A decorative graphic consisting of a thin yellow circle on the left side, partially overlapping a horizontal bar. The bar has a light green-to-white gradient. A large black left square bracket is positioned on the left side of the bar, and a yellow right square bracket is on the right side. The title text is centered within the bar.

An Integrated QoS Control  
Architecture for IEEE 802.16  
Broadband Wireless Access Systems

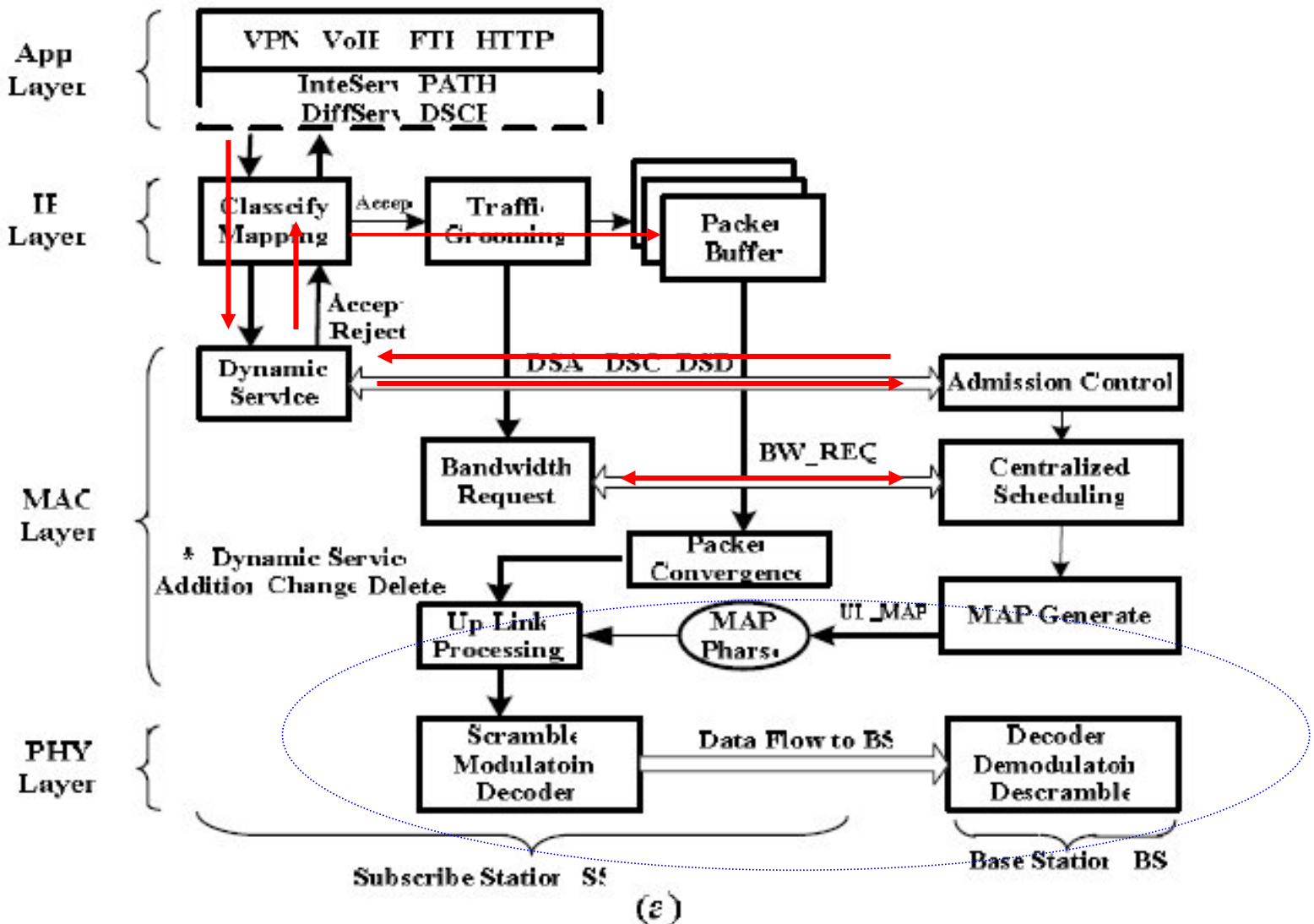
GLOBECOM 2005

Speaker: Jen-Chu Liu

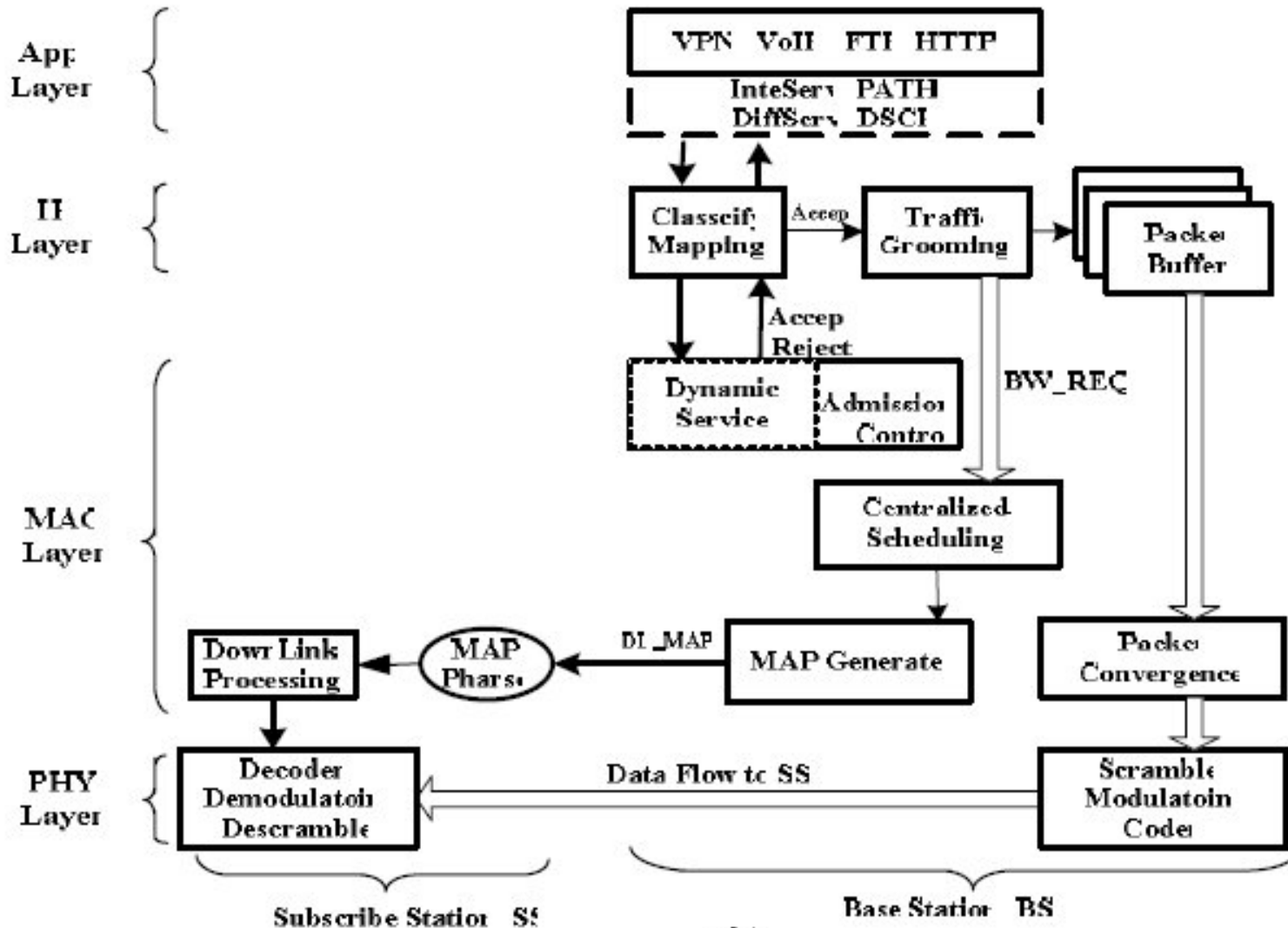
# Introductions

- This paper proposes a new integrated QoS architecture for IEEE 802.16-2004.
  - A multi-layer architecture
  - Guarantee different level QoS
  - Prioritize the traffic classes
  - Adjust resource allocation dynamically
  - Share resources fairly

