

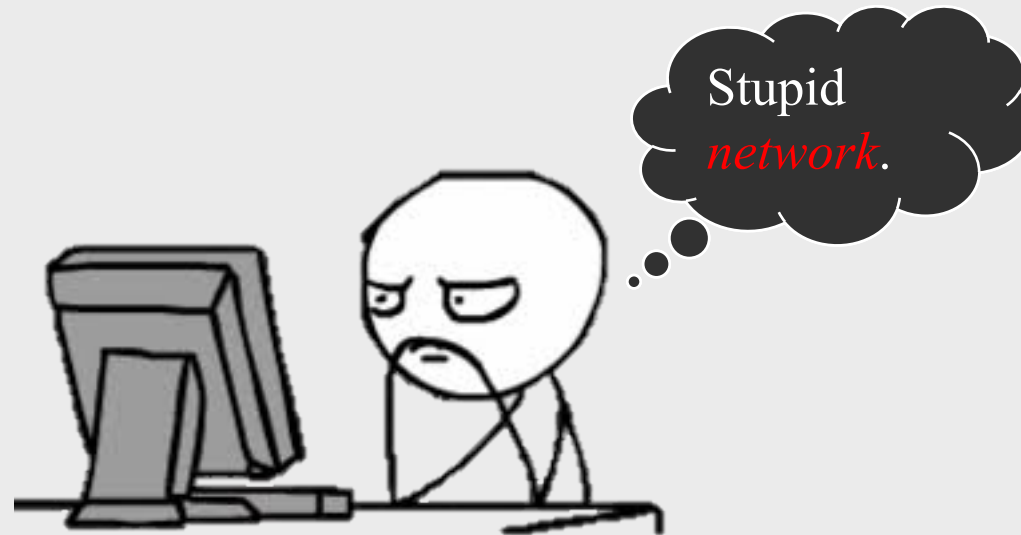
# Network Performance and ChoiceNet

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Ken Calvert, Jim Griffioen (U Kentucky)  
*Rudra Dutta*, George Rouskas (NCSU)  
Ilya Baldine (UNC-CH)



# Performance Woes

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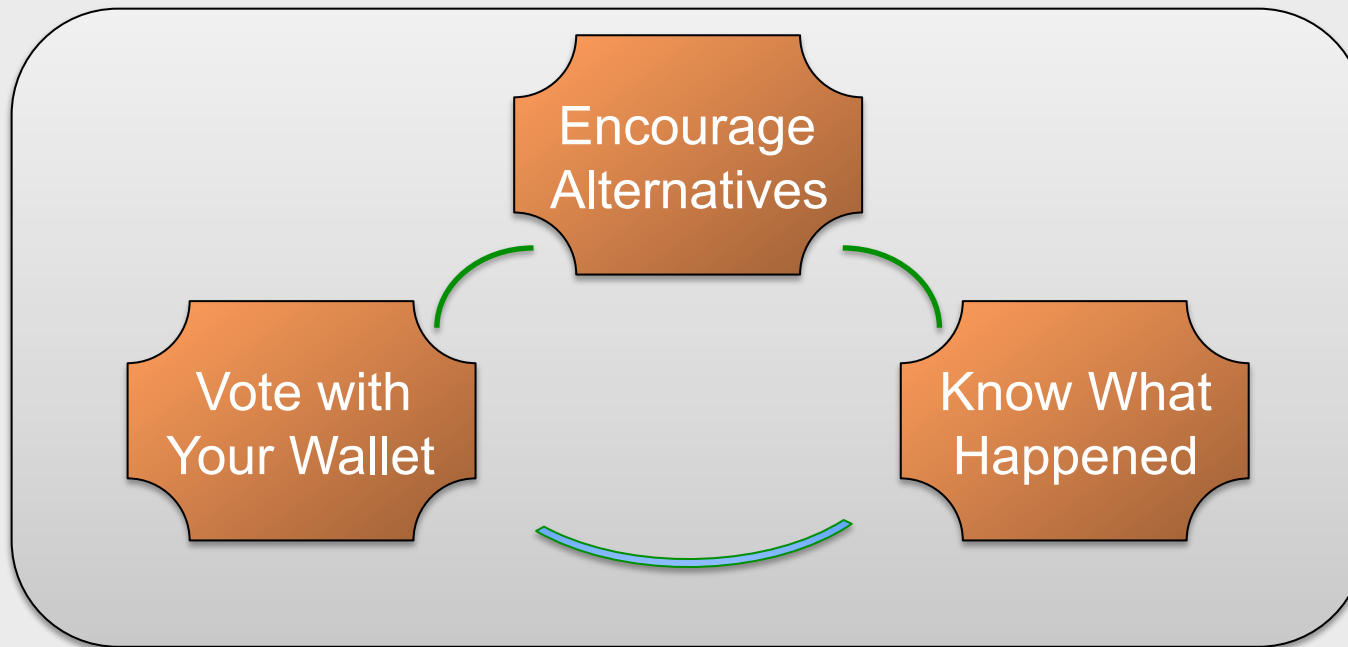


- Informed exercise of choice (backed by money) can reward providers with good performance
- Select for helpful providers, beneficial ecosystem



# Architectural Need

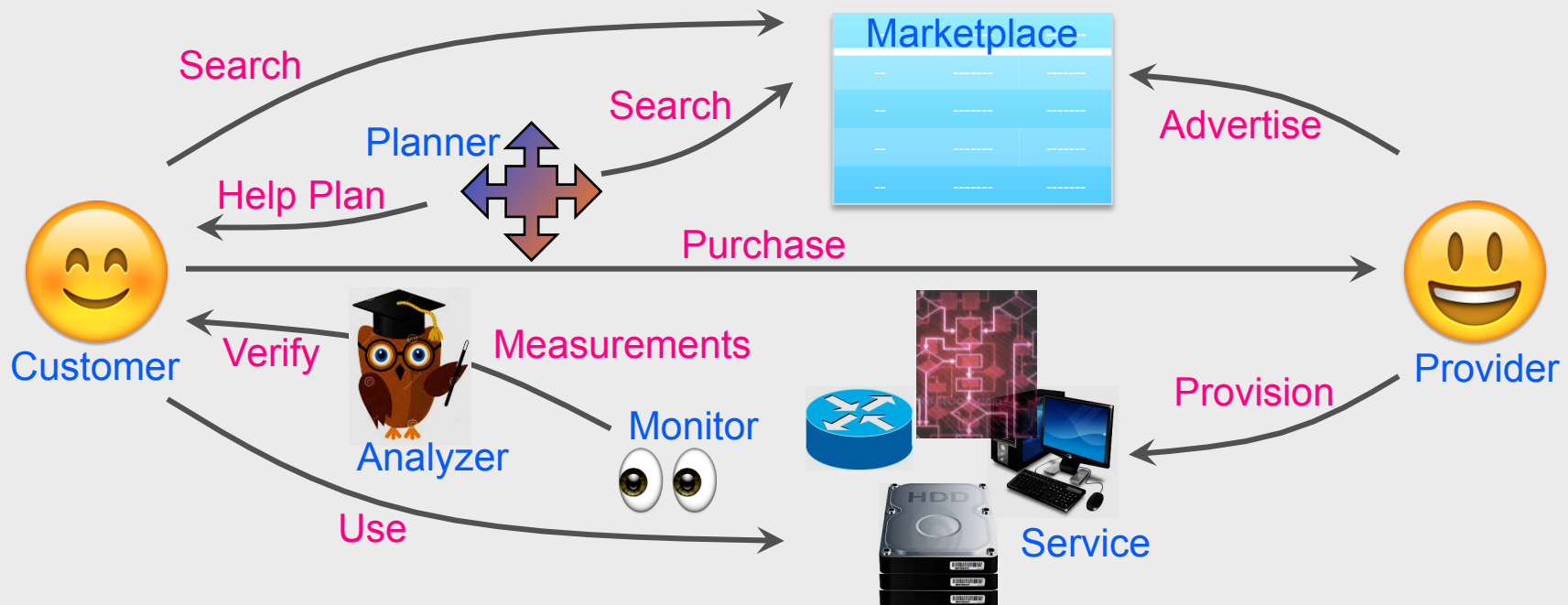
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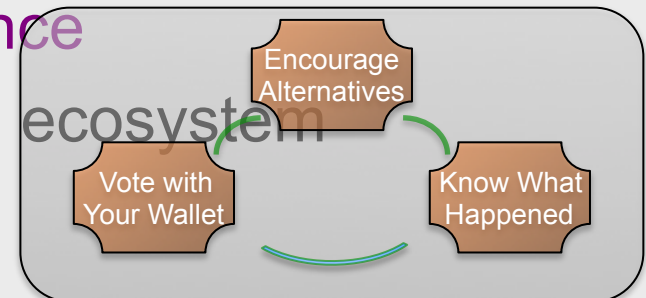
- Informed exercise of choice (backed by money) can reward providers with good performance
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# Entities and Interactions

