PhantomNet
An end-to-end mobile network testbed

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Why another mobile network testbed?

- Mobile networking growing traffic-wise and growing in importance
  - Mobile devices increasing in sophistication and becoming the "compute platform of choice"
- Current network architectures (LTE/EPC) are packet based
  - But under the hood look a lot like their circuit switched forebears
- Major technology trends reshaping the way we do things
  - Cloud computing, software defined networking
- Current measurement studies
  - From the "outside", no ground truth

Need a realistic "playground" where as a community we can:
- **explore/invent mobile network architectures in an end-to-end manner**
- **look "under the hood" of existing mobile network architectures**

PhantomNet

Programmable end-to-end mobile testbed to enable research at the intersection of mobile networking, cloud computing and software defined networking

- Remotely accessible and sharable
  - Emulab style

Base functionality

- Physical deployment
  - Mobile devices
  - Small cell deployment (LTE based)
  - SDN capable backbone
  - Cloud infrastructure
- Software
  - "Mobile network toolkit":
    - Modular evolved packet core (EPC) software
    - Emulab control framework

Mobile Device

Small-cell with compute platform
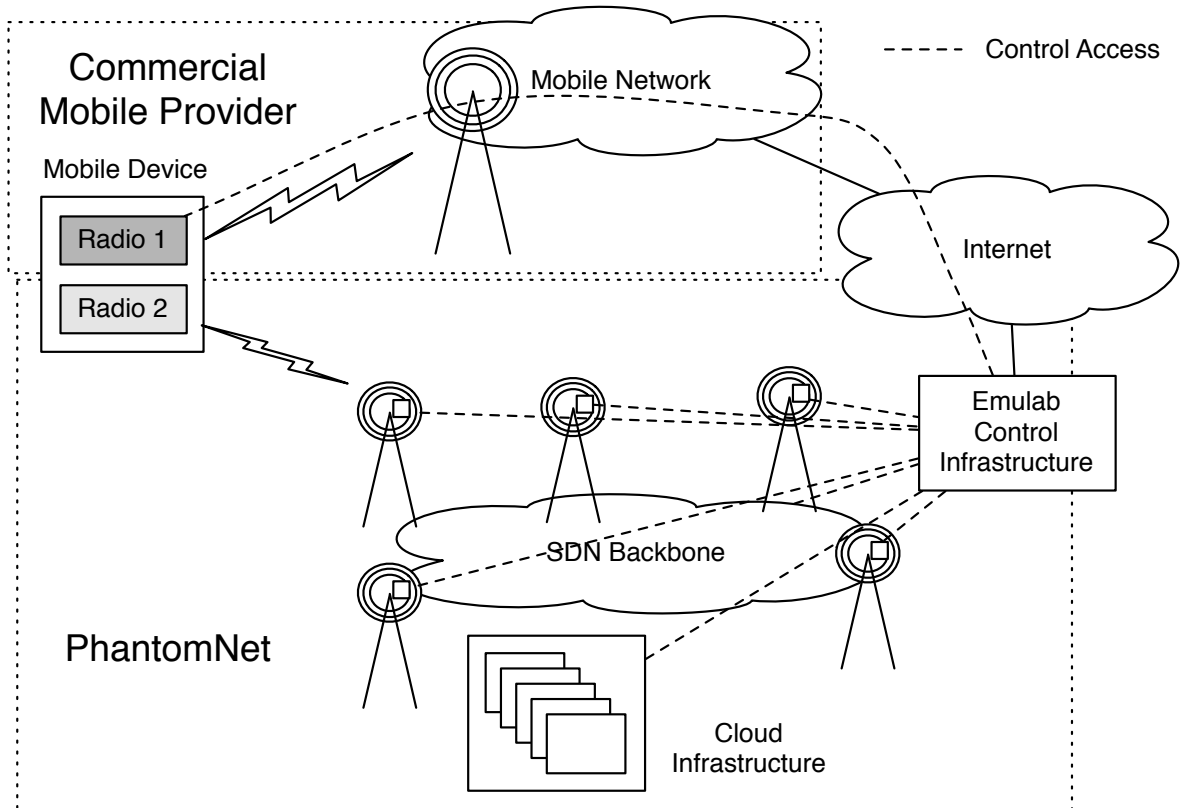
SDN Backbone

