IoT in the Home: Cloud-based Gateway Management

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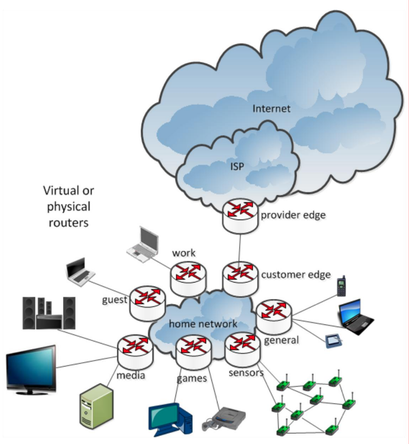
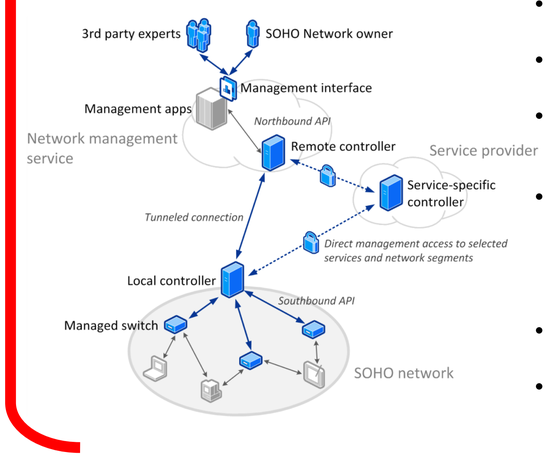
Managing Complex Home Networks

- Smart homes are the convergence points for many new IoT technologies and devices
- Home networks are becoming complex, eg IETF HomeNet architecture allows multiple subnets with intra-home routing and automatic service discovery
- But the home owner receives little help in managing the network
- Difficult to co-operate with expert advisors to jointly manage the network, if all the control resides in the home



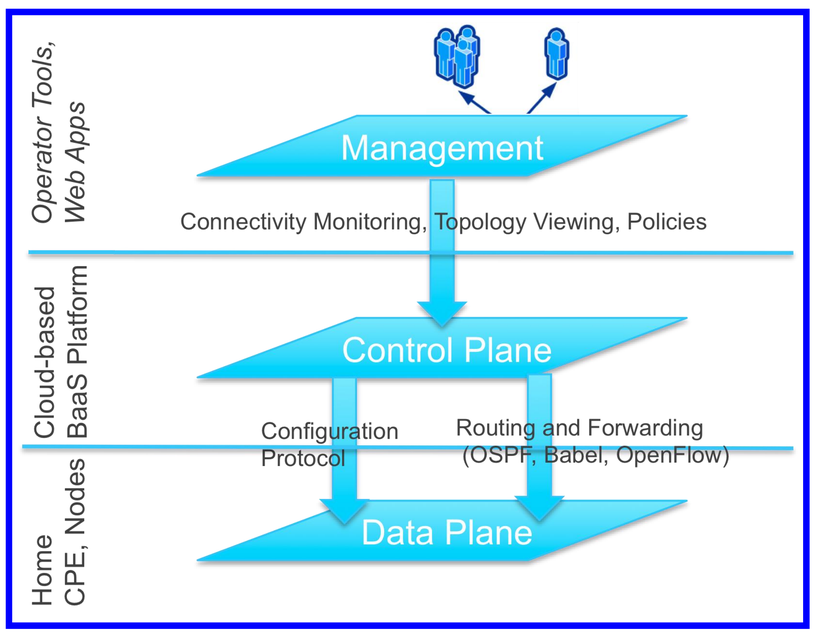
Collaborative Management Efforts

- Allow expert assistance / co-management by using SDN-like 3-layer model
- Allow the management and control interface to be hosted outside the home using cloud-based network management controllers

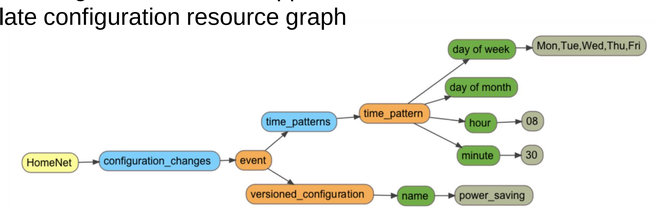


- Separate the roles and network view of home owners, ISPs and 3rd party providers
- Allows operators and service providers the ability to co-manage homes without remotely accessing CPE.
- Service providers get e2e access, can manage their devices and service also inside the home, and gain insight into customer usage
- User policies and access control can be easier provisioned
  - Forwarding and routing policies
  - Traffic engineering, energy saving profiles
  - Security policies (firewall configuration, ACLs)
- Homenet router configuration and network configuration snapshots stored in the cloud
- New business in the form of providing dynamic network provisioning and management service