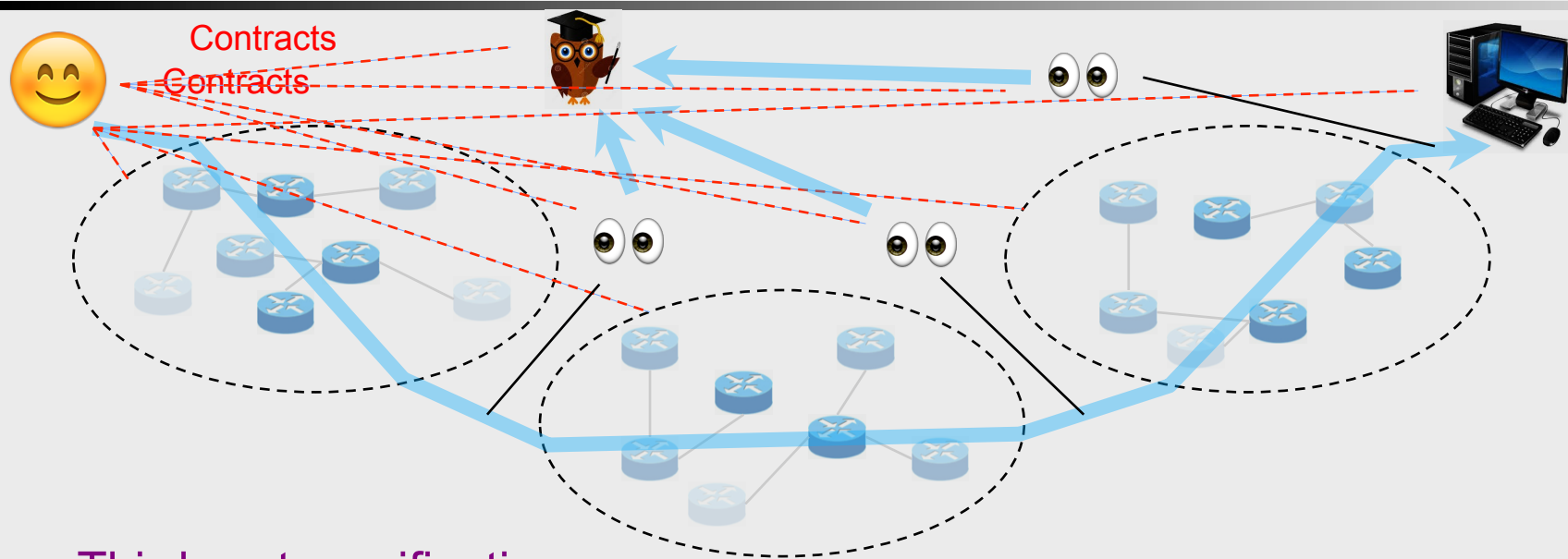


- Informed exercise of choice (backed by money) can reward providers with good performance
- Select for helpful providers, beneficial ecosystem





# A Verification Case Study

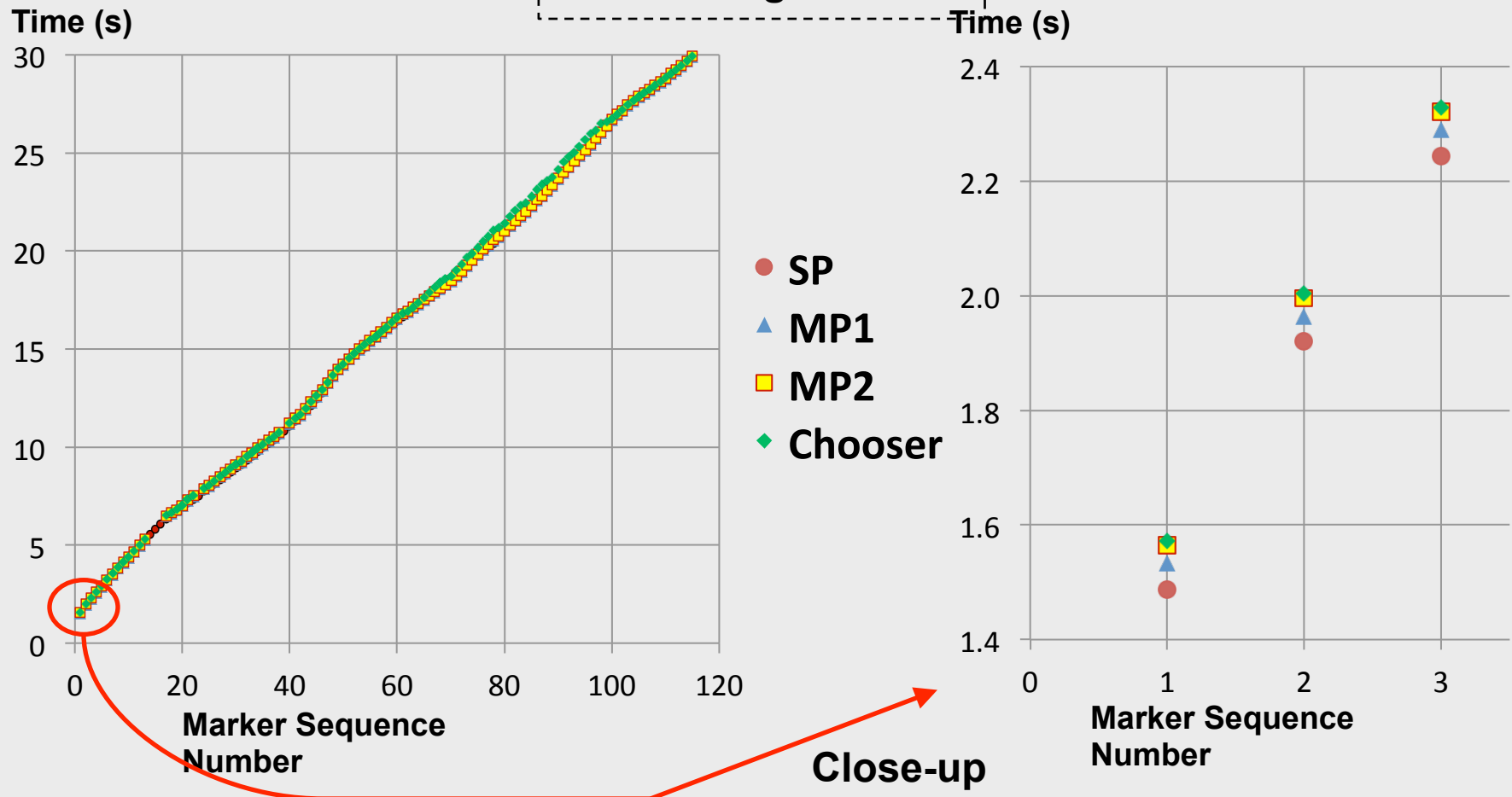


- Third-party verification
- A possible measurement service: timestamp marker packets
  - Packets recognized by flow, and shim header inserted by companion code at source
  - Can be split off, not necessarily in-flight at wire-speed
- “A verification service architecture for the future internet”, A C Babaoglu, R Dutta, ICCCN 2013
- GENI and NS-3 prototypes



