SCONE Applicability for IEEE 802.11 Access Networks

draft-gundavelli-scone-wifi-applicability-00

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SCONE
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Abstract

This document describes the applicability of the Standard Communication with Network Elements (SCONE) protocol to IEEE 802.11 based access networks. SCONE defines a mechanism by which an on-path network element can provide advisory downlink throughput guidance to QUIC endpoints. The SCONE protocol is access agnostic and does not assume any specific access technology.

In IEEE 802.11 deployments, such constraints may be derived at access points or controllers that combine policy awareness, with visibility into access network conditions. This document explains how existing SCONE roles and throughput advice semantics apply in these deployments without assuming any specific IEEE 802.11 MAC or PHY behavior.

This document does not define new protocol extensions and does not modify SCONE behavior. Its purpose is to clarify deployment considerations for IEEE 802.11 environments.

Status of This Memo

Why an Applicability Draft

Base SCONE Draft

- Protocol Specification

- signaling behavior
- packet formats
- endpoint processing

Wi-Fi Applicability Draft

- Deployment Guidance

- SCONE Network Element placement
- operational considerations
- performance and airtime efficiency benefits
- Wi-Fi network visibility into link capacity
- parameters for SCONE rate calculation
- example algorithm for rate calculation

Highlights additional value for Wi-Fi deployments:

- potential benefits of uplink rate guidance and the utility for such signal in Wi-Fi context.

- No Protocol Changes

The Problem We are solving

- Wi-Fi Access Capacity Depends on Radio Conditions

- stations sharing airtime
- PHY rate adaptation (MCS)
- channel load / interference
- network rate limits or user specific policies

- Applications Observes

- packet loss
- RTT variation
- congestion feedback
- no explicit rate signal; do not know the UL/DL rates

- SCONE signals an estimated DL rate over the current observation window.

SCONE Protocol Recap

- SCONE allows on path network element to insert rate-guidance. The client sees the most restrictive value for that path.

In-band Signaling

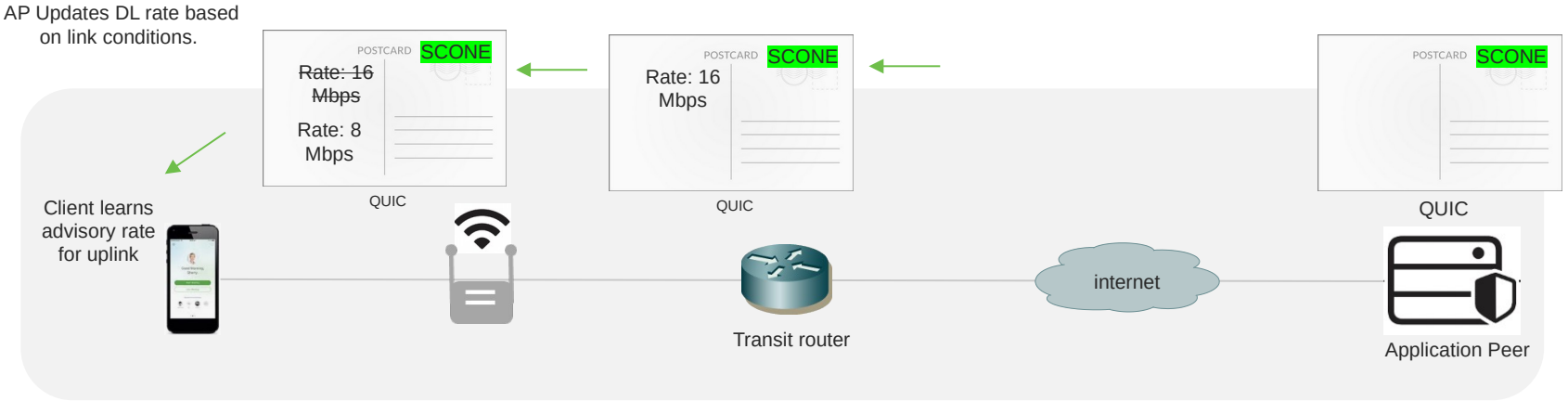
- SCONE rate guidance carried in QUIC Packets

