

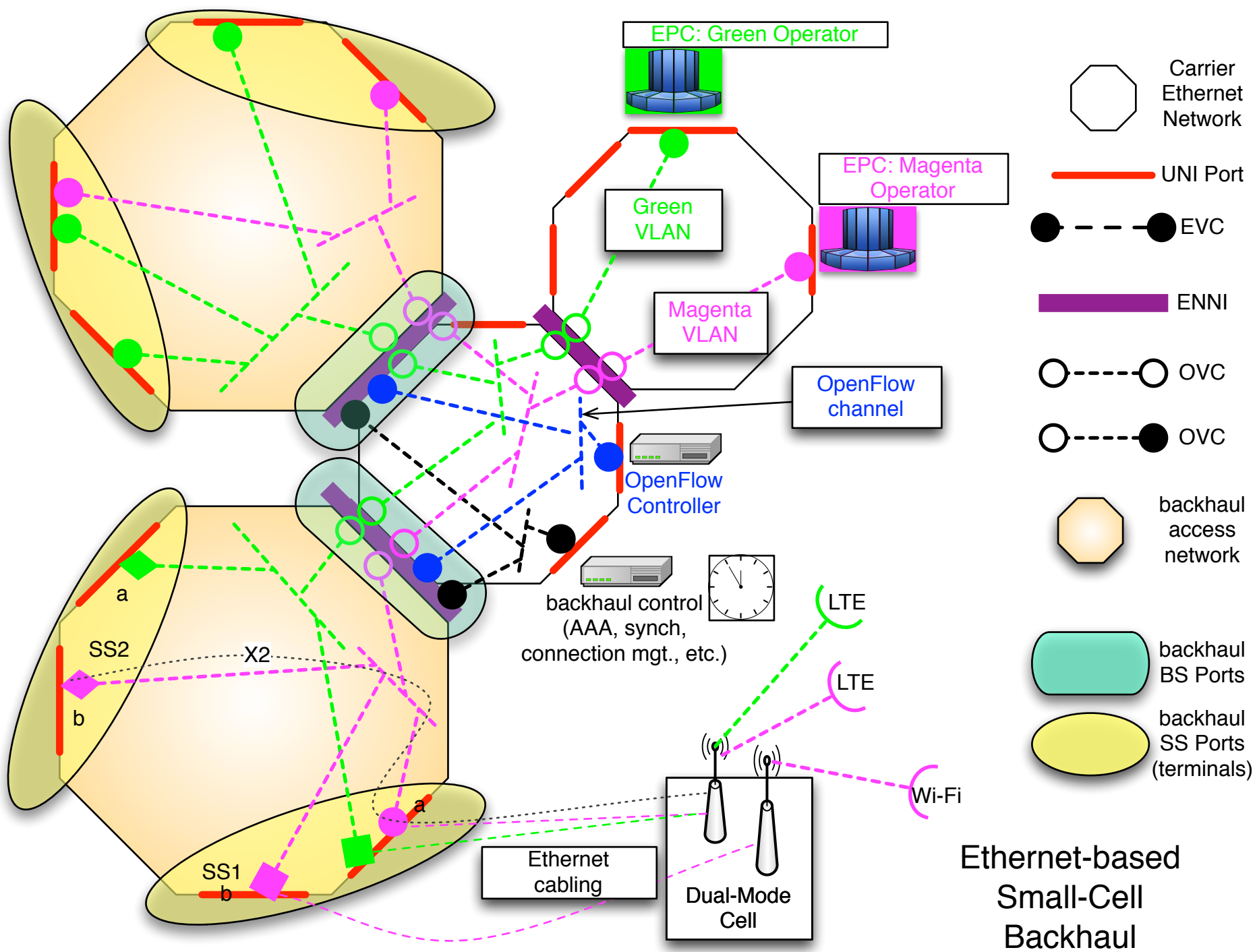
View of  
Connection-Oriented Software-Defined  
Networking for  
Wireless Backhaul of Small Cells

IEEE Project P802.16r

18 July 2013

# Wireless Backhaul of Small Cells

- Fixed broadband wireless access can provide Carrier Ethernet services to sites not accessible with wired Carrier Ethernet.
  - supporting Ethernet Virtual Connections among a set of ports
- A major application is backhaul of wireless cells
  - particularly small cells (LTE, Wi-Fi, etc.) that require placement choice driven by user capacity requirements rather than wired backhaul availability
  - mobile operators prefer Ethernet backhaul connectivity for cells
  - IP rides over Ethernet
- Backhaul may be shared
  - could be provided by an independent provider of backhaul service, to multiple mobile operator customers, just like wired Carrier Ethernet
  - cells may carry user traffic and control signaling for LTE, 3G, Wi-Fi, etc.
  - even the cell may be shared among multiple mobile operators
- Capacity must be shared
  - capacity sliced among mobile operators and services, with SLA commitments
  - customer traffic is comprised of multiple flows with varying QoS requirements
- Problem being addressed in IEEE 802.16r project