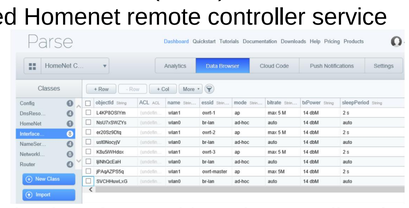
Co-Managed Configuration and Control



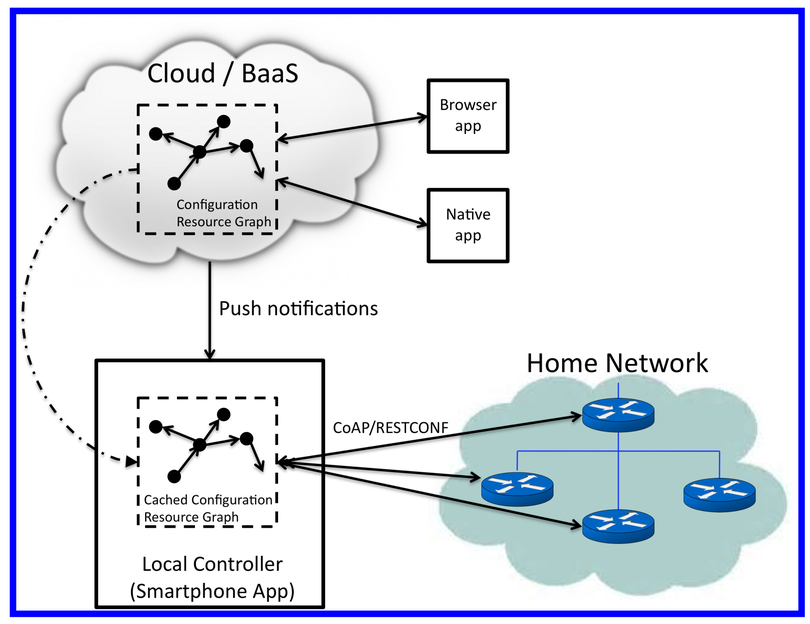
- Network management tools and apps work with cloud-based data and manipulate configuration resource graph



- Parse.com back-end as a service (BaaS) selected for developing scalable cloud-based Homenet remote controller service

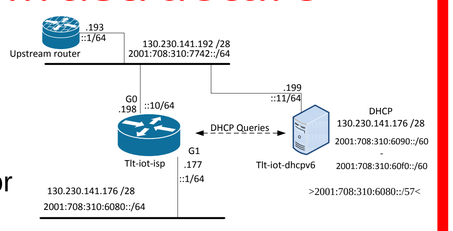


- The BaaS cloud service interfaces with an intermediate local controller (smartphone/tablet/laptop) to trigger management actions
  - Introducing local controller allows management of network in case of uplink disruptions
- Local control element interfaces to routers and switches in the home using configuration protocol

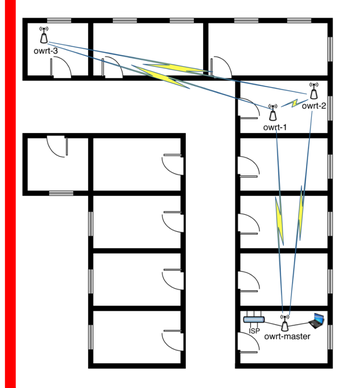


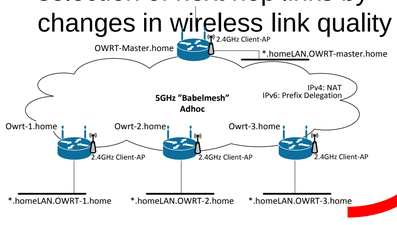
Deploying Homenet-based infrastructure

- Infrastructure consists of both ISP and home network
- ISP provided DHCP for IPv4 but supported IPv6 prefix delegation for home routers



- Fixed and Mobile OpenWRT APs with HNCP and Babel routing protocol
- HNCP discovers external links, configures Babel and allocates IP addresses to routers
  - DHCP and NAT for IPv4
  - Prefix delegation for IPv6
- Babel dynamically adjusts selection of next hop links by changes in wireless link quality





Privacy, Access Control, and Authorisation

- HTTPS-based communication with BaaS service and apps
- Class-level permissions and object-level access control is permitted for cloud data
- BaaS-specific user management, access control and views according to user role
- Smartphone as a trusted local controller to audit and execute configuration changes on home devices, using SIM-based authentication
- Need to be able to ascertain the local controller's credentials and access rights to manage the home network, but also grant time and role-based access rights to others to co-manage
  - Combine access control and access rights mechanisms from BaaS systems with ISP-based AAA solutions for privileged operations by smartphone

REST-Based Communication

- Cloud controller supports push notifications to mobile apps or alternatively apps can pull data using REST APIs
- Resources exposed in the cloud can be retrieved and manipulated by authenticated HTTP/CoAP proxies and clients
- Easy integration with other 3rd party IoT or REST-based policy engines for home network management
  - IFTTT as a possible service-specific controller eg for time-/presence-based energy-savings profiles for Homenet-based routers and Access Points
- Communication between local controller and nodes at home uses REST-based API to interact with the Unified Configuration Interface of OpenWRT
  - CoAP and LWM2M-based management approaches under investigation

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