Cloud Infrastructure
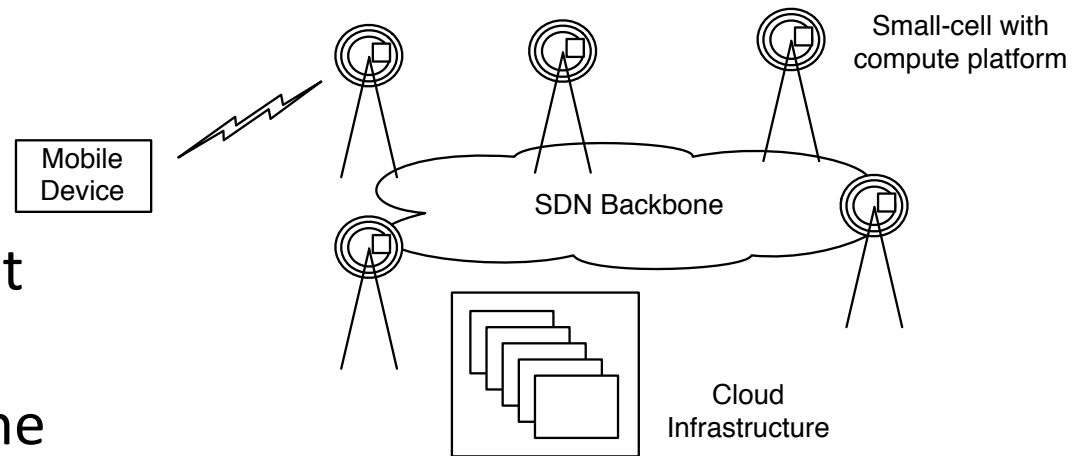
Mobile network toolkit

- Create "standard" mobile network architectures:
  - E.g., 4G: LTE + EPC
- Replace some/all components to realize different architectures:
  - Cloudlet-like architecture
 - Mobility First approaches
  - Softcell
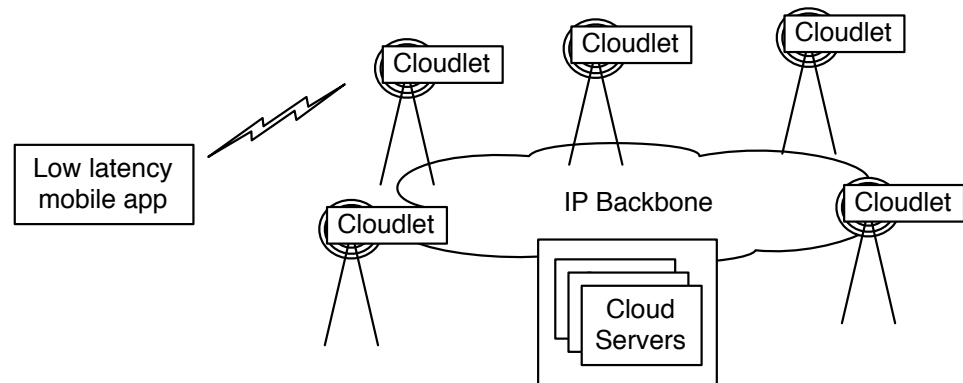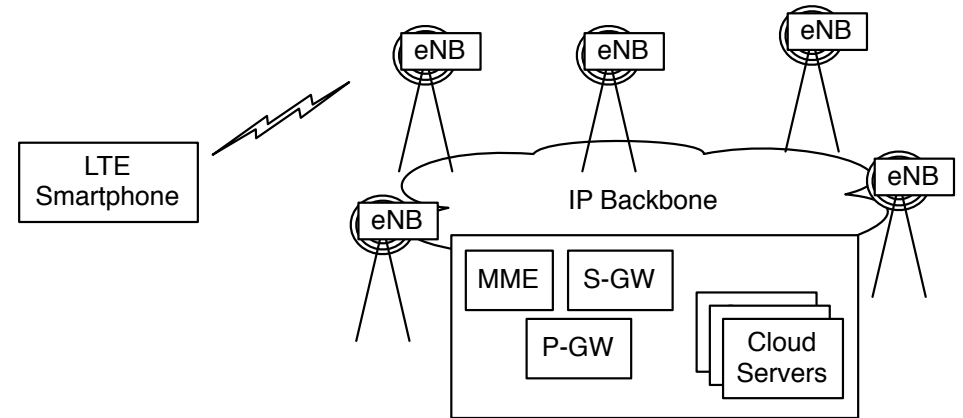
Mobile device platform

- Exploit dual active radio devices
- One radio: commercial provider
  - Allow volunteers to use as regular handsets
  - Provide out-of-band control channel
  - **Hoping we can use SciWiNet**
- Second radio: PhantomNet
  - Part of testbed resources