# Jitter Apportionment for Video UX

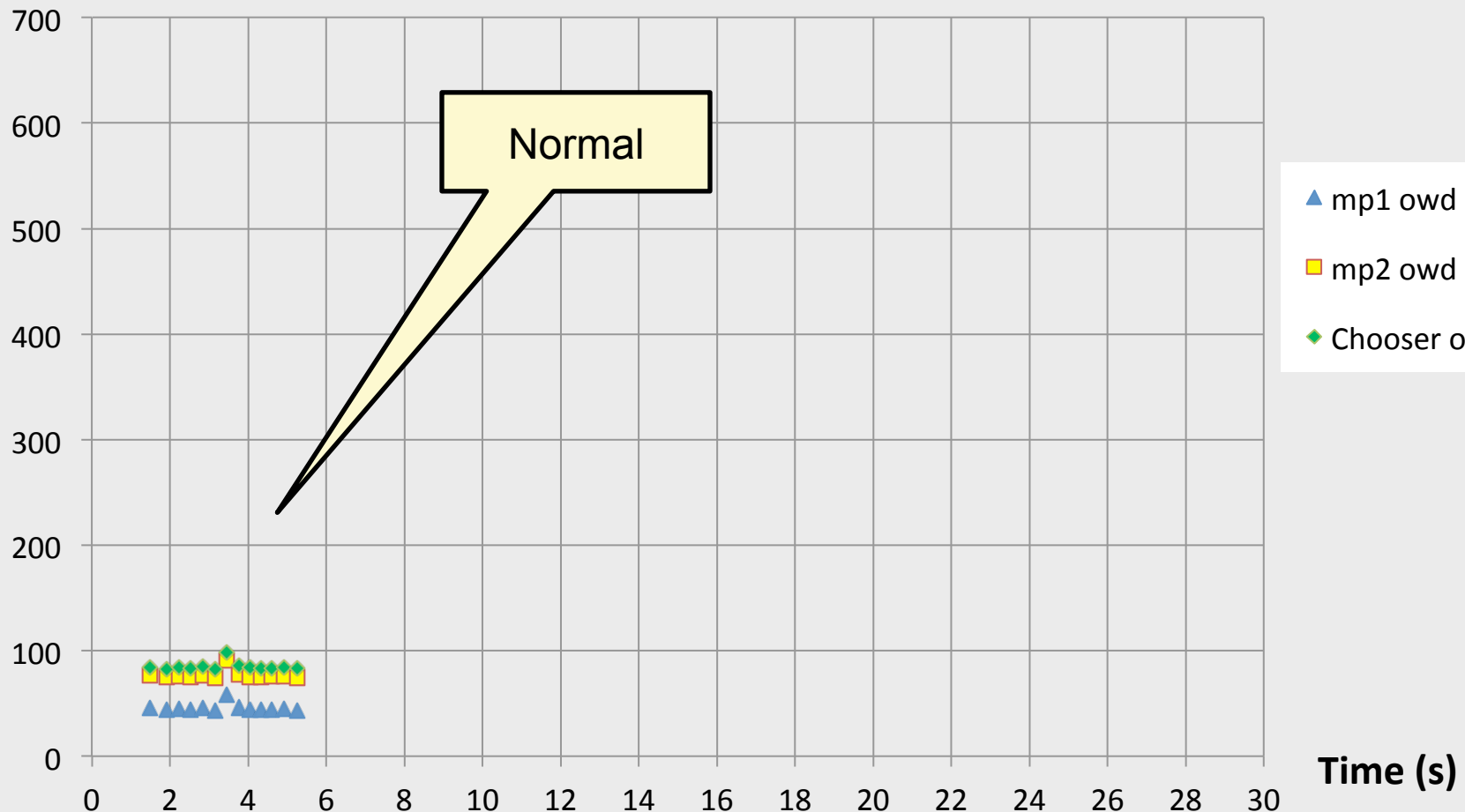
Raw MD Figures





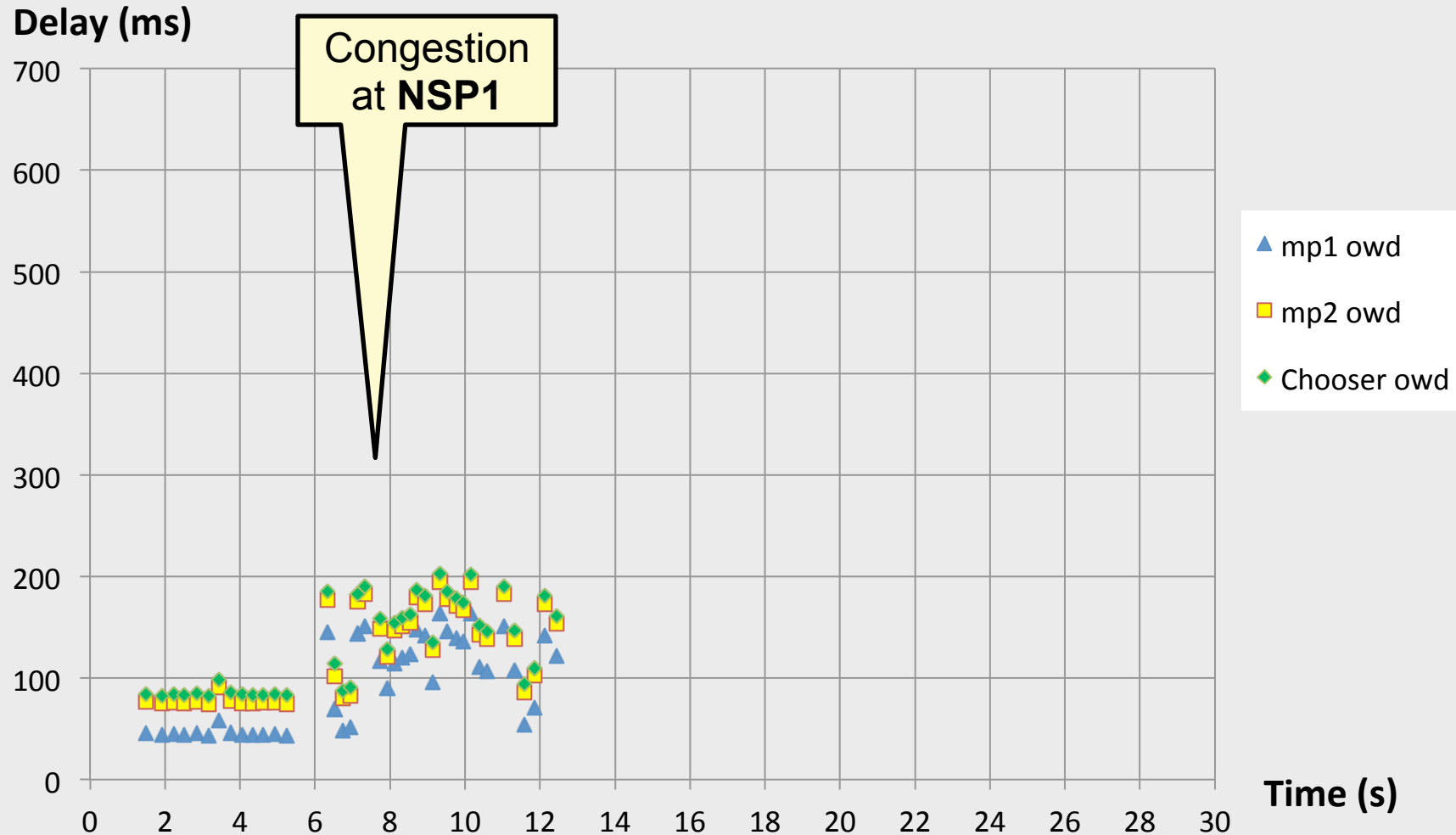
# Jitter Apportionment for Video UX

Delay (ms)