# The Multi-layer Integrated QoS Control Architecture – Uplink Traffic



# The Multi-layer Integrated QoS Control Architecture – Downlink Traffic



# Traffic Classification and Mapping for IntServ Services

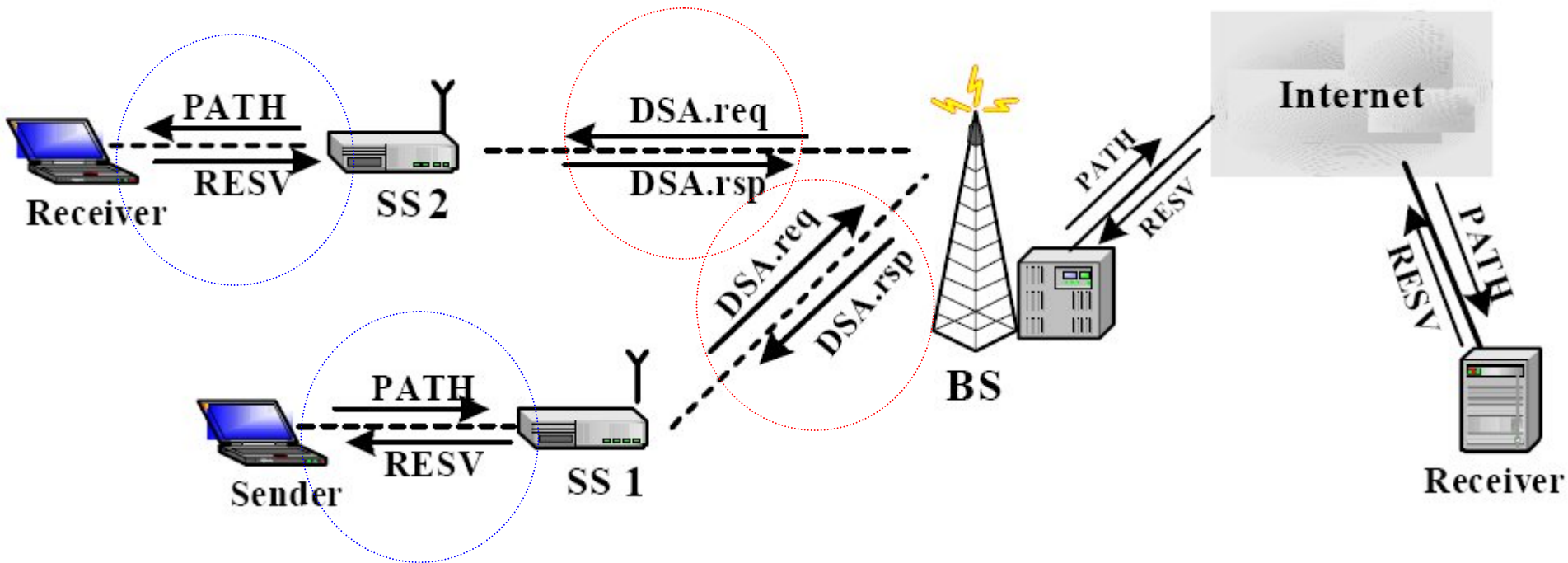


TABLE I. Mapping Rules for IntServ Services

Traffic Class	Bandwidth Requirements	Delay / Jitter / Loss Rate	MAC layer Services
<i>Hard QoS guarantee(eg. VPN tunnel, Leased line E1/T1)</i>	<i>Constant bandwidth</i>	<i>Minimum packet delay, jitter and loss rate</i>	Unsolicited Grant Service
<i>Soft QoS guarantee(eg. VoIP, VOD, digital TV, FTP, gaming.)</i>	<i>Guaranteed</i>	<i>Regular delay, jitter require</i>	Real-Time Polling Service
	<i>Not guaranteed</i>	<i>long delay, jitter require</i>	Non-Real-Time Polling Service
<i>Best effort (eg. HTTP)</i>	<i>Only basic connection</i>	<i>N/A</i>	Best Effort

TABLE II. Mapping Rules for DiffServ Services

Traffic Class	Service Description	DS Octet (DS5-3)	MAC layer Services
<i>Hard QoS guarantee(eg. VPN tunnel, Leased line E1/T1)</i>	<i>Critical</i>	<i>101</i>	Unsolicited Grant Service
<i>Soft QoS guarantee(eg. VoIP, VOD, digital TV, FTP, gaming.)</i>	<i>Flash, Immediate</i>	<i>100 / 011/010</i>	Real-Time Polling Service
	<i>Priority,</i>	<i>001</i>	Non-Real-Time Polling Service
<i>Best effort (eg. HTTP)</i>	<i>Runtime</i>	<i>000</i>	Best Effort

## Differentiated Services Code Point

ToS	P2	P1	P0	T3	T2	T1	T0	Zero
DS Octet	DS5	DS4	DS3	DS2	DS1	DS0	ECN1	ECN0
	(Class Selector)			(Drop Precedence)				