On-path Updates

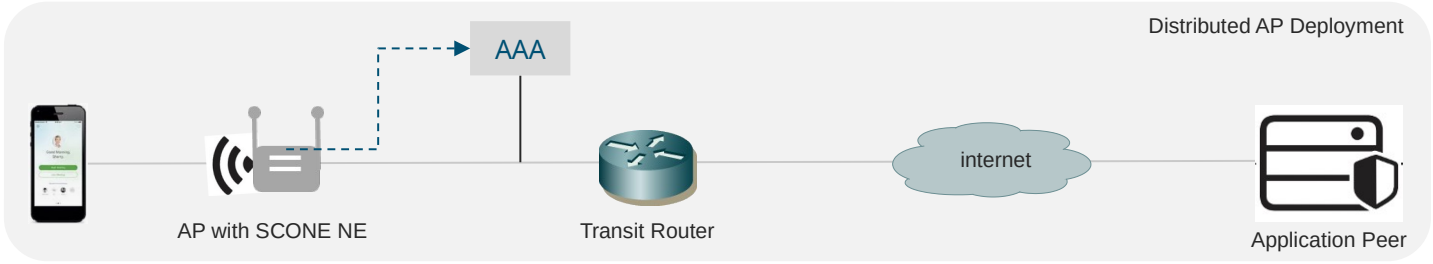
- Network elements on the path may update the SCONE rate value based on the observed conditions

Bottleneck Proximity

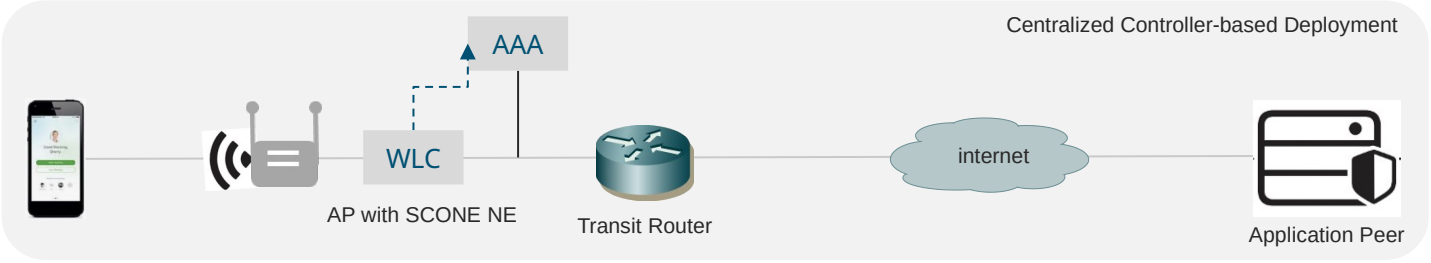
- In Wi-Fi deployments, the air interface is typically the bottleneck, and the access point has direct visibility into achievable throughput.