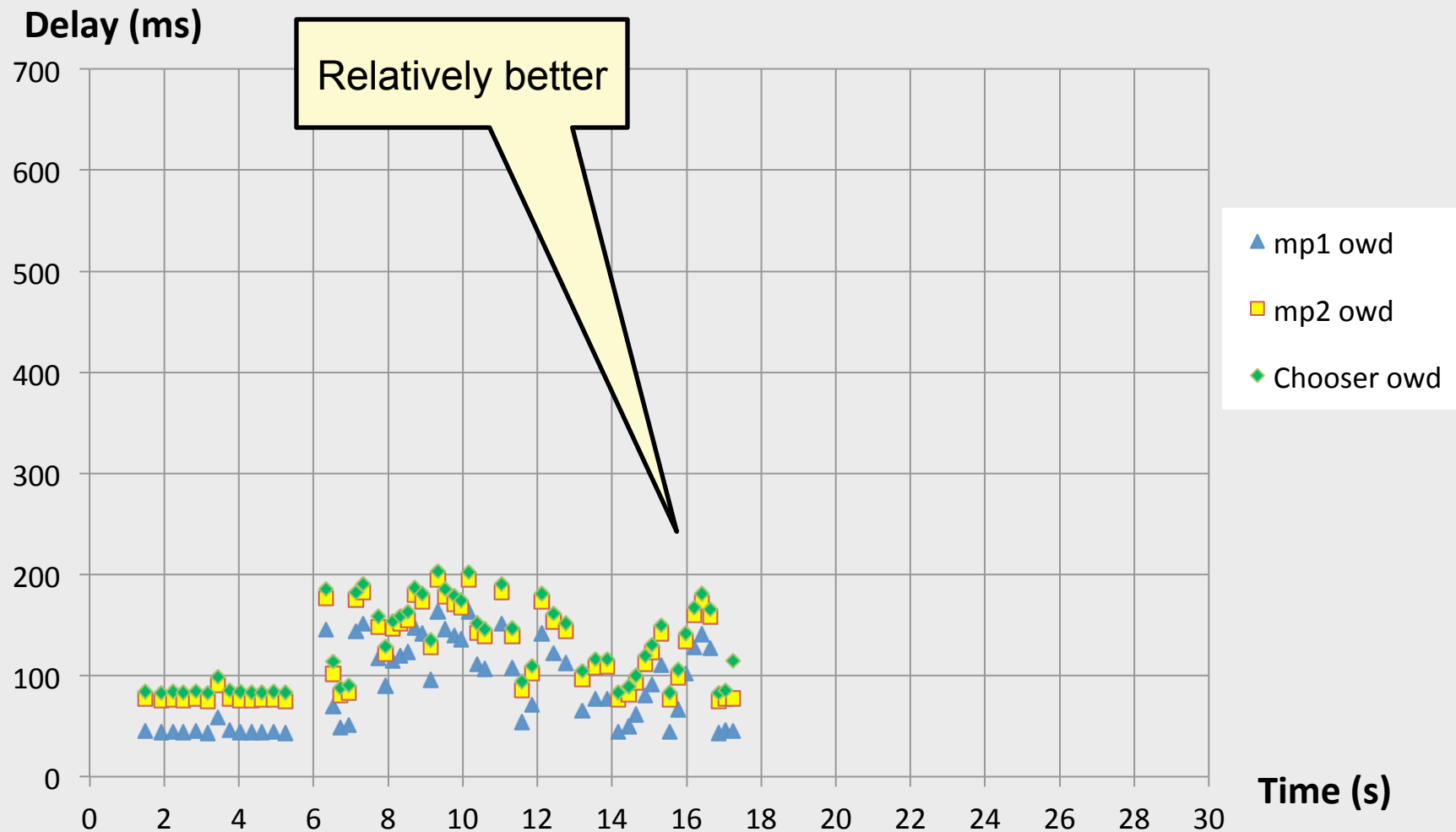
# Jitter Apportionment for Video UX





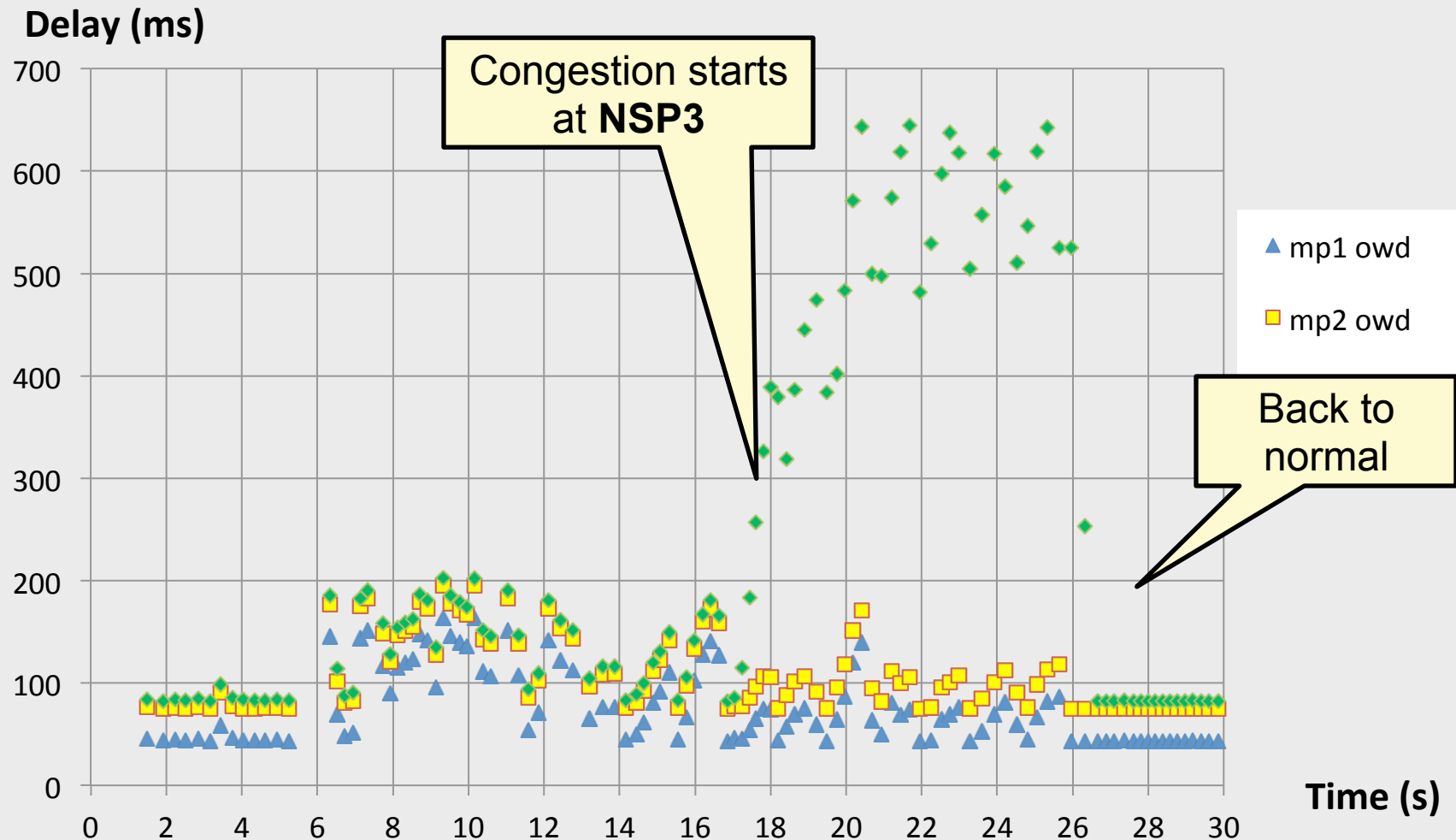


# Jitter Apportionment for Video UX



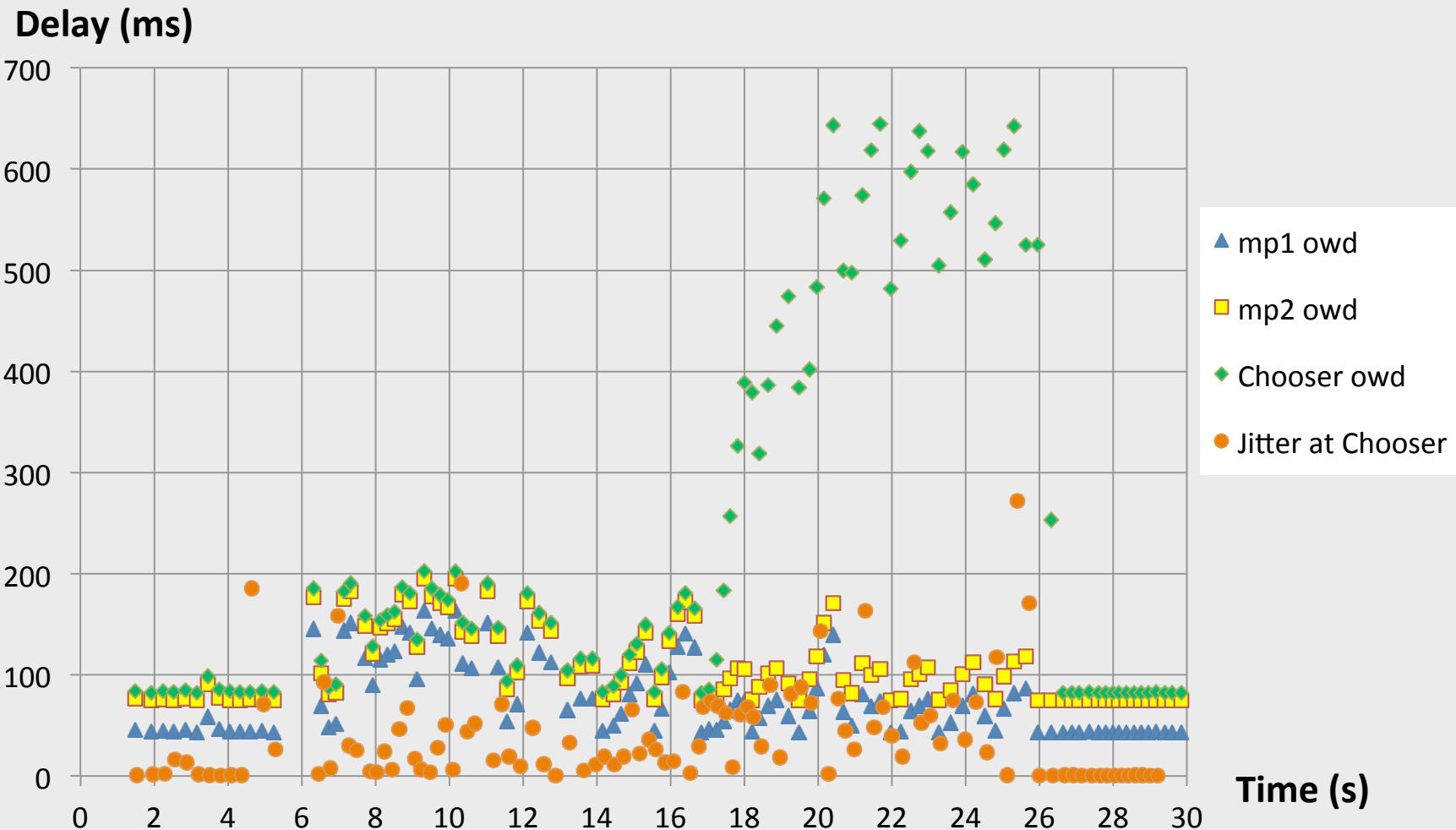


# Jitter Apportionment for Video UX



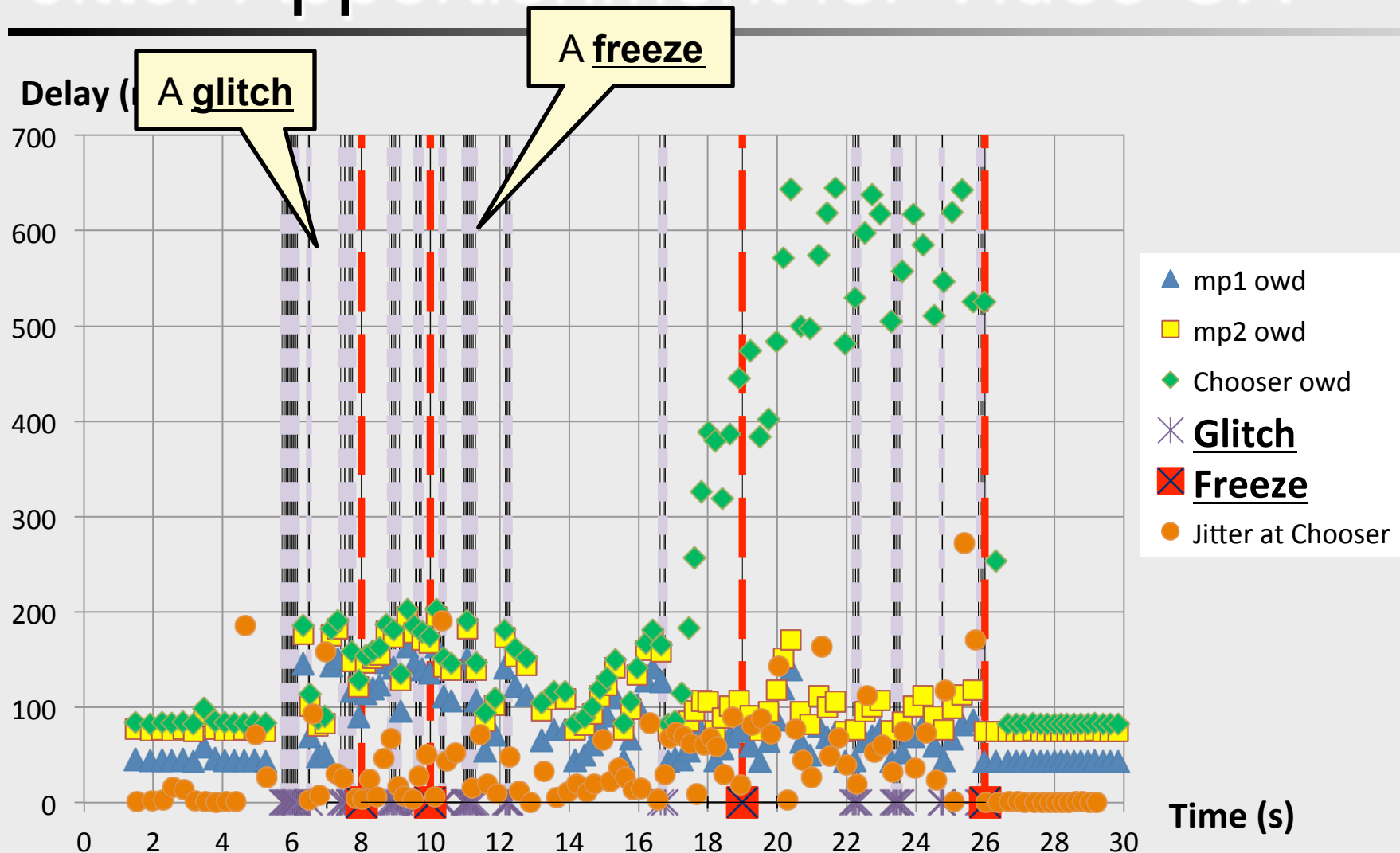


# Jitter Apportionment for Video UX





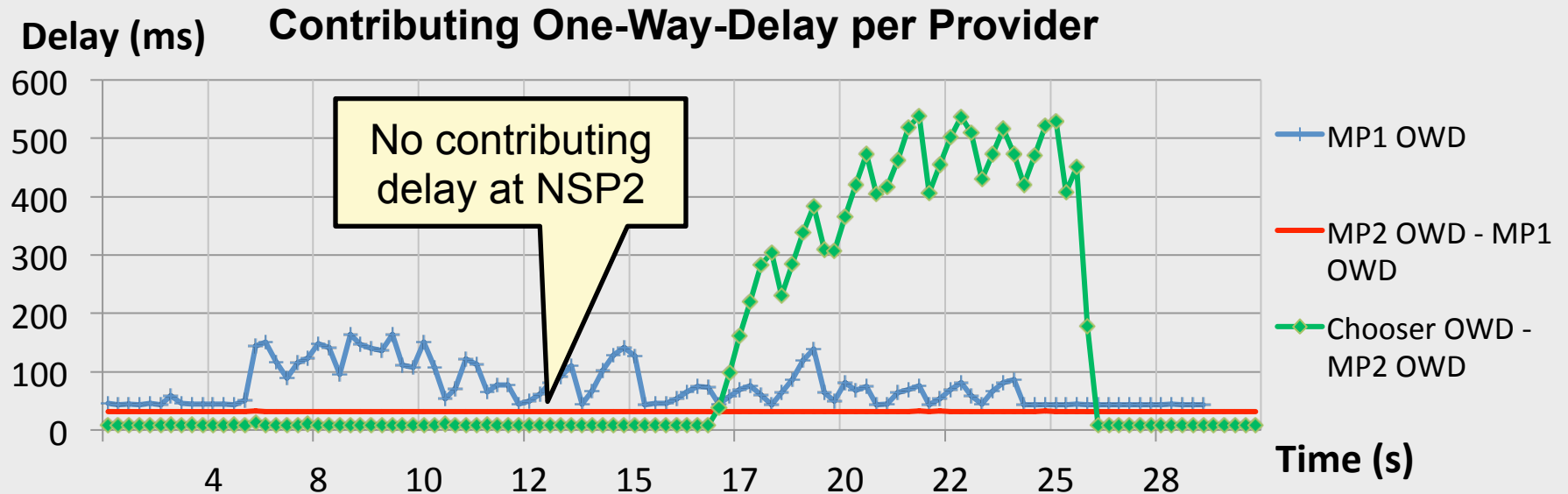
