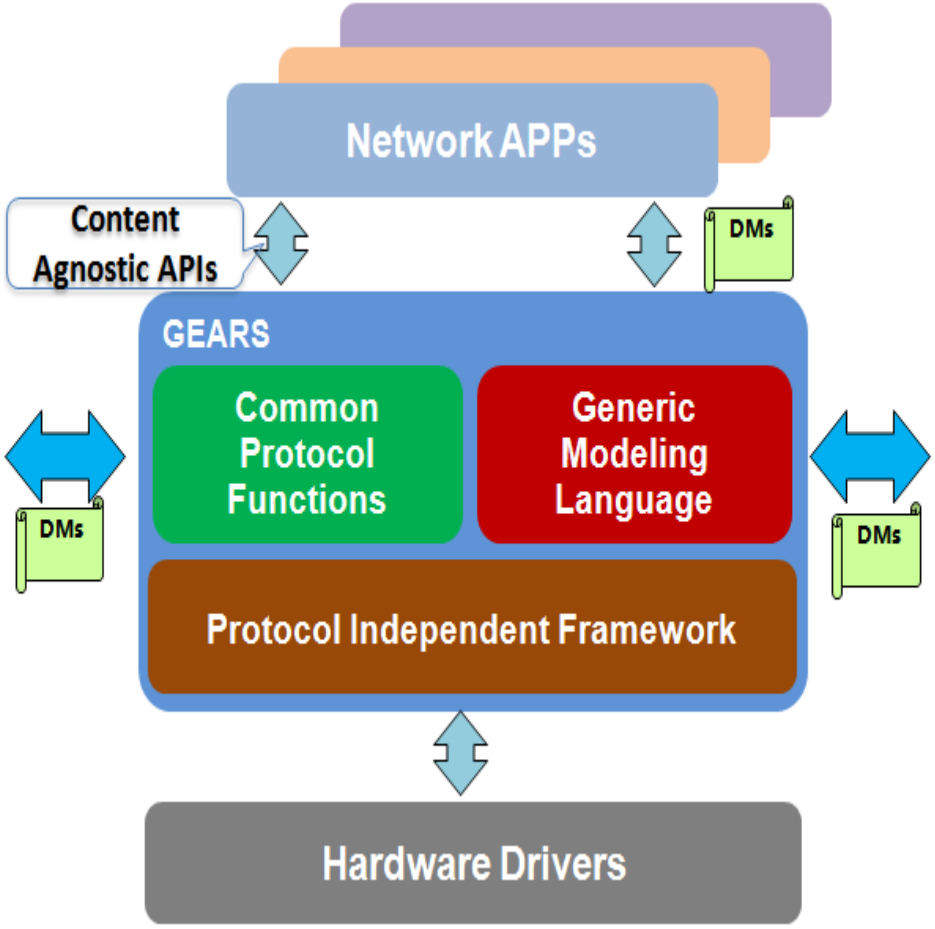
Principle of GEARS

- Layered architecture
  - Re-organize the functions of routing system and protocols



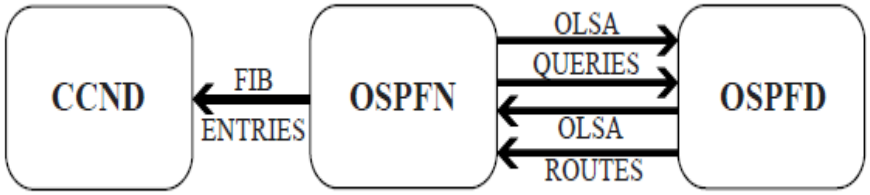
Network innovation similar to develop & install APPs on mobile phone

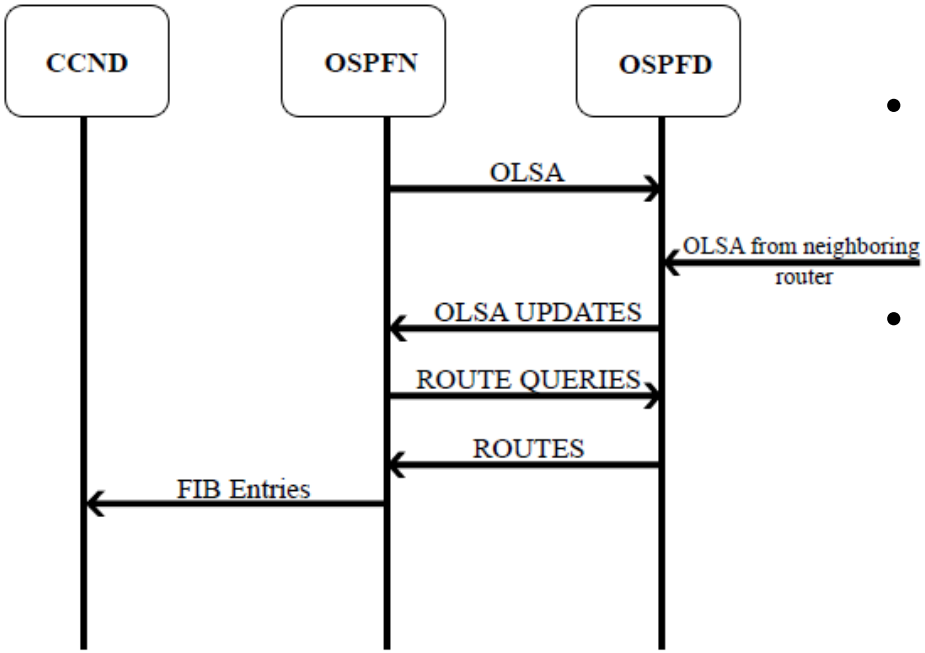
Overview of GEARS



- Open protocol/platform
  - Abstract and implement common protocol functions
  - Provide content agnostic APIs to Apps
  - Provide common single transport channel for all Apps
- Model driven protocol/platform
  - Data model based protocol data exchange
  - Introduce new protocol by defining new models
  - Standardize data models for interoperability