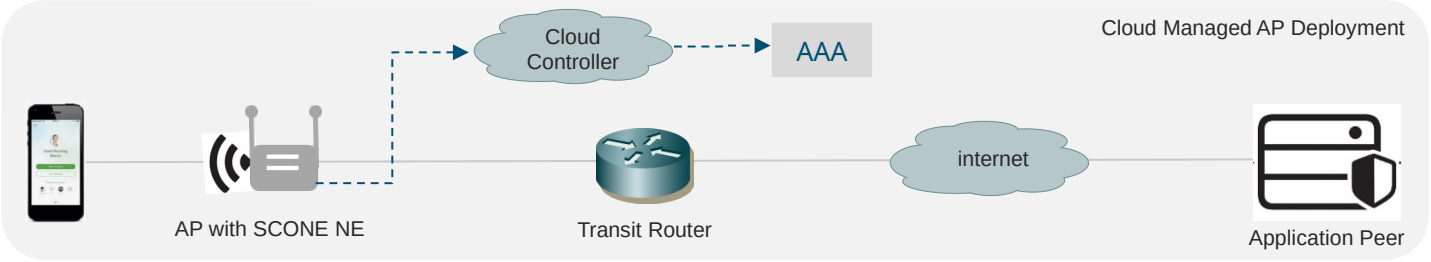
SCONE Network Placement in Wi-Fi



- **SCONE NE collocated with the AP**
- **AP has air interface and MAC layer visibility**
- **Guidance derived locally**

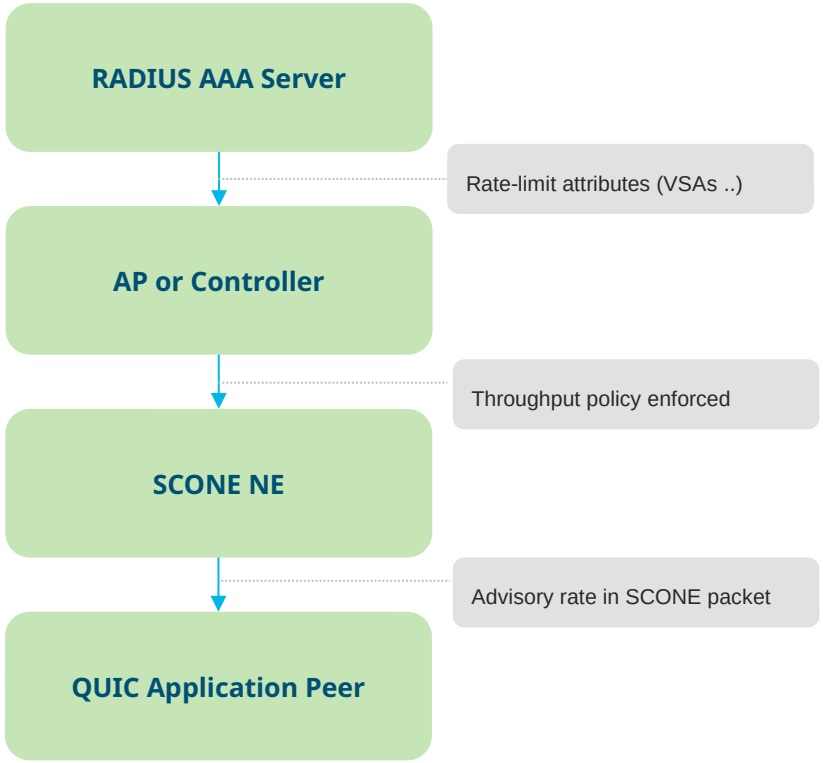


- **SCONE NE collocated with the WLC, or AP.**
- **Controller enforces policy and rate limits, and has AP's MAC layer visibility**



- **SCONE NE collocated with the AP**
- **Policy inputs from the cloud management functions**
- **Guidance derived locally**

Policy Driven Throughput: AAA -> NE



Why this matters for Wi-Fi?

- AAA/RADIUS already defines per-user bandwidth policies using existing VSAs.
- The AP or controller enforces these limits and can derive an advisory throughput value.
- SCONE exposes this resulting rate guidance to the endpoint.

What the Wi-Fi Access Network Knows

- The AP/WLC has direct visibility into air-interface conditions and policy limits. Can be grouped into three categories: a.) Link Quality b.) Medium Conditions c.) Traffic Demand & Policy.

PHY Rate (MCS Index)

- Modulation & coding scheme drives physical throughput

Channel Load

- Medium utilization and interference on the channel affects the available airtime for transmissions.

Policy Limits

- Network enforced rate policies for the subscription.