# Jitter Apportionment for Video UX



**Glitches** denote the losses and **Freezes** denote video playback freezes

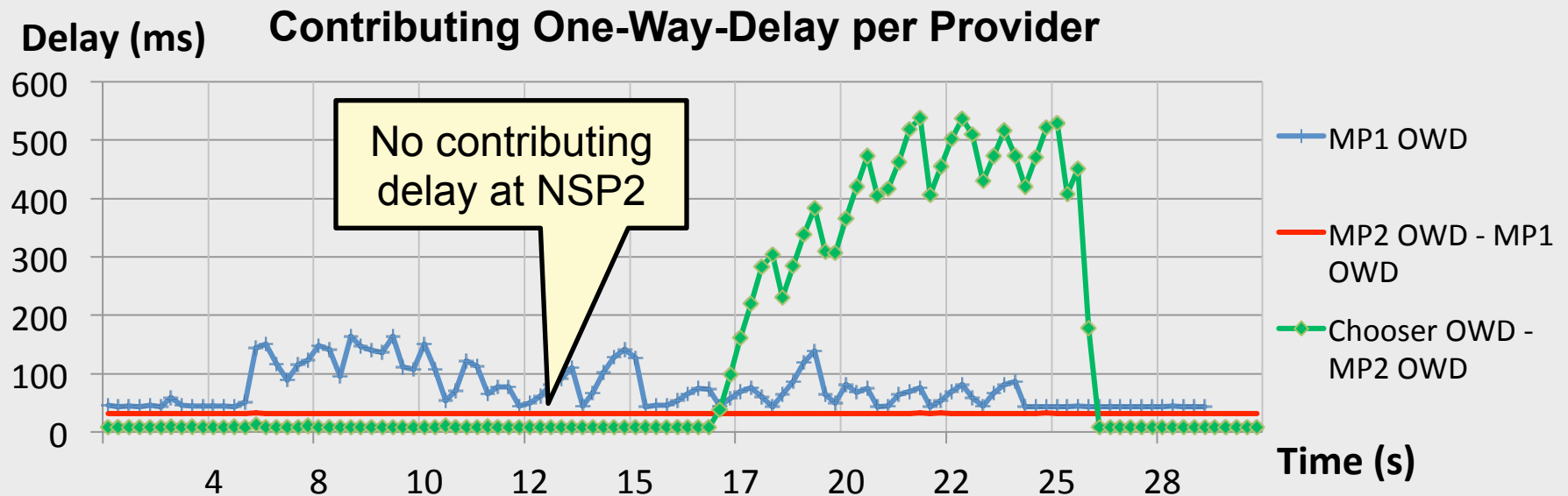


# Jitter Apportionment for Video UX





# Jitter Apportionment for Video UX



## Basic Analysis Results

Provider	Mean Jitter %	Std. Dev. Jitter %	Max Jitter %
NSP1	44.6 %	32.8 %	25.3 %
NSP2	0.2 %	0.3 %	0.2 %
NSP3	55.2 %	66.9 %	74.5 %