# Hierarchical Structure of Bandwidth Allocation (for BS)

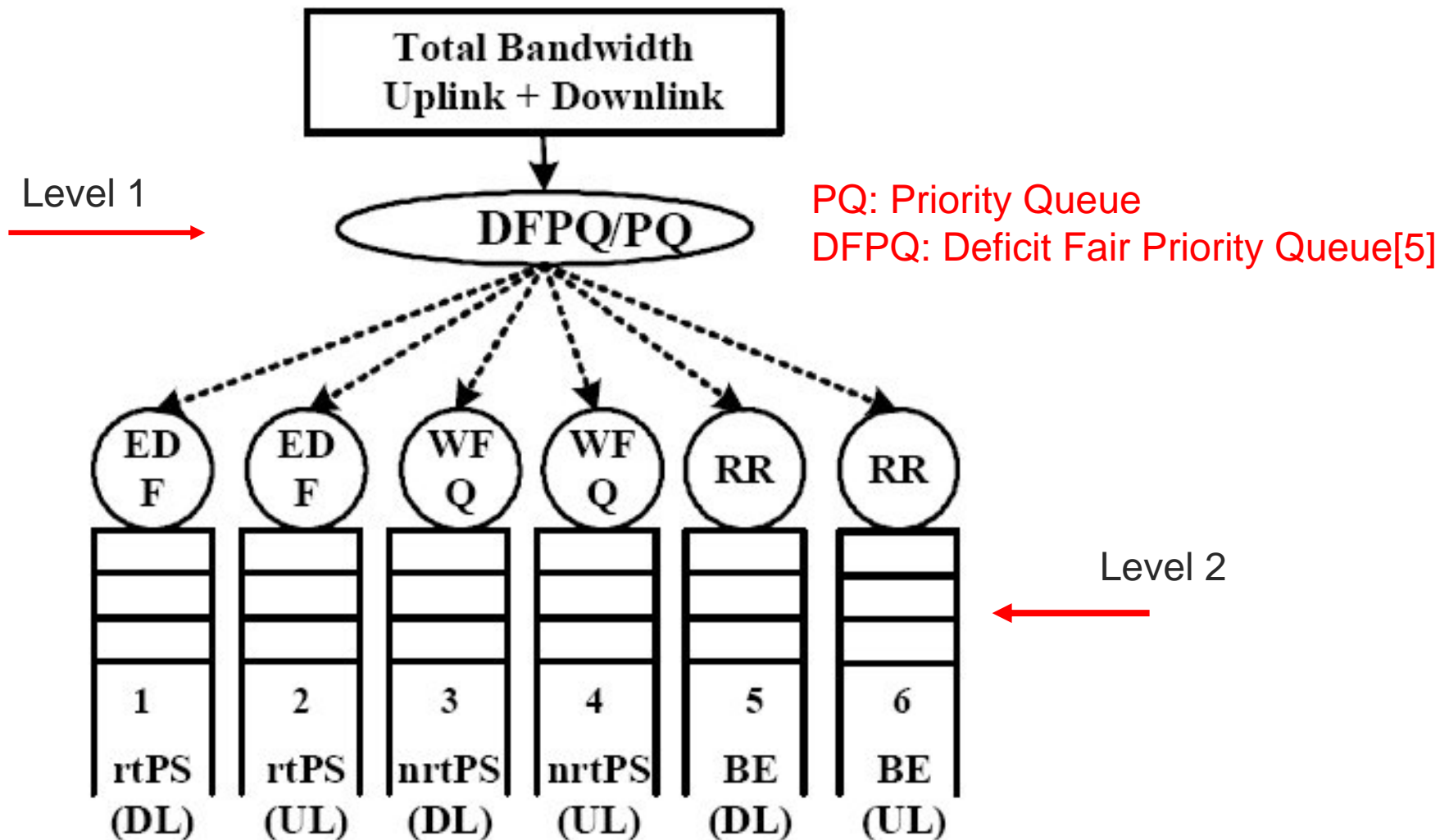


TABLE III Traditional way of RSVP

SS		BS	
1: Received PATH Check if resource are available Update the state, Send PATH	PATH →	2: Received PATH Check whether IP QoS are available;Update the state Transfer PATH to next hop	
4: Received RESV Reserve Resource Map QoS from IP MAC Send DSA-REQ	←RESV	3: Received RESV Reserve Resource of IP QoS Transfer RESV	
6:Received DSA-RSP Transfer RESV to previous hop	DSA-REQ →	5: Received DSA-REQ MAC Admission Control Send DSA-RSP	
	←DSA-RSP		

TABLE IV Proposed way of RSVP

SS	BS	
1: Received PATH Check if resource are available MAC layer QoS mechanism Map PATH to MAC QoS Send DSA-REQ	DSA-REQ →	2: Received DSA-REQ MAC Admission Control Send DSA-REQ to next hop
4:Received DSA-RSP Map DSA-RSP to RESV RESV received by IP Layer Transfer RESV to previous hop	DSA-RSP←	3: Received DSA-REQ from the next hop MAC Admission Control Send DSA-RSP