Packet Error Rate / Retries

- Higher retry rates indicate link degradation, reducing effective throughput.

Queue Backlog

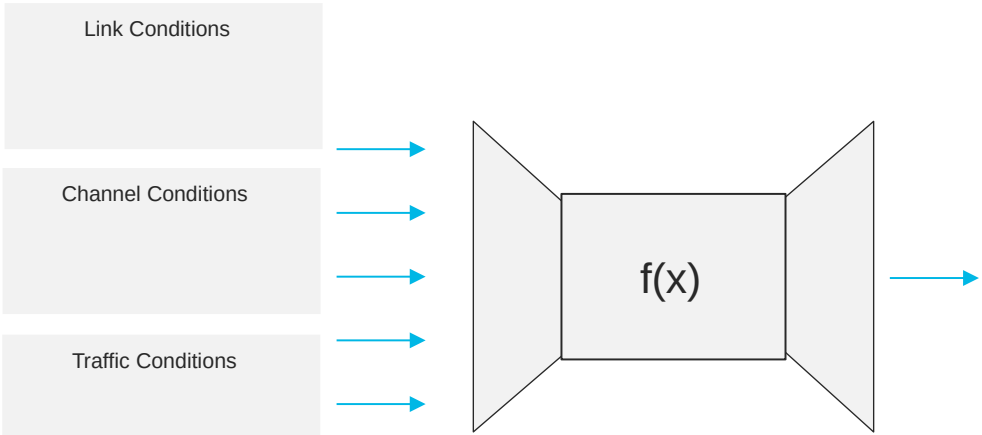
- Queue length indicates traffic demand and available airtime.

Airtime Contention

- Shared medium, Competing transmissions in the BSS reduce the airtime available for downlink traffic.

Rate Guidance Calculation (Unspecified)

- Conceptual model for rate guidance.



Encoded into:

Bitrate	Rate Signal
100 Kbps	0
112 Kbps	1
126 Kbps	2
141 Kbps	3
1 Mbps	20
1.12 Mbps	21
10 Mbps	40
11.2 Mbps	41
100 Mbps	60
112 Mbps	61
1 Gbps	80
1.12 Gbps	81
10 Gbps	100
11.2 Gbps	101
100 Gbps	120
112 Gbps	121
199.5 Gbps	126
Unknown	127

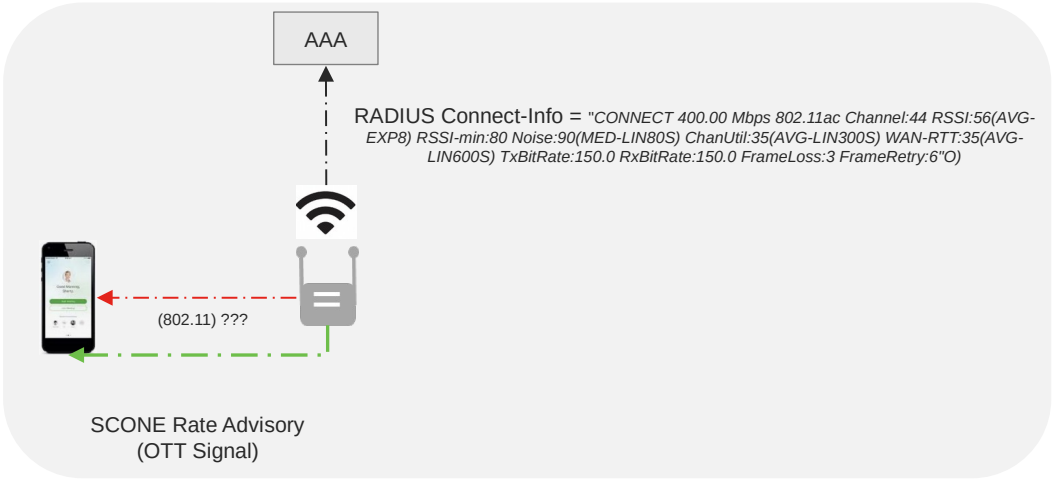
Rate Signal Expressed in logarithmic scale

Closing the Connect-Info Loop

- With RADIUS Connect-Info, the AP reports the link quality parameters to the identity provider (IDP), allowing link characterization for authorization decisions. However, there is no interface for signaling the same to the client. Relying on the QUIC eco-system, and an agnostic interface will have a faster realization path than looking for 802.11 based signals.

