CSE590 Evalulations Information Page

Implementation Link
https://github.com/dailinsubjam/Themis-code
https://github.com/HeenaNagda/Order-Fairness
https://github.com/hot-stuff/libhotstuff
https://github.com/Pompe-org/Pompe-HS
https://github.com/siddhantsharma301/narwhal-fino

# **Protocols**

Protocol	Transaction Ordering	Comm. Complexity	Liveness	Censorship Resistance	Corruption
Themis	γ-batch order-fairness	O(n²)	Standard	Yes	$n > \frac{4f}{2\gamma - 1}$
Rashnu	Data-dependent order-fairness	O(n)	Standard	Yes	$n > \frac{4f}{2\gamma - 1}$
Hotstuff	None	O(n)	Standard	-	
Pompe	Ordering Linearizability	O(n²)	Standard	No	n ≥ 3f + 1
Fino	Total ordering	O(n²)	Standard	Yes	n ≥ 3f + 1

CSE590 Evalulations Rashnu (RAW)

	https://github.com/HeenaNagda/Order-Fairness		
Prod. 7586, 7786, 7486, 7486, 7480	mups.//gittiub.com/meenaivagda/order-naimess		
Prod. 7586, 7786, 7486, 7486, 7480	4f		
Prod. 7586, 7786, 7486, 7486, 7480	$n > \frac{1}{2\nu - 1}$		
Prod. 7586, 7786, 7486, 7486, 7480	21 1		
Prod. 7586, 7786, 7486, 7486, 7480			
Prod. 7586, 7786, 7486, 7486, 7480	(1) varying network size		
1-1   1-1   1-2	(, , , , , , , , , , , , , , , , , , ,	[7500, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 7500, 7400, 7400, 7300, 7500, 7500, 7500, 7500, 7500, 1700]	
Body Code Code Code Code Code Code Code Code		lat = 53.951ms	
	f = 1; γ = 1; n = 5; blocksz = 100		
Fig. 17   13   13   13   13   13   13   13		lat = 63.501ms	
F   F   F   F   F   F   F   F   F   F	f = 3; γ = 1 ; n = 13 ; blocksz = 100	lat = 62.633ms	
F   F   F   F   F   F   F   F   F   F		[4600, 4600, 4600, 4527, 4573, 4700, 4600, 4600, 4600, 4600, 4600, 4600, 4600, 4600, 4500, 4600, 4596, 104]	
1	f = 5; y = 1; n = 21; blocksz = 100		
1		[3126, 3074, 3100, 3100, 3100, 3100, 3100, 3200, 3300, 3199, 3101, 3200, 3200, 3176, 3224, 3200, 3000]	
(2) regions failure (shut down fregless)  (3) regions failure (shut down fregless)  (4) regions failure (shut down fregless)  (5) regions failure (shut down fregless)  (5) regions failure (shut down fregless)  (5) regions failure (shut down fregless)  (6) regions failure (shut down	f = 10: y = 1 : p = 41 : blockez = 100		
Prior 1790   7800   7	1 - 10, Y - 1, II - 41, DIOCKSZ - 100	ldt = 120.720IIIS	
Prior 1790   7800   7	(2) replica failure (shut down f replicas)		
	f = 1 · v = 1 · n = 5 · blocksz = 100		
	,, ., ., ., ., ., ., ., ., ., ., ., .		
\$450, \$400	L	lat = 62.745ms	lat = 63.501ms
= 5, y = 1, n = 21, blocker = 100	f = 3; γ = 1 ; n = 13 ; blocksz = 100		
F = 5; F = 1, F = 2; blocksz = 100			[4600, 4600, 4600, 4527, 4573, 4700, 4600, 4600, 4500, 4600, 4600, 4600, 4600, 4600, 4500, 4600, 4596, 104]
1   1   1   1   1   1   1   1   1   1	f = 5; γ = 1; n = 21; blocksz = 100		
1			
(3) block size (e8220)  (40, 600, 615, 595, 620, 620, 625, 605, 610, 620, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 625, 625, 620, 620, 620, 620, 620, 620, 620, 620	f = 10: y = 1 : p = 41 : blockez = 100		lat = 127.028ms
40, 600, 615, 595, 620, 620, 620, 620, 620, 620, 620, 620	1 - 10, Y - 1, II - 41, BIOCKSZ - 100	181 - 120.200118	181 = 120.720118
1	(3) block size (c8220)		
1		[490, 600, 615, 595, 620, 620, 625, 605, 610, 620, 625, 620, 620, 625, 615, 625, 585, 210]	
2800, 2875, 2900, 2825, 2900, 2900, 2805, 2800, 2900, 2855, 2800, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 1850	f = 1 : y = 1 : n = 5 : blockez = 5		
al = 140 520ms   lat = 1940 520ms   lat = 1940 520ms   lat = 193 847ms   lat = 195 847ms   lat = 195 350 sal   lat = 195 350	1 - 1 , y - 1 , II - 3 , DIOCKS2 - 3		