Carrier Ethernet Network

UNI Port

EVC

ENNI

OVC

OVC

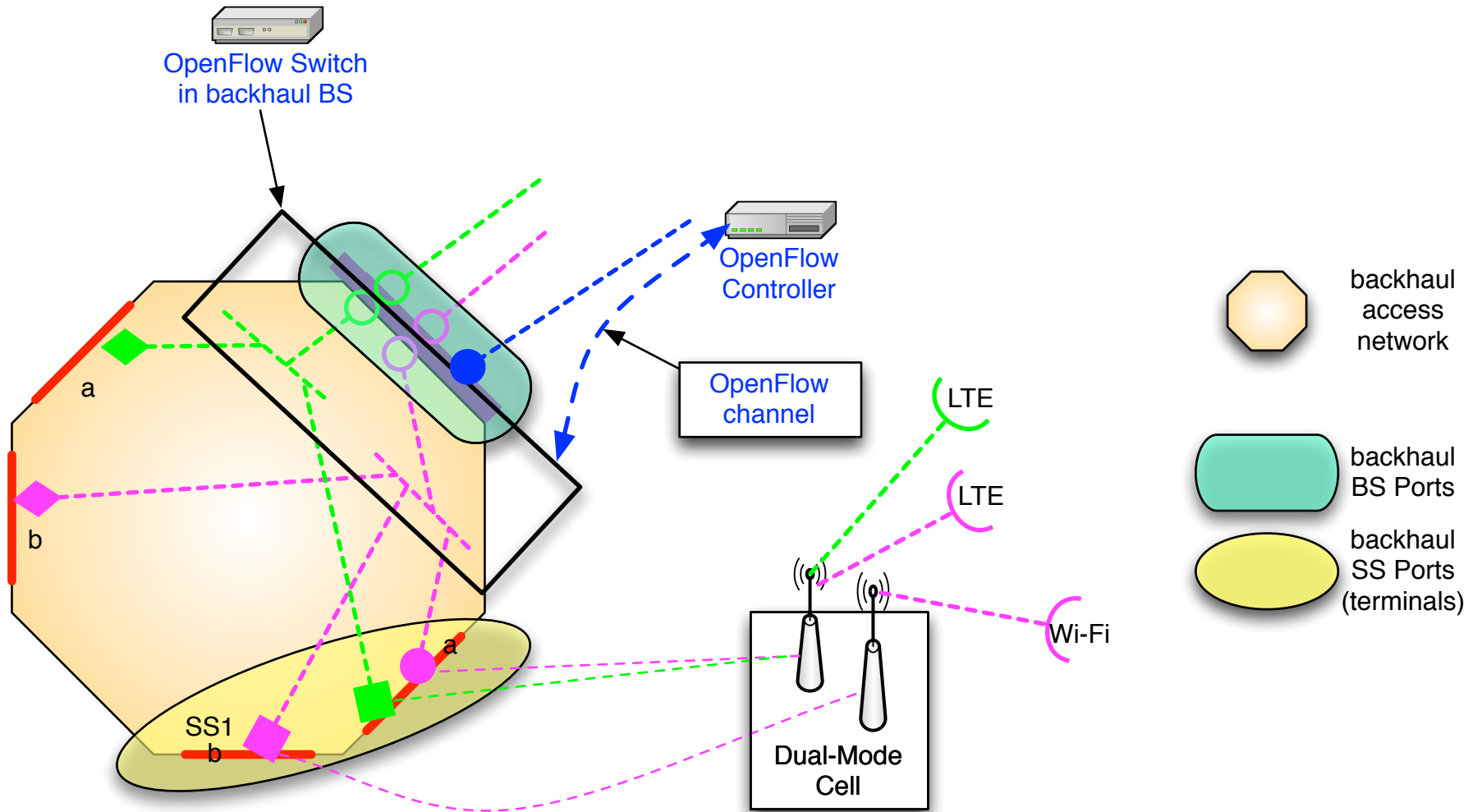
backhaul access network

backhaul BS Ports

backhaul SS Ports (terminals)