# Jitter Apportionment for Video UX

## Analysis for freeze 1 [t=6 and t=10]

	Mean %	Std dev %	Max J %
NSP1	<b>96.7 %</b>	<b>93.8 %</b>	<b>94.7 %</b>
NSP2	0.2 %	0.6 %	0.2 %
NSP3	3.1 %	5.6 %	5.1 %

## Analysis for freeze 2 [t=8 and t=12]

	Mean %	Std dev %	Max J %
NSP1	<b>98.5 %</b>	<b>97.2 %</b>	<b>97.2 %</b>
NSP2	0.0 %	0.0 %	0.0 %
NSP3	1.5 %	2.8 %	2.8 %

Delay (ms)

250

200

150

100

50

0

Freeze 1 is at  
t=8s

Freeze 2  
is  
at t=10s

- ▲ mp1 owd
- mp2 owd
- ◆ Chooser owd
- ✱ Glitch
- ❏ Freeze
- Jitter at Chooser

5

7

9

11

Time (s)



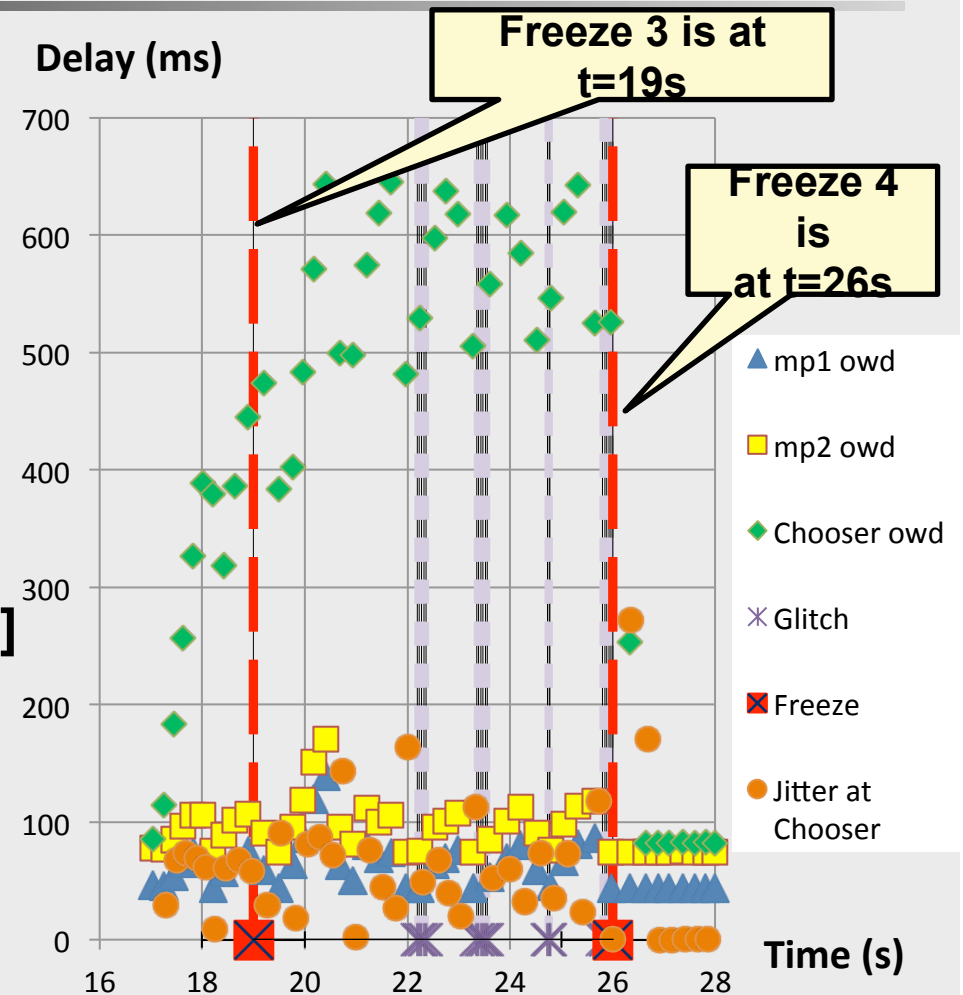
# Jitter Apportionment for Video UX

## Analysis for freeze 3 [t=17 and t=21]

	Mean %	Std dev %	Max J %
NSP1	27.7 %	42.2 %	50.2 %
NSP2	0.2 %	0.4 %	0.3 %
NSP3	72.1 %	57.4 %	49.5 %

## Analysis for freeze 4 [t=24 and t=28]

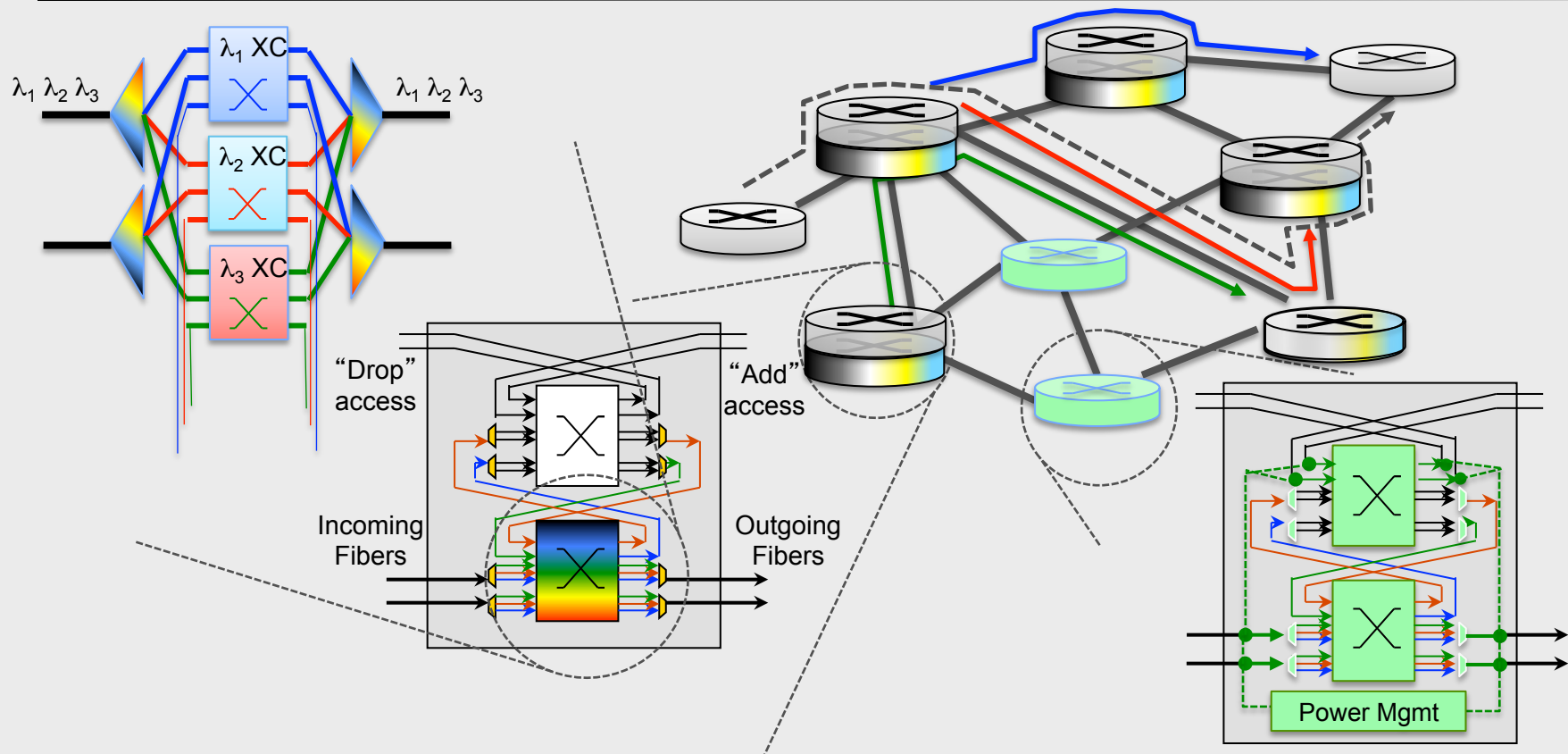
	Mean %	Std dev %	Max J %
NSP1	14.0 %	13.8 %	13.6 %
NSP2	0.2 %	0.2 %	0.2 %
NSP3	85.8 %	86.0 %	86.2 %