\$450, \$350		lat = 140.520ms	
1	f = 1; γ = 1; n = 5; blocksz = 25		
f = 1; y = 1; n = 5; blocksz = 50			
1	f = 1; γ = 1; n = 5; blocksz = 50		
S00, S200, S00, S00, S00, S00, S00, S00	f = 1 : v = 1 : n = 5 : blocksz = 100	lat = 53.951ms lat = 53.812ms	
1		[5000, 5200, 5000, 5000, 5200, 5000, 5000, 5000, 5000, 5200, 5000, 4867, 4933, 5000, 4921, 4879, 4800, 5000, 5000, 18	000]
2800, 2800	f = 1 = 1 = 5 . blasker = 200	lat = 160.181ms	
al = 576.208ms   al = 576.208ms   al = 576.208ms   al = 574.337ms   al = 574.208ms   al = 574.208ms   al = 53.951ms   al = 574.208ms   al = 574.209, 7400, 7500, 7400, 7500, 7400, 7500, 7500, 7400, 7500, 7500, 7400, 7500, 7500, 7400, 750	1 = 1 , γ = 1; Π = 5; DIOCKSZ = ZUU		
(4) Geo distributed  (7500, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 75		lat = 576.208ms	
1,750,7286,7314,7400,7300,7400,7500,7400,7500,7500,7500,7500,75	f = 1 ; γ = 1 ; n = 5 ; blocksz = 400	lat = 574.337ms	
1,750,7286,7314,7400,7300,7400,7500,7400,7500,7500,7500,7500,75	(1) Goo distributed		
at = 53.951ms   at = 53.951m	(4) Geo distributed	[7500 7286 7314 7400 7300 7400 7500 7400 7500 7400 7400 7300 7500 7500 7500 7500 1700]	
f = 1; γ = 1; n = 5; blocksz = 100 (ALL IN Clemson)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)  f = 1; γ = .60; n = 21; blocksz = 100  f = 1; γ = .60; n = 21; blocksz = 100  f = 1; γ = .75; n = 9; blocksz = 100  f = 1;		lat = 53.951ms	
at = 329.832ms   at = 324.409ms   at = 329.832ms   at = 324.409ms   at =	f = 1; γ = 1; n = 5; blocksz = 100 (ALL IN Clemson)	lat = 53.812ms	
f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin) lat = 324.409ms  (5) Order fairness parameter  [4600, 4600, 4507, 4573, 4700, 4600, 4600, 4500, 4600, 4500, 4600, 4500, 4			
(5) Order fairness parameter  [4600, 4600, 4500, 4527, 4573, 4700, 4600, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500	f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)		
[4600, 4600, 4507, 4573, 4700, 4600, 4600, 4600, 4600, 4600, 4600, 4600, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500, 4600, 4500			
iat = 87.314ms lat = 87.314ms lat = 87.315ms lat = 87.315ms lat = 87.15 ms lat = 87.15 ms lat = 87.15 ms lat = 60.073ms lat = 59.818ms lat =	(5) Order fairness parameter		
f = 1; y = .60; n = 21; blocksz = 100   lat = 87.135ms   [6687, 6700, 6800, 6700, 6800, 6700, 6600, 6600, 6600, 6600, 6684, 6616, 6700, 6700, 6688, 6712, 1600]   lat = 60.073ms   lat = 59.818ms   59.818ms   59.07, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 7500, 7500, 7500, 7500, 7500, 1700]   lat = 59.951ms   10.073ms			
lat = 60.073ms   lat = 59.818ms   lat = 59.818ms   [7500, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 7500, 7500, 7500, 7500, 7500, 1700]   lat = 59.951ms   l	f = 1; γ = .60; n = 21; blocksz = 100		
f = 1; y = .75; n = 9; blocksz = 100   lat = 59.818ms   75.00, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 7500, 7500, 7500, 7500, 7500, 1700]   lat = 59.951ms   10.0000000000000000000000000000000000			
[7500, 7286, 7314, 7400, 7300, 7400, 7500, 7400, 7500, 7400, 7300, 7500, 7500, 7500, 7500, 1700] lat = 53.951ms	f = 1 · v = 75 · n = 9 · blocksz = 100	lat = 59.818ms	
lat = 53.951ms	,, ., ., ., ., ., ., ., ., ., ., ., .		
$f = 1 \cdot y = 1 \cdot p = 5 \cdot b \log (e^2 = 100)$ [at = 53.812ms]		lat = 53.951ms	
1-1,1-1,1-0,00002-100 (81-00,012110	f = 1; γ = 1; n = 5; blocksz = 100	lat = 53.812ms	