# Simulation Results

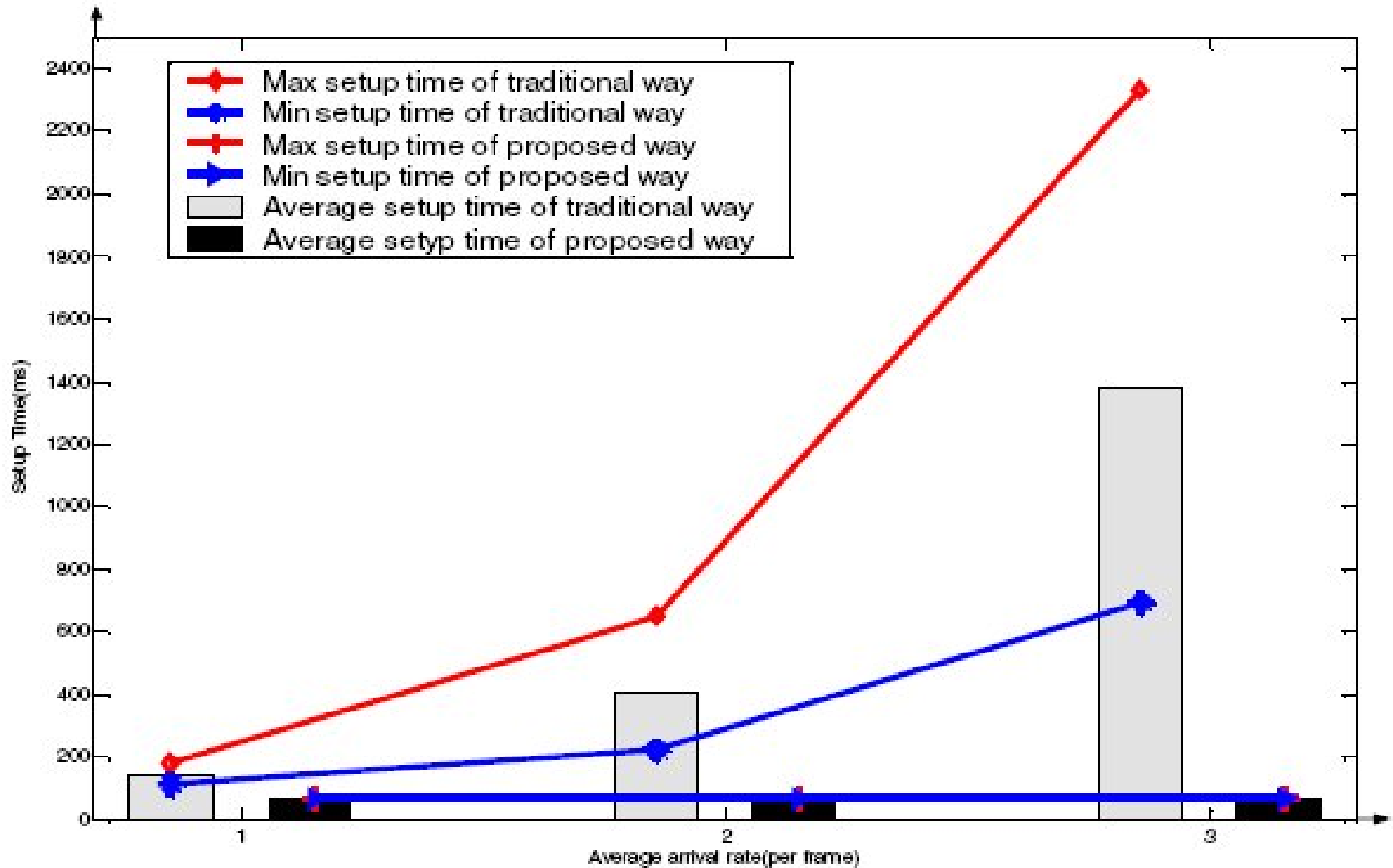
TABLE V MAC Layer Overhead

PATH message		RESV message	
$\Delta_{M\_Send} = 10\text{ms}$	$\Delta_{M\_P} = 10\text{ms}$	$\Delta_{M\_R} = 20\text{ms}$	$\Delta_{M\_Rec} = 20\text{ms}$