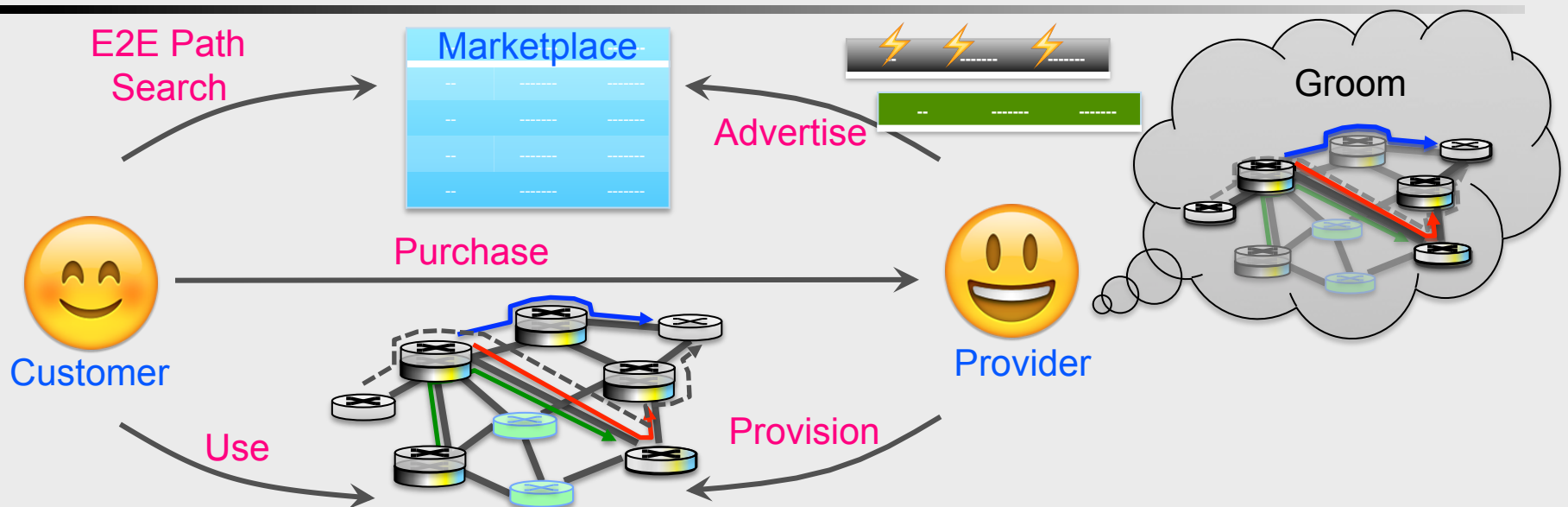
# Customizing Performance



- Does providing choice affect the provider's performance ?
- Impact of choice on provider-side utilization? Hurt? Help?
- Traffic grooming for various network-wide objectives



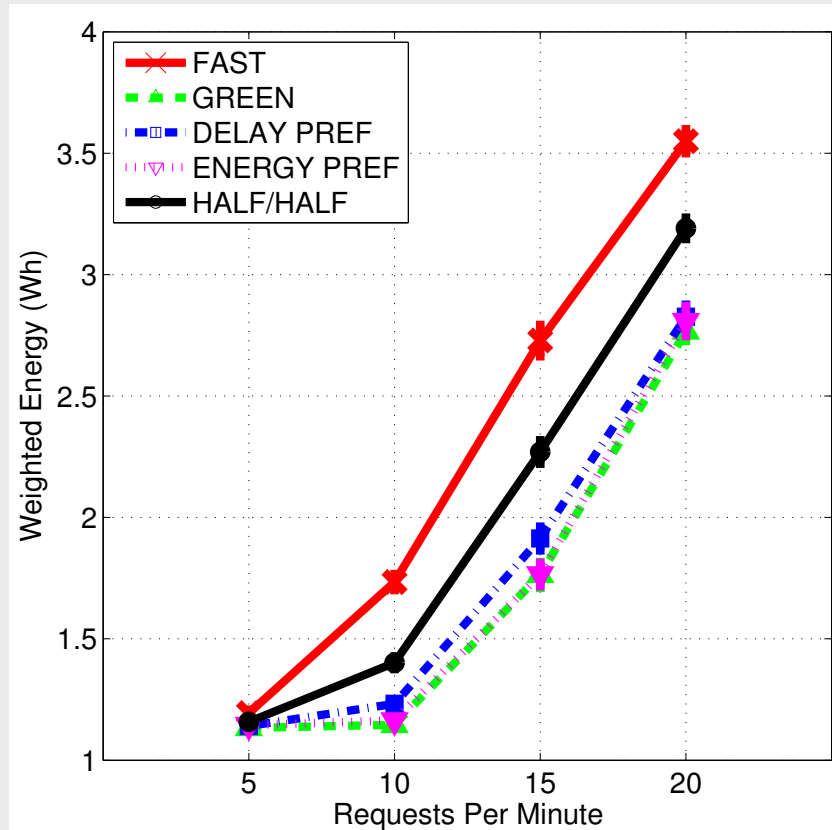
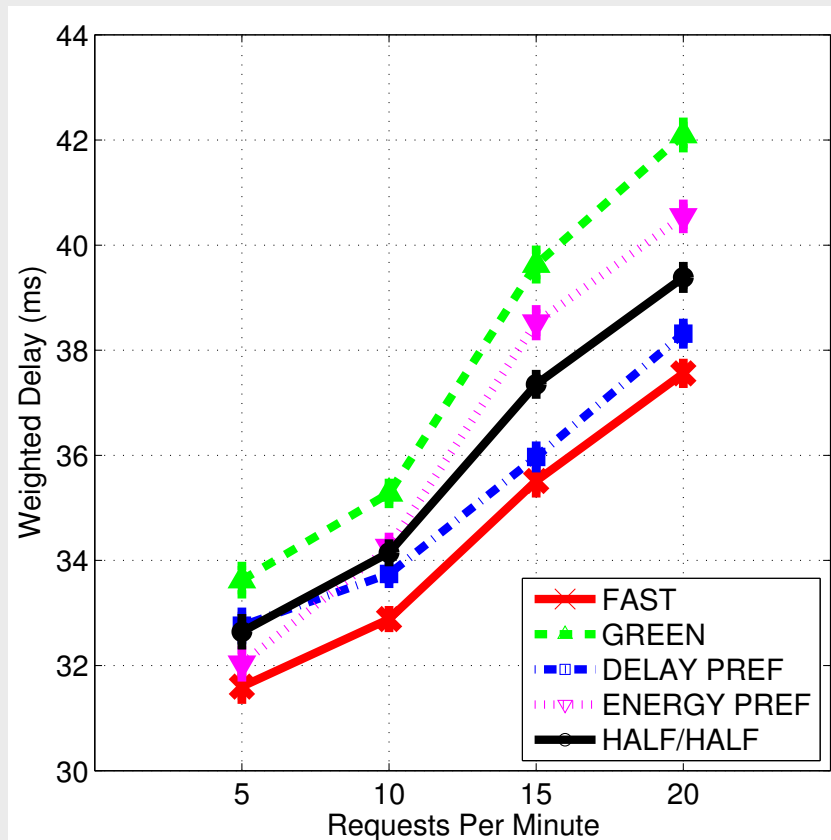
# Providing Choice



- Provider provides two alternatives for every (potential) connection request: FAST (least delay); GREEN (least power)
- Customer strategies
  - FAST, GREEN, DELAY-PREF, ENERGY-PREF, HALF
- Simulations on NSFNET, USNET
- A C Babaoglu, S Huang, R Dutta