https://github.com/HeenaNagda/Order-Fairness		
Section 1		
$n > \frac{4f}{2\gamma - 1}$		
$2\gamma - 1$		
(4)		
(1) varying network size	[3800, 3700, 3800, 3800, 3800, 3739, 3761, 3800, 3800, 3700, 3800, 3700, 3700, 3700, 3800, 3800, 3700, 200]	
	lat = 106.354ms	
f = 1 ; γ = 1 ; n = 5 ; blocksz = 100	lat = 106.178ms	
	[3404, 3396, 3400, 3300, 3300, 3300, 3300, 3300, 3400, 3300, 3400, 3300, 3400, 3300, 3400, 3300, 3300, 3300, 1300] lat = 120.424ms	
f = 3; γ = 1 ; n = 13 ; blocksz = 100	lat = 119.783ms	
	[800, 600, 800, 700, 700, 600, 700, 700, 700, 700, 7	
f = 5; γ = 1; n = 21; blocksz = 100	lat = 2338.828ms	
	[700, 700, 700, 700, 661, 539, 700, 600, 700, 700, 600, 700, 600, 600	
f = 10; γ = 1; n = 41; blocksz = 100	lat = 2424.117/118	
(2) replica failure (shut down f replicas)	TOO OOO OOO OOO OOO OTAL OTE OOO OTAL OTE OOO OTO	[0000 0700 0000 0000 0700 0701 0000 0000
	[3800, 3800, 3800, 3800, 3800, 3744, 3756, 3800, 3700, 3800, 3700, 3700, 3700, 3800, 3700, 3800, 3700, 900] lat = 106.276ms	[3800, 3700, 3800, 3800, 3800, 3739, 3761, 3800, 3800, 3700, 3800, 3700, 3800, 3700, 3800, 3700, 200] lat = 106.354ms
f = 1 ; γ = 1 ; n = 5 ; blocksz = 100	lat = 105.833ms	lat = 106.178ms
	[3400, 3400, 3300, 3300, 3400, 3300, 3300, 3300, 3315, 3285, 3400, 3300, 3300, 3361, 3339, 3300, 3300, 800] lat = 120.657ms	[3404, 3396, 3400, 3300, 3300, 3300, 3300, 3400, 3300, 3400, 3300, 3400, 3300, 3400, 3300, 3300, 3300, 1300] lat = 120.424ms
f = 3; γ = 1; n = 13; blocksz = 100	lat = 120.057/118 lat = 120.088ms	lat = 120.424ms
	[800, 600, 800, 700, 700, 600, 700, 800, 700, 700, 700, 700, 600, 600, 700, 7	[800, 600, 800, 700, 700, 600, 700, 700, 700, 700, 7
f = 5; γ = 1; n = 21; blocksz = 100	lat = 2287.674ms lat = 2328.988ms	lat = 2294.108ms lat = 2338.828ms
	[700, 700, 700, 693, 607, 700, 600, 700, 700, 700, 600, 600	[700, 700, 700, 700, 661, 539, 700, 600, 700, 700, 600, 700, 600, 600
f = 10; γ = 1; n = 41; blocksz = 100	lat = 2429.446ms lat = 2471.148ms	lat = 2424.117ms lat = 2465.256ms
1 - 10, γ - 1, 11 - 41, DIOCKS2 - 100	ldt = 2471.140111S	ldt = 2400.230IIIS