Commercial Mobile Provider

Mobile Network

Control Access

Mobile Device

Radio 1

Radio 2

Internet

Emulab Control Infrastructure

SDN Backbone

PhantomNet

Cloud Infrastructure

Mobile device platform

- Dual radio devices
- "Tiered" abstractions for experimenter access:
  - JVM: Android applications
  - Basic command shell
- **Planning to explore Seattle framework**
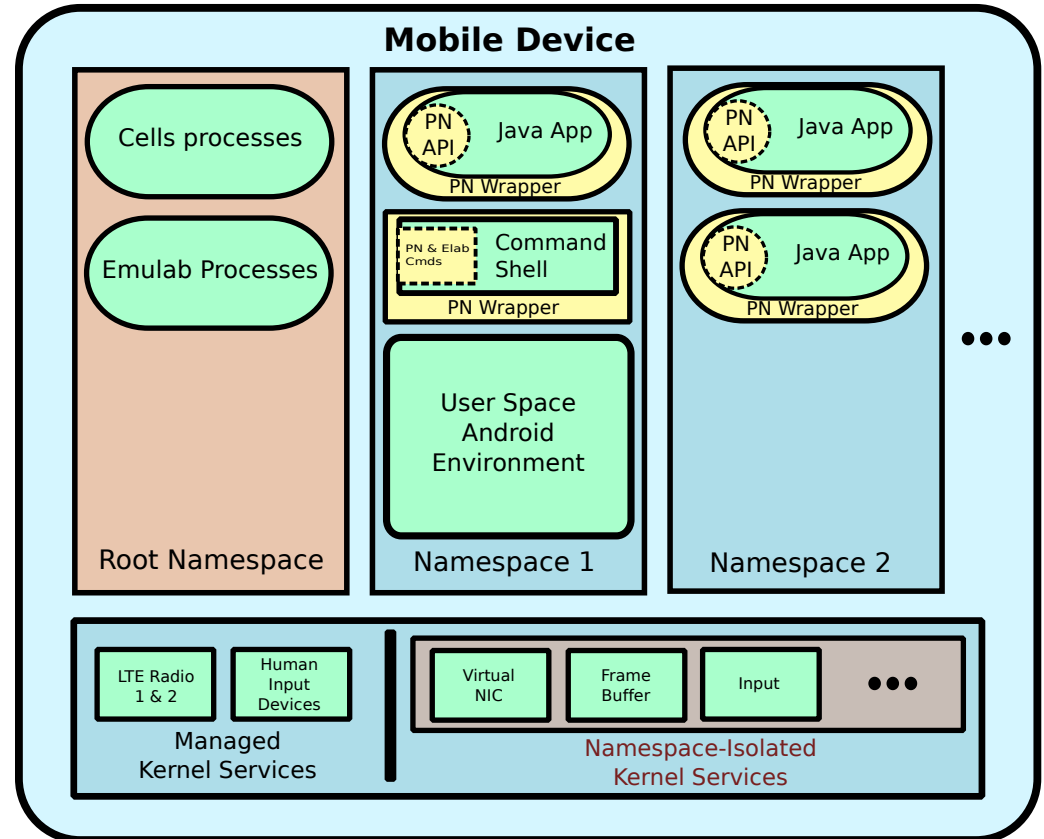
Practicalities/challenges

- Spectrum!
  - No magic... experimental licenses
- Small cell
  - Increased availability
  - Key question is degree of programmability
- Mobile devices
  - Readily available
- Challenge: all the parts have to align!
  - Spectrum where can get small cells and mobile devices
- Software
  - Emulab control framework
  - OpenEPC for EPC

Status

- Integrated OpenEPC with Emulab
  - Uses emulation for RAN (UE and eNodeB)
  - Specifies LTE/EPC topology using NS file with PhantomNet enhancements
  - Brings up experiment with correct e2e configurations
  - External availability by end of April
- Hardware RAN interworking with EPC
  - End-to-end lab setup:
    - UE (Huawei modem), eNodeB (ipaccess small cell)
      - band 4
  - Functioning with OpenEPC in Emulab environment

Next steps

- Focus on hardware RAN
  - (small cell) eNodeB with more programmability
  - different spectrum options
- Handsets
  - dual radio
  - Seattle / SciWiNet
- Toolkit
  - exploring different abstraction
- Deployment and build out..

If you have thoughts about how PhantomNet could better serve your research needs please let us know!