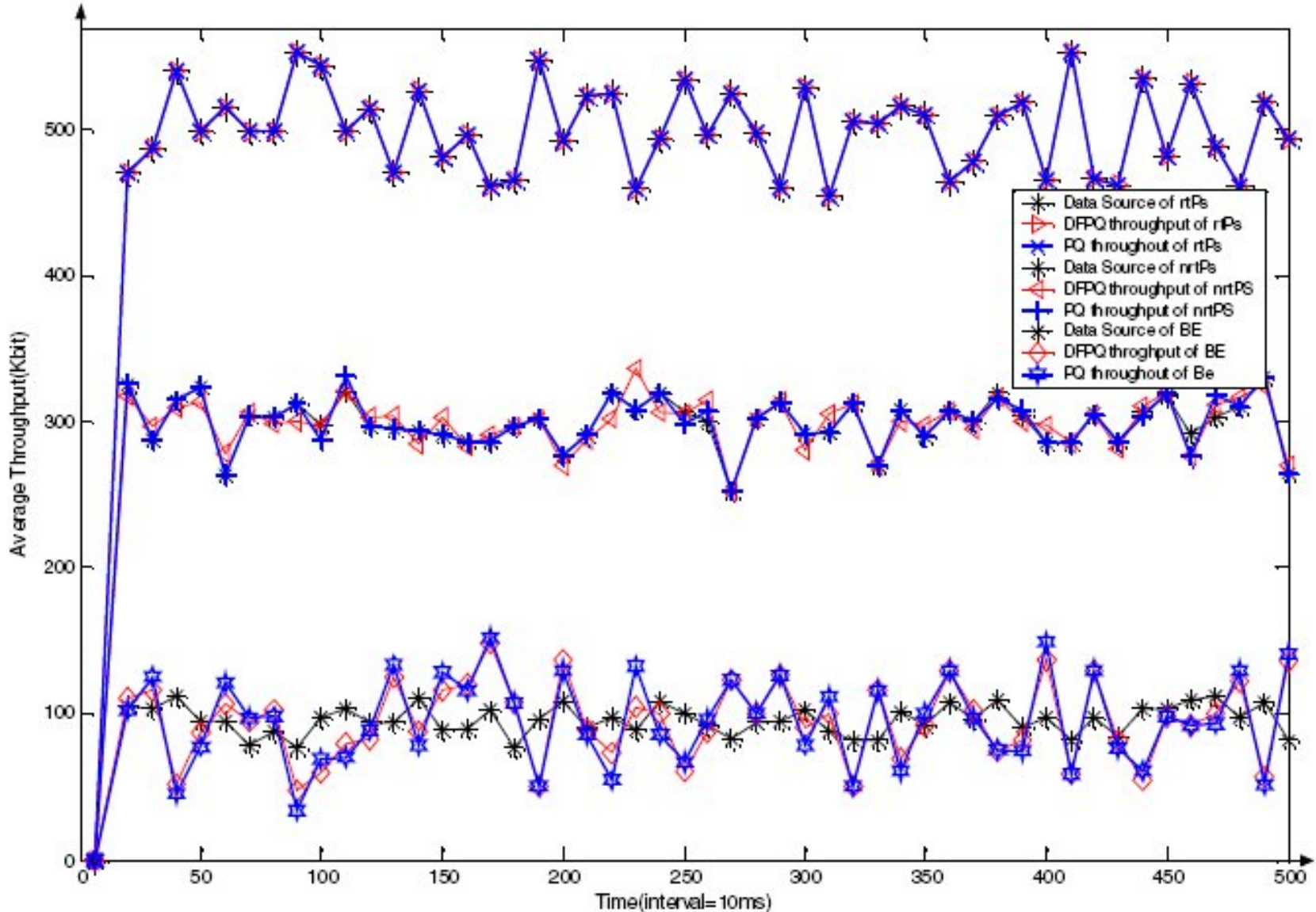
TABLE VI Input Service Flow

Service Type	Mapped Type	CID	Average Bandwidth (Kbit)	Max. Delay (ms)	Max.sustained traffic rate (Kbit)	Min.reserved rate (Kbit)
VoIP	DL_rtPS	1	10	60	12	8
		2	10	40	12	8
		3	10	20	12	8
VoIP	UL_rtPS	4	7	70	8.4	5.6
		5	7	50	8.4	5.6
		6	6	30	7.2	4.8
FTP	DL_nrtPS	7	6	100	6	4
		8	6	100	5	4
		9	6	100	5	4
FTP	UL_nrtPS	10	4	100	6	4
		11	4	100	5	4
		12	4	100	5	4
HTTP	DL_BE	13	2	240	-	1.6
		14	2	240	-	1.6
		15	2	240	-	1.6
HTTP	UL_BE	16	2	300	-	1.6
		17	1	300	-	0.8
		18	1	300	-	0.8