(3) block size (c8220)		
	[555, 640, 670, 645, 670, 675, 665, 640, 675, 670, 670, 670, 665, 665, 660, 630, 670, 70]	
f = 1; γ = 1; n = 5; blocksz = 5	lat = 600.637ms lat = 599.090ms	
	[3025, 3075, 3075, 3025, 3075, 3025, 2975, 3050, 3050, 3025, 3000, 3025, 3000, 2928, 3047, 2975, 3025, 1075]	
f = 1; γ = 1; n = 5; blocksz = 25	lat = 132.219ms lat = 131.802ms	
1 - 1 , 7 - 1 , 11 - 3 , 5100132 - 25	[5300, 5300, 5350, 5248, 5302, 5300, 5200, 5150, 5300, 5300, 5150, 5200, 5200, 5250, 5200, 5050, 5050, 1850]	
f - 1 1 . p - 5 . blasker - 50	lat = 76.592ms lat = 76.044ms	
f = 1; γ = 1; n = 5; blocksz = 50	[3800, 3700, 3800, 3800, 3800, 3739, 3761, 3800, 3800, 3700, 3800, 3700, 3700, 3700, 3800, 3800, 3700, 200]	
	lat = 106.354ms	
f = 1; γ = 1; n = 5; blocksz = 100	lat = 106.178ms [2000, 1800, 1800, 2000, 1800, 1800, 1800, 1992, 1808, 1800, 1800, 1800, 1800, 1800, 1800, 2000, 1800, 1800]	
	lat = 436.163ms	
f = 1 ; γ = 1 ; n = 5 ; blocksz = 200	lat = 435.247ms	
	[1200, 800, 800, 800, 800, 800, 800, 1200, 800, 800, 800, 800, 800, 800, 800,	
f = 1 ; γ = 1 ; n = 5 ; blocksz = 400	lat = 1892.005ms	
(4) Geo distrbuted		
	[3800, 3700, 3800, 3800, 3800, 3739, 3761, 3800, 3800, 3700, 3800, 3800, 3700, 3700, 3800, 3800, 3700, 200] lat = 106.354ms	
f = 1; γ = 1; n = 5; blocksz = 100 (ALL IN Clemson)	lat = 106.354HIS lat = 106.178ms	
	[600, 600, 600, 600, 600, 600, 600, 600,	
f = 1; γ = 1; n = 5; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)	lat = 2680.635ms lat = 2771.834ms	
, , , , , , , , , , , , , , , , , , ,		
(5) Order fairness parameter		
	[800, 600, 800, 700, 700, 600, 700, 700, 700, 700, 7	
f = 1 ; γ = .60 ; n = 21 ; blocksz = 100	lat = 2338.828ms	
	[3500, 3600, 3500, 3495, 3405, 3500, 3500, 3500, 3500, 3400, 3500, 3600, 3400, 3400, 3500, 3400, 3500, 3432, 468]  at = 115.441ms	
f = 1; γ = .75; n = 9; blocksz = 100	lat = 115.441ms lat = 114.760ms	
	[3800, 3700, 3800, 3800, 3800, 3739, 3761, 3800, 3800, 3700, 3800, 3700, 3700, 3700, 3800, 3800, 3700, 200]	
	lat = 106.354ms	