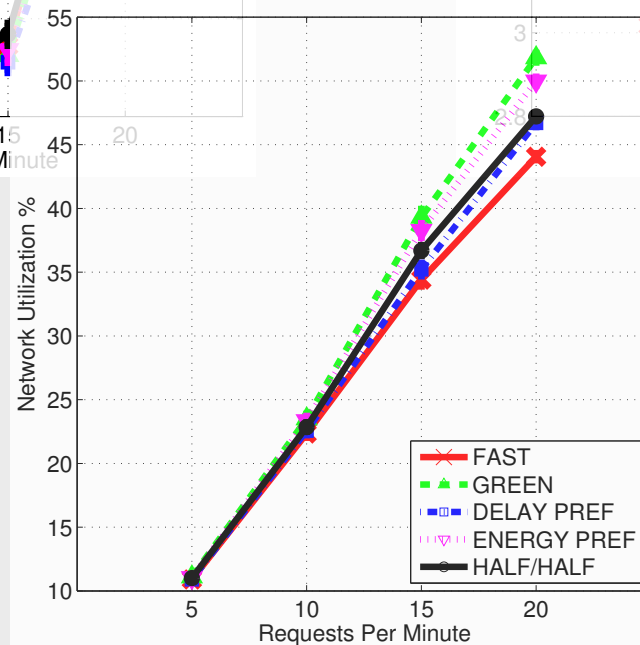
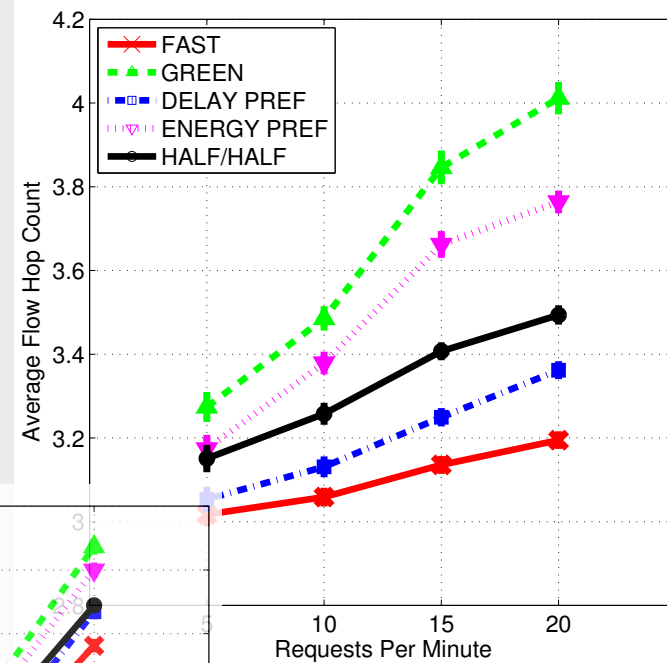
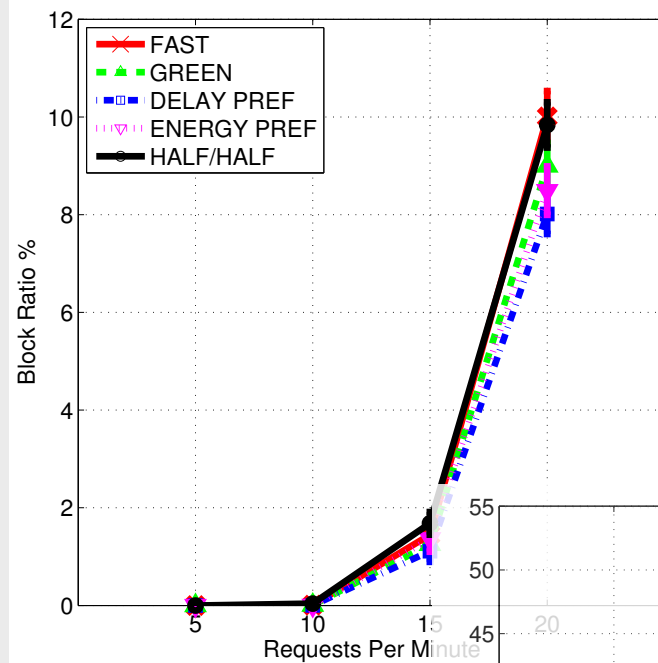


# The Impact of Choice



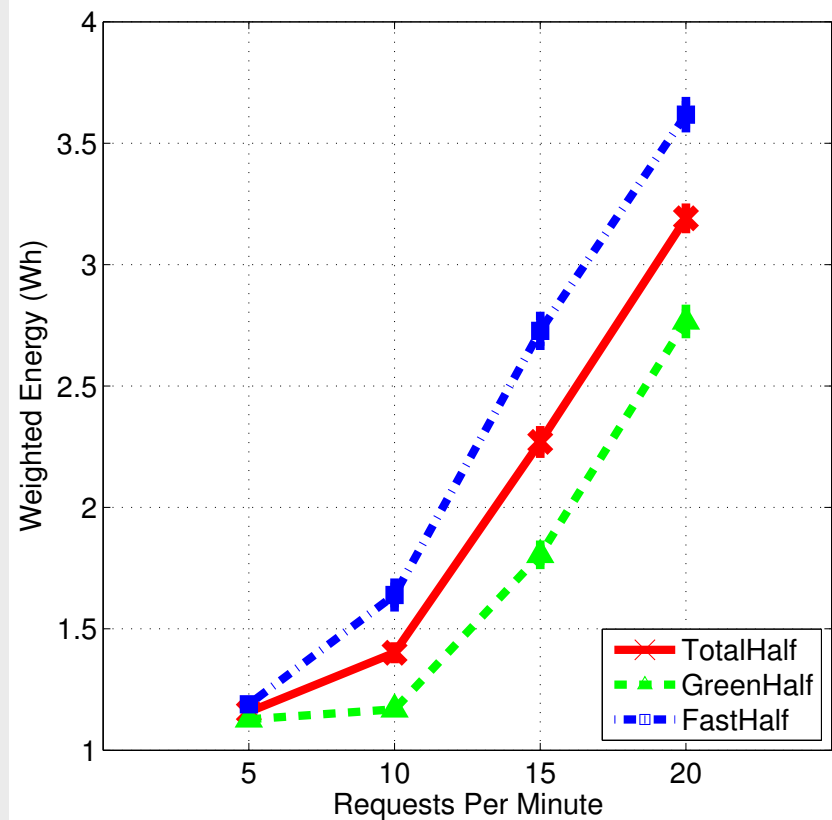
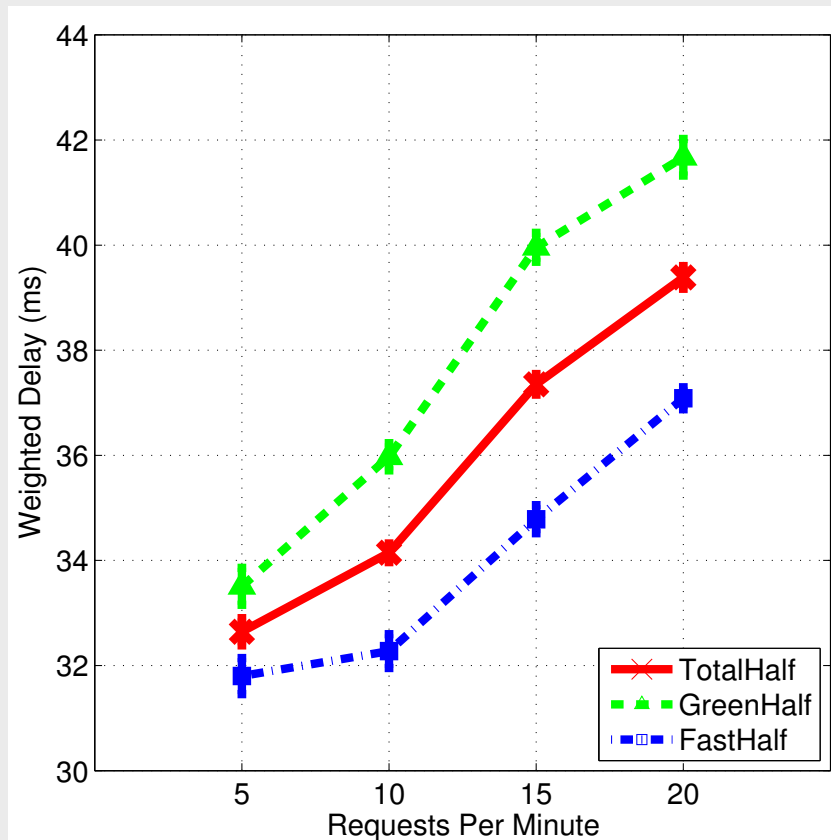


# The Impact of Choice





# The Impact of Choice





# Summation

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- Role of choice in performance
  - Architecture can encourage/nurture diversity and transparency in network entity ecosystems
  - Healthy ecosystem can achieve networking solutions
  - Lower entry barrier, encourage new (small) providers of innovative services, not just replacements of existing ones
  - Money (rather “consideration”) only to back up choice
- Left out:
  - Marketplace advertisement semantics
  - Automated planning (“composition”)
  - Economy plane performance
  - Trust, identity, authorization, authentication
  - Equilibrium and evolution of economic ecosystem
  - ...



# Architectural Problems

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- Architectural entities provide natural “roles” for players in distributed multi-owner systems
  - Interfaces provide natural “cut-points”
  - Allows eco-system to form, evolve, respond
- Architectural problem considerations
  - Are there missing entities? Redundant entities?
  - Are the entity separations “natural” (is there good motivation for each “role”)?
  - Are there under-defined / over-defined interactions?
- ChoiceNet: explicit architectural entities/interactions for choice, economy