Application

1. **ANP Performance Characterization**
2. **Offload/ Authorization Logic**



Application

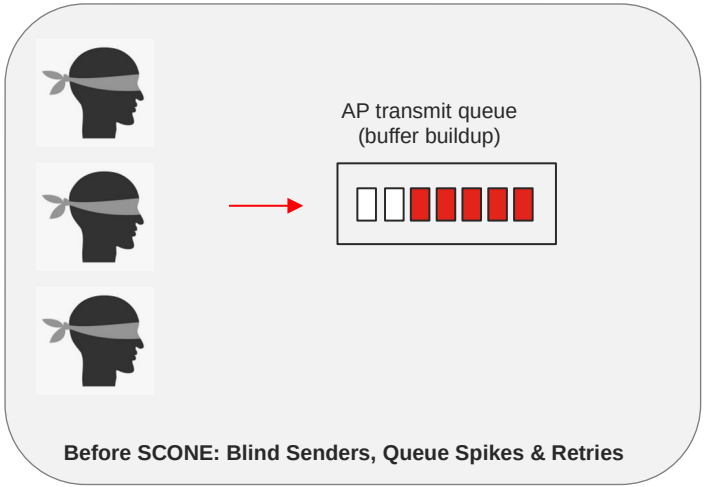
1. App-Rate Adaptation
2. HO Decision Logic

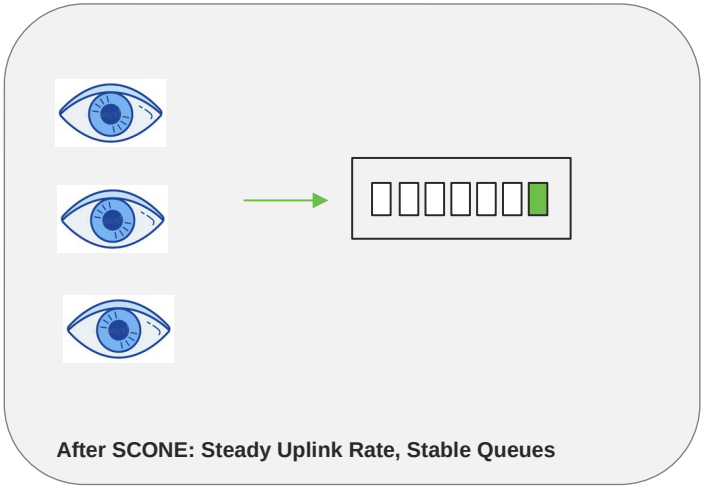
Roaming & Handovers

- SCONE guidance is path-specific; Roaming changes the access path and conditions.
- New AP generates updated SCONE guidance.
- A brief gap in guidance during handover is expected.
- Endpoint may use last known value temporarily.
- Existing roaming context transfer could carry SCONE specific state.

Why Uplink Rate Guidance Matters

- Not all applications use receiver-centric rate adaptation
- Uplink and downlink rates are both equally important for an application peer.
- Sender overshoot leads to queue buildup, retransmissions and latency.
- A slow-rate SCONE (UL/DL) signal has broader utility; can be the basis for access selection.





Summary

- SCONE is access-agnostic; this draft explains applicability to Wi-Fi deployments.
- AP/WLC visibility into radio conditions and policy enables rate estimation.
- Existing AAA/RADIUS policies can inform SCONE guidance.
- Uplink rate signal may benefit some applications.

Questions?