OSPFN Overview

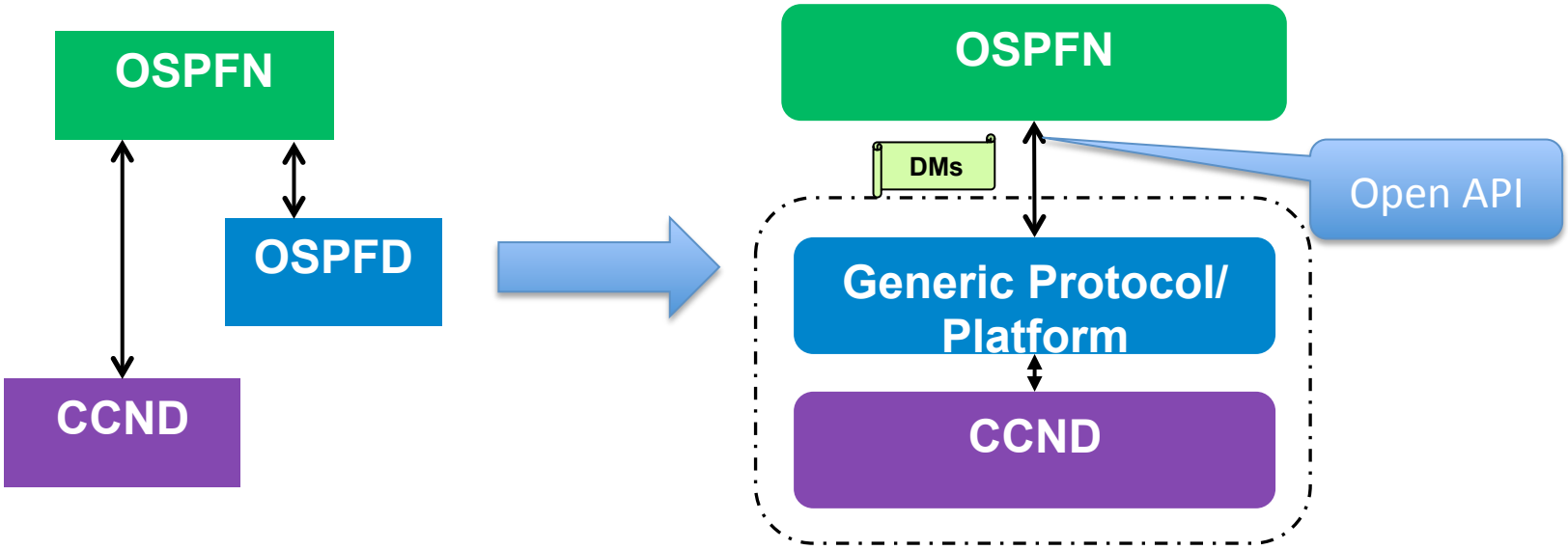




Cited from the OSPFN paper

- Leverage the OSPF Opaque LSA (OLSA) for name prefix distribution
- Name prefix distribution:
  - OSPFN generates OLSAs and injects them to OSPFD, OSPFD floods them within the specified routing domain
- Name prefix reception:
  - OSPFD (a parallel running process) receives the OLSAs and delivers them to OSPFN.
- Route query:
  - OSPFN will query the route based on Router ID from OSPFD
  - Route calculation based OSPF, normally shortest path provided, not perfect to support multi-path

GEARS for OSPFN



- OSPFD is replaced by the Generic Protocol Platform (GEARS)
- The interface between OSPFN and GEARS is replaced by the GEARS open APIs
- The OSPFN name prefixes and messages are modeled by YANG
- OSPFN or GEARS can be enhanced to support multi-path function without the limitation of OSPF
  - OSPFN enhancement is equivalence to introduce a new protocol, or
  - Add the multi-path algorithm as a Common Protocol Function to GEARS

Example of OSPFN-OLSA Yang Module

```
module: ospfn
   +--rw ospfn-olsa
      +--rw lsa-age?                uint16
      +--rw options?                bits
      +--rw ls-type?                enumeration
      +--rw opaque-type?            enumeration
      +--rw opaque-id?              uint32
      +--rw router-id?              yang:dotted-quad
      +--rw lsa-sequence-number?    uint32
      +--rw lsa-checksum?           uint16
      +--rw lsa-length?             uint16
      +--rw size?                   uint32
      +--rw prefix-format?          enumeration
      +--rw name-prefix?            string
```

Summary

- Simplify protocol design and implementation
- Make innovation easier and faster
- Shorten the standard process and time to market

Next step

- Plan to open it if there are interests
- Contributions and collaborations are always welcome!