CSE590 Evalulations

Hotstuff (RAW)

https://github.com/HeenaNagda/Order-Fairness				
n >= 3f + 1				
(1) varying network size	[26700, 26500, 27100, 26900, 26800, 27200, 26900, 11600]			
f = 1; γ = 1; n = 4; blocksz = 100	lat = 14.881ms lat = 14.843ms			
	[18600, 18700, 18700, 18628, 18672, 18800, 19100, 18959, 19241, 19000, 11300] lat = 21.232ms			
f = 3; γ = 1; n = 10; blocksz = 100	lat = 21.212ms [14800, 14500, 14600, 14500, 14659, 14641, 14553, 14747, 14500, 14600, 14600, 14600, 14578, 9822]			
f = 5; γ = 1; n = 16; blocksz = 100	[1400, 1400,			
f = 10; y = 1; n = 31; blocksz = 100	[8977, 9049, 8974, 8900, 8900, 8950, 8850, 8900, 8900, 8800, 8800, 8885, 8815, 8800, 8862, 8881, 8915, 8997, 645] lat = 44.936ms lat = 44.875ms			
(2) replica failure (shut down f replicas)	[67000 67700 6704 67000 67400 67400 67001	[0.700 0.700 0.700 0.000 0.700		
f = 1; γ = 1; n = 4; blocksz = 100	[27800, 27728, 27941, 27801, 27030, 27400, 27201, 6799] lat = 14.503ms lat = 14.457ms	[26700, 26500, 27100, 26900, 26800, 27200, 26900, 11600] lat = 14.881ms lat = 14.843ms		
f = 3; γ = 1 ; n = 10 ; blocksz = 100	[17156, 17244, 17424, 17817, 17259, 16000, 16000, 16700, 16500, 16700, 17000, 13900] lat = 23.680ms lat = 23.470ms	[18600, 18700, 18700, 18628, 18672, 18800, 19100, 18959, 1 lat = 21.232ms lat = 21.212ms	9241, 19000, 11300]	
1 - 3, y - 1 , 11 - 10 , DIOCKSZ - 100	[14500, 14400, 14400, 14200, 14400, 14600, 14600, 14630, 14704, 14720, 14644, 14502, 14600, 10800]	[14800, 14500, 14600, 14500, 14659, 14641, 14553, 14747, 1	4500 14600 14600 14600 14578 9822]	
f = 5; γ = 1; n = 16; blocksz = 100	lat = 27.524ms lat = 27.491ms	[14000, 1		
6 10 1 01 hlb.du- 100	[8800, 8900, 8800, 8771, 8795, 8734, 8800, 8800, 8737, 8763, 8900, 8861, 8839, 8800, 8763, 8748, 8789, 8788, 8181 = 45.482ms	lat = 44.936ms	8800, 8985, 8815, 8800, 8862, 8881, 8915	, 8997, 645]
f = 10; γ = 1; n = 31; blocksz = 100	lat = 45.418ms	lat = 44.875ms		
(3) block size (c8220)				
f = 1; y = 1; n = 4; blocksz = 5	[3755, 3755, 3750, 3745, 3750, 3740, 3690, 3735, 3745, 3750, 3757, 3768, 3805, 3825, 3846, 3750, 3739, 2035] lat = 106.130ms lat = 106.625ms			
f = 1; y = 1; n = 4; blocksz = 25	[18518, 18232, 17875, 18136, 18190, 18049, 17996, 18054, 18466, 17784, 17950, 675] lat = 22.071ms lat = 22.041ms			
f = 1 = 1 = 4 . blasten = 50	[33508, 33092, 33186, 33914, 33800, 32350] lat = 11.901ms			
f = 1; γ = 1; n = 4; blocksz = 50	lat = 11.859ms [26700, 26500, 27100, 26900, 26800, 27200, 26900, 11600]			
f = 1; γ = 1; n = 4; blocksz = 100	lat = 14.843ms			
f = 1; y = 1; n = 4; blocksz = 200	[34400, 33800, 34272, 34110, 33618, 29200] lat = 23.521ms lat = 23.410ms			
, , 222	[38544, 38334, 38625, 37297, 38400, 7600] lat = 42.003ms			
f = 1 ; γ = 1 ; n = 4 ; blocksz = 400	lat = 41.681ms			
(4) Geo distrbuted				
	[26700, 26500, 27100, 26900, 26800, 27200, 26900, 11600] lat = 14.881ms			
f = 1 ; γ = 1 ; n = 4 ; blocksz = 100 (ALL IN Clemson)	lat = 14,843ms [1700, 17	0]		
f = 1 ; γ = 1 ; n = 4 ; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)				