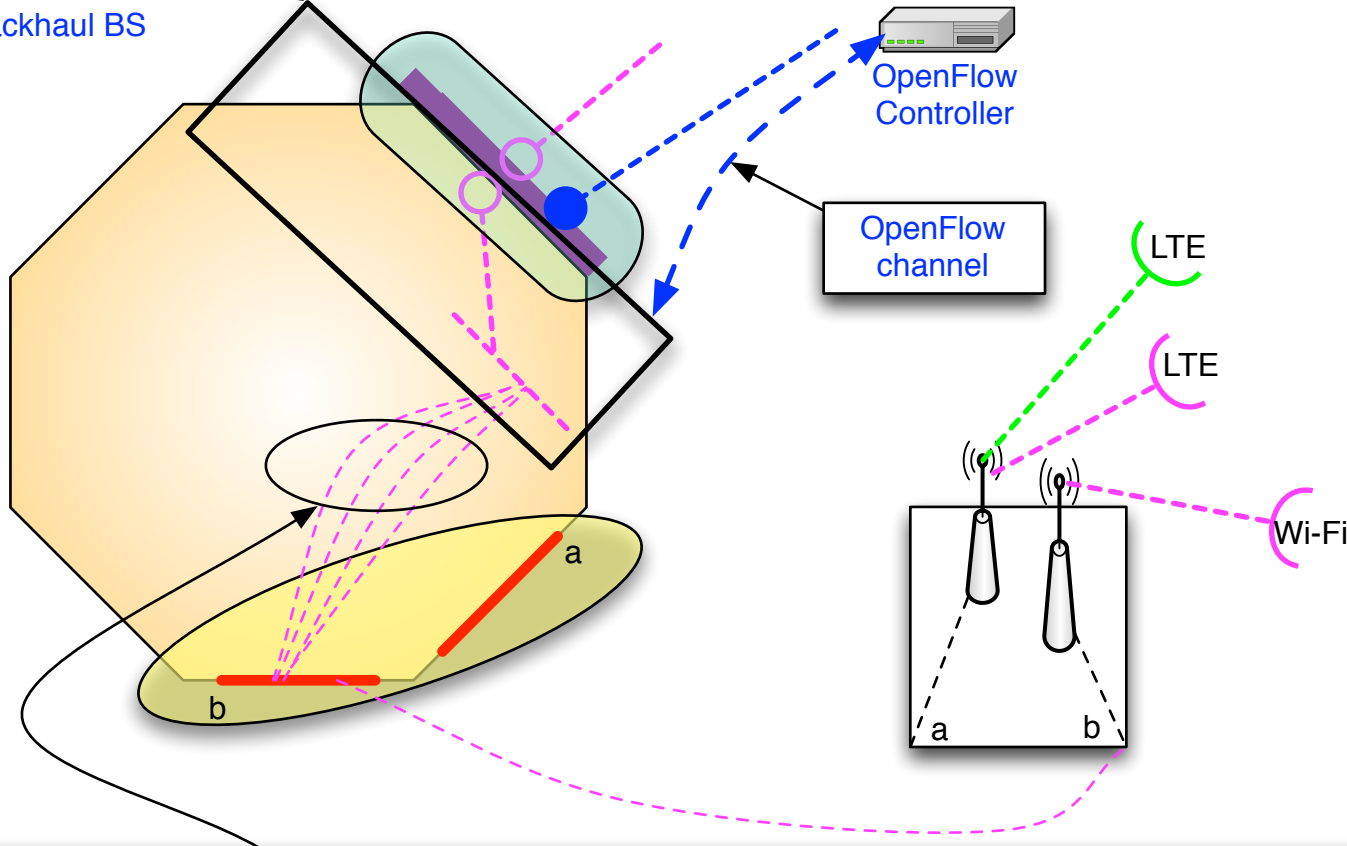
Ethernet-based Small-Cell Backhaul

# Highlight: OpenFlow Switch and Controller



# Highlight: Transport Connections

OpenFlow Switch  
in backhaul BS



backhaul  
access  
network

backhaul  
BS Ports

backhaul  
SS Ports  
(terminals)

- multiple transport connections (typically over the air or on other bandwidth-constrained channel)
  - for example, IEEE 802.16 point-to-multipoint access, providing connection-oriented service over the air
- each connection maps one switch (virtual) port to one SS (virtual) port
- differentiated QoS; each connection has specified QoS parameters, known to OpenFlow controller
- connections can be assigned to mix of channels and technologies
  - for example, some connections may be point-to-point microwave, Wi-Fi, wired Ethernet, etc.
- connections assigned by OpenFlow switch per flow based on programmed flow tables
- backhaul controller manages connections, radio parameters, scheduling, etc. to meet specified QoS
  - OpenFlow controller not responsible for details
  - backhaul controller feeds back status and reporting to OpenFlow controller

# First-Order Open Issue

- OpenFlow should be enabled to assign both port and connection identifier via flow tables (as programmed by controller)
  - port assignment is already inherent in OpenFlow
  - connection assignment should also be provided; two possible approaches:
    - connection assignment could be mapped to an existing OpenFlow field, such as output queue or logical port
    - a new explicit connection identifier field could be added