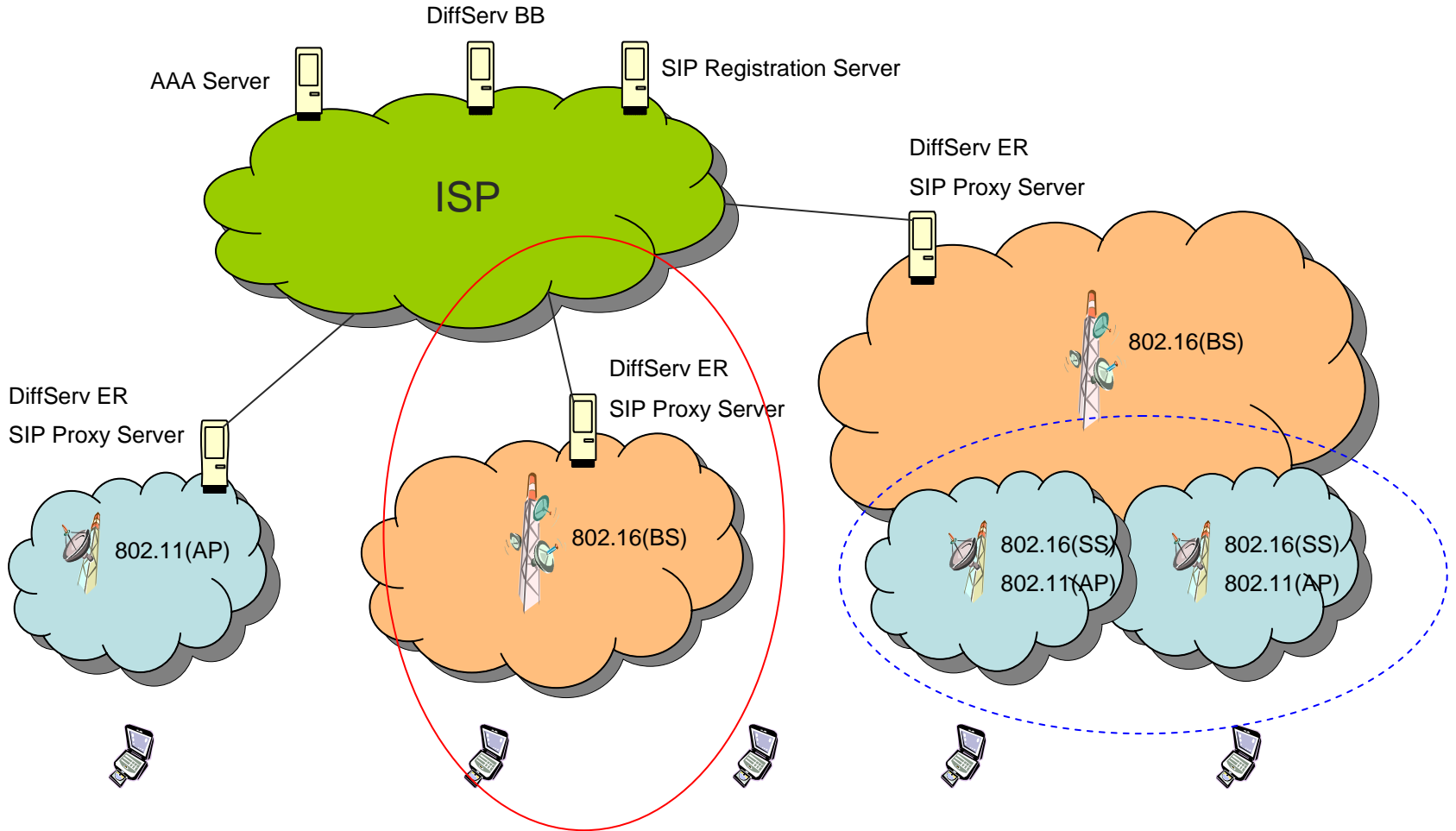
# Setup Time vs. Arrival rate



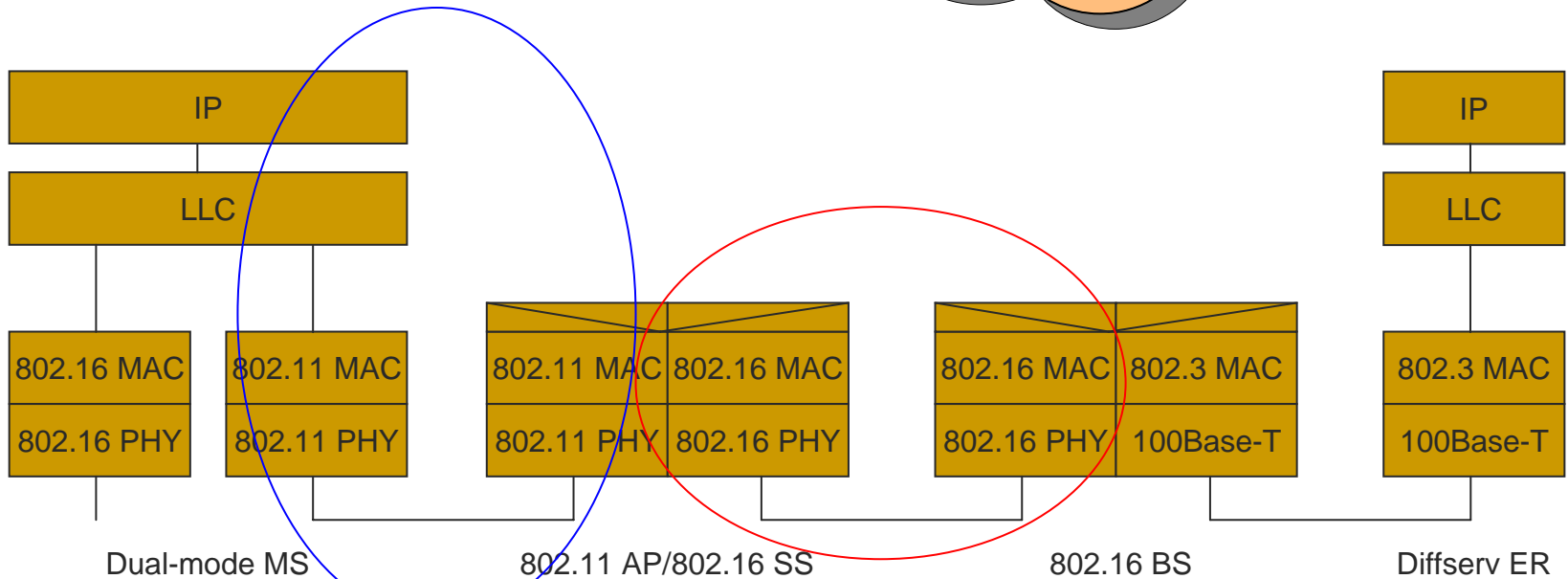
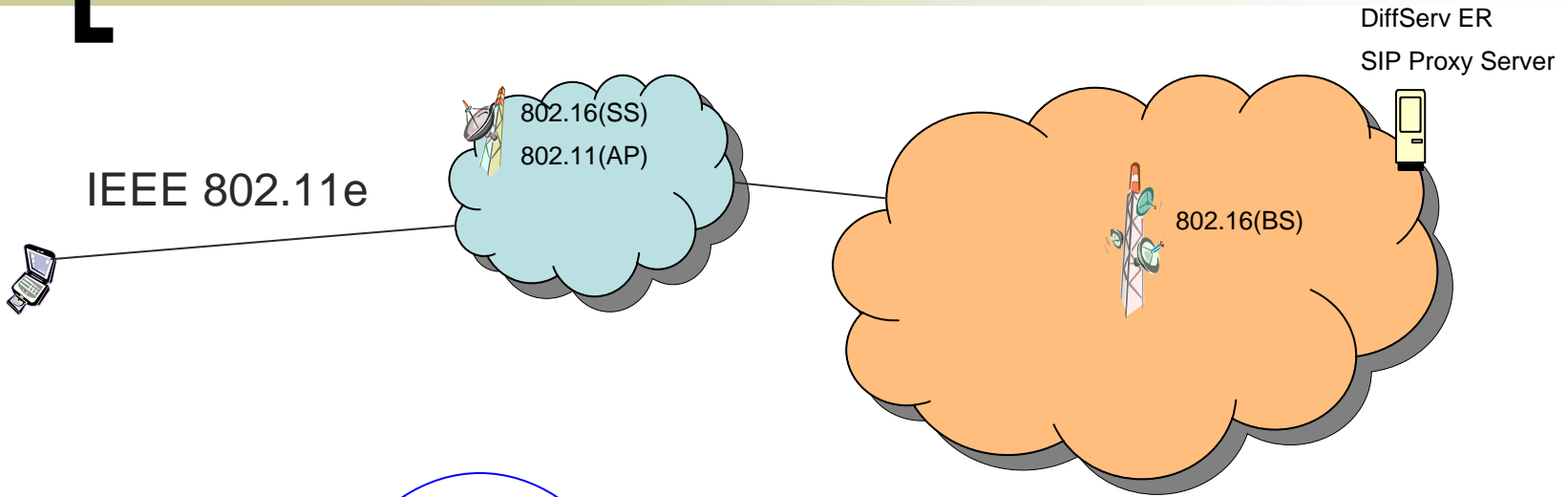
# Input Service Flow vs. Service Curve



# Discussions



# Discussions



# [ Summaries ]

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- This paper proposed an architecture to provide multi-layer QoS control for IEEE 802.16-2004.
- Both IntServ and DiffServ are supported.