CSE590 Evalulations

### https://github.com/Pompe-org/Pompe-HS

#### n >= 3f + 1

#### (1) varying network size

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 100

$$f = 3$$
;  $y = 1$ ;  $n = 10$ ; blocksz = 100

$$f = 5$$
;  $\gamma = 1$ ;  $n = 16$ ; blocksz = 100

$$f = 10$$
;  $y = 1$ ;  $n = 31$ ; blocksz = 100

## (2) replica failure (shut down f replicas)

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 100

$$f = 3$$
;  $\gamma = 1$ ;  $n = 10$ ; blocksz = 100

$$f = 5$$
;  $y = 1$ ;  $n = 16$ ; blocksz = 100

$$f = 10$$
;  $\gamma = 1$ ;  $n = 31$ ; blocksz = 100

## (3) block size (c8220)

$$f = 1$$
;  $\gamma = 1$ ;  $n = 4$ ; blocksz = 5

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 25

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 50

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 100

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 200

$$f = 1$$
;  $\gamma = 1$ ;  $n = 4$ ; blocksz = 400

# (4) Geo distrbuted

$$f = 1$$
;  $\gamma = 1$ ;  $n = 4$ ; blocksz = 100 (ALL IN Clemson)

$$f = 1$$
;  $y = 1$ ;  $n = 4$ ; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)

CSE590 Evalulations Fino

# https://github.com/siddhantsharma301/narwhal-fino

#### n >= 3f + 1

#### (1) varying network size

f = 1;  $\gamma = 1$ ; n = 4; blocksz = 100

f = 3; y = 1; n = 10; blocksz = 100

f = 5;  $\gamma = 1$ ; n = 16; blocksz = 100

f = 10; y = 1; n = 31; blocksz = 100

## (2) replica failure (shut down f replicas)

f = 1; y = 1; n = 4; blocksz = 100

f = 3;  $\gamma = 1$ ; n = 10; blocksz = 100

f = 5; γ = 1; n = 16; blocksz = 100

f = 10;  $\gamma = 1$ ; n = 31; blocksz = 100

## (3) block size (c8220)

f = 1;  $\gamma = 1$ ; n = 4; blocksz = 5

f = 1;  $\gamma = 1$ ; n = 4; blocksz = 25

f = 1; y = 1; n = 4; blocksz = 50

f = 1; γ = 1; n = 4; blocksz = 100

f = 1; y = 1; n = 4; blocksz = 200

f = 1;  $\gamma = 1$ ; n = 4; blocksz = 400

## (4) Geo distrbuted

f = 1;  $\gamma = 1$ ; n = 4; blocksz = 100 (ALL IN Clemson)

f = 1; y = 1; n = 4; blocksz = 100 (Utah, Emulab, Clemson, Wisconsin)