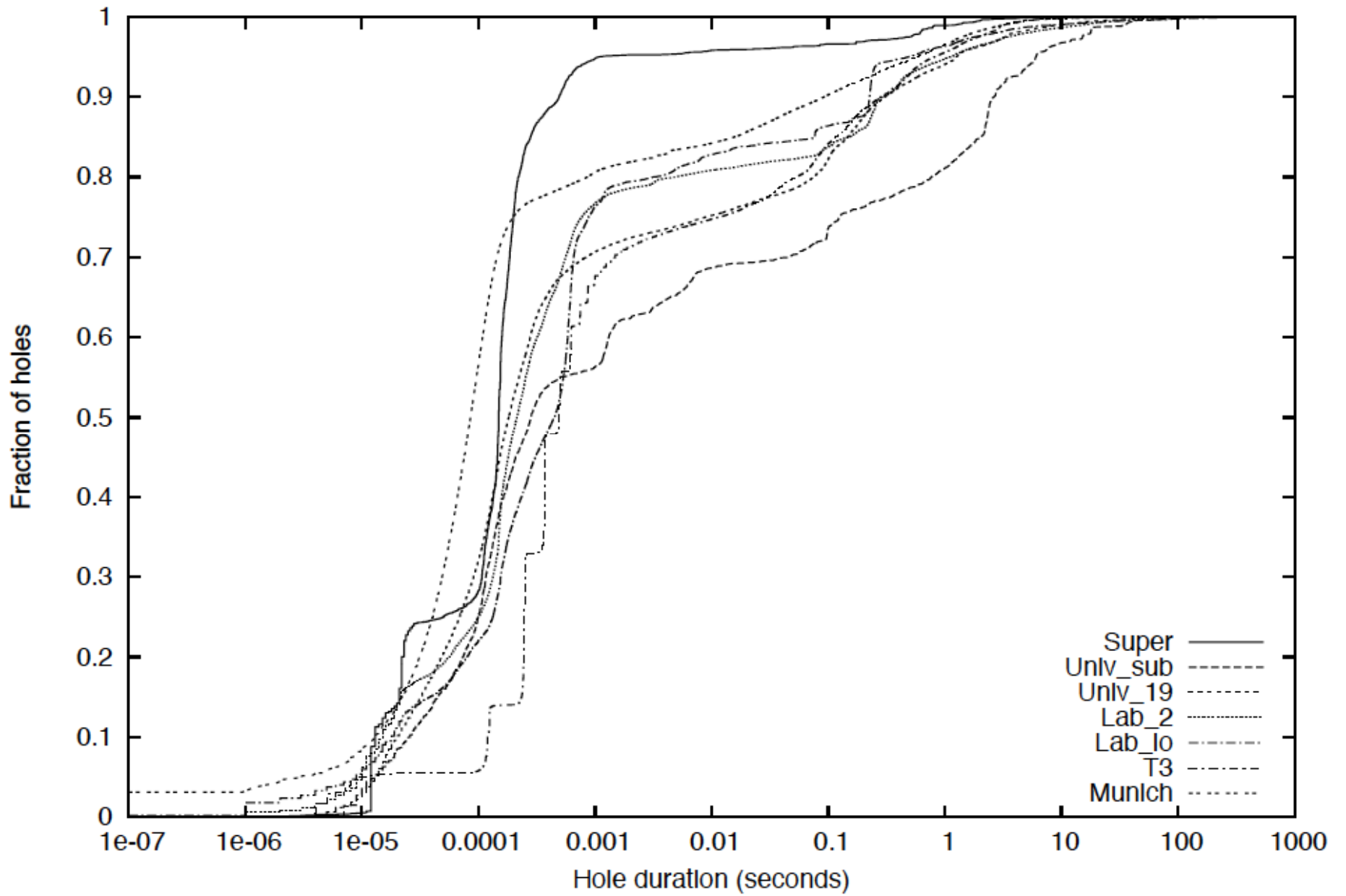


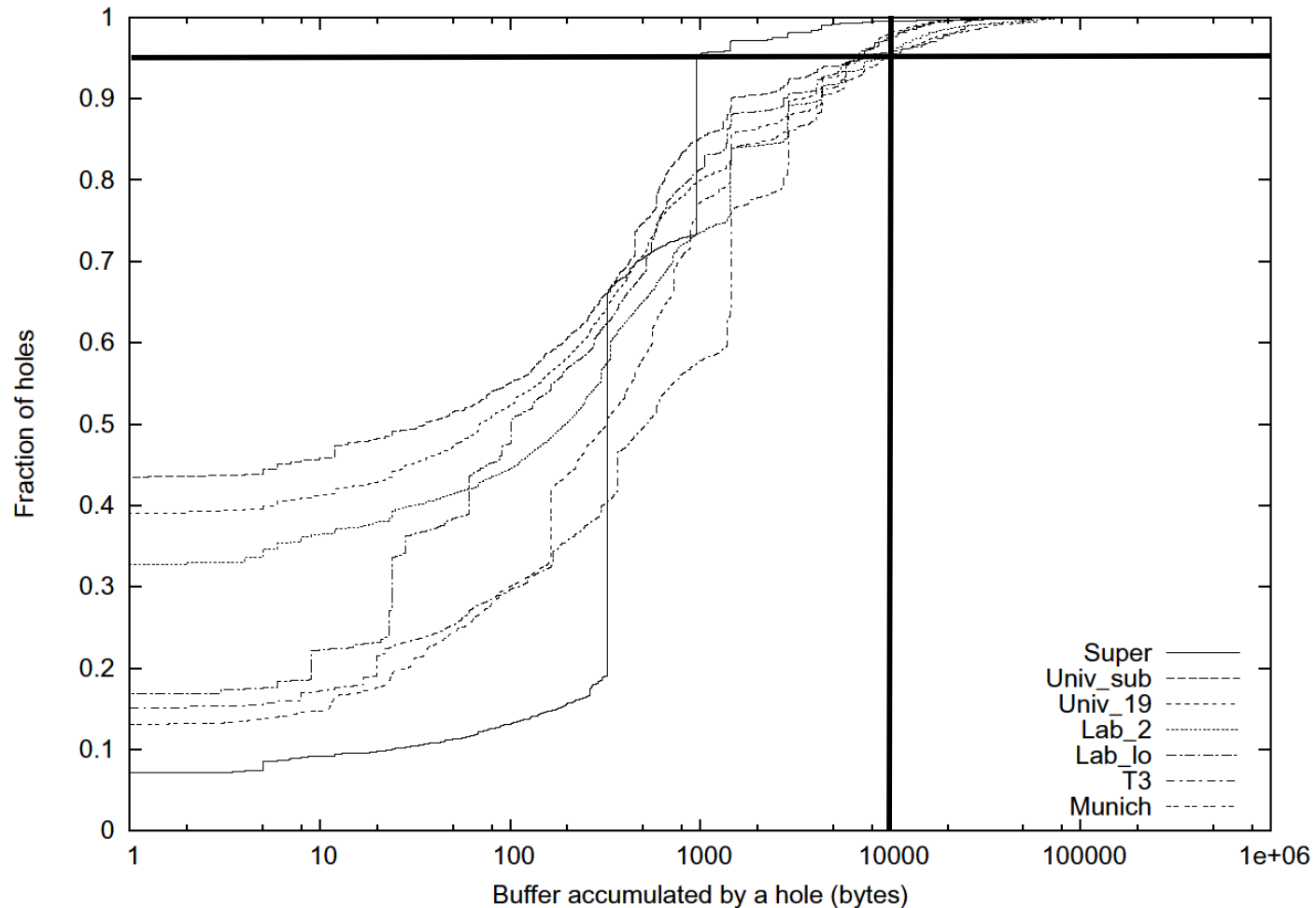
	<i>Univ_{sub}</i>	<i>Univ₁₉</i>	<i>Lab_{lo}</i>	<i>Lab₂</i>	<i>Super</i>	<i>T3</i>	<i>Munich</i>
Trace duration (seconds)	303	5,697 / 300*	3,602	3,604	3,606	10,800	6,167
Total packets	1.25M	6.2M	1.5M	14.1M	3.5M	36M	220M
Total connections	53K	237K	50K	215K	21K	1.04M	5.62M
Connections with holes	1,146	17,476	4,469	41,611	598	174,687	714,953
Total holes	2,048	29,003	8,848	79,321	4,088	575K	1.88M
Max buffer required (bytes)	128 KB	91 KB	68 KB	253K	269 KB	202 KB	560KB
Avg buffer required (bytes)	5,943	2,227	3,111	13,392	122	28,707	178KB
Max simultaneous holes	15	13	9	39	6	94	114
Max simultaneous holes in single connection	9	16	6	16	6	85	61
Fraction of holes with < 3 packets in buffer	90%	87%	90%	87%	97%	85%	87%
Fraction of connections with single concurrent hole	96%	98%	96%	97%	97%	95%	97%
Fraction of holes that overlap hole on another connection of same <i>external</i> host (§ 5.1)	0.5%	0.02%	0.06%	0.06%	0%	0.46%	0.02%

- Many connections have holes, but little buffer required



Adversary can fill the entire buffer with just a single connection!

Policy 1: Restrict per-connection buffer to threshold (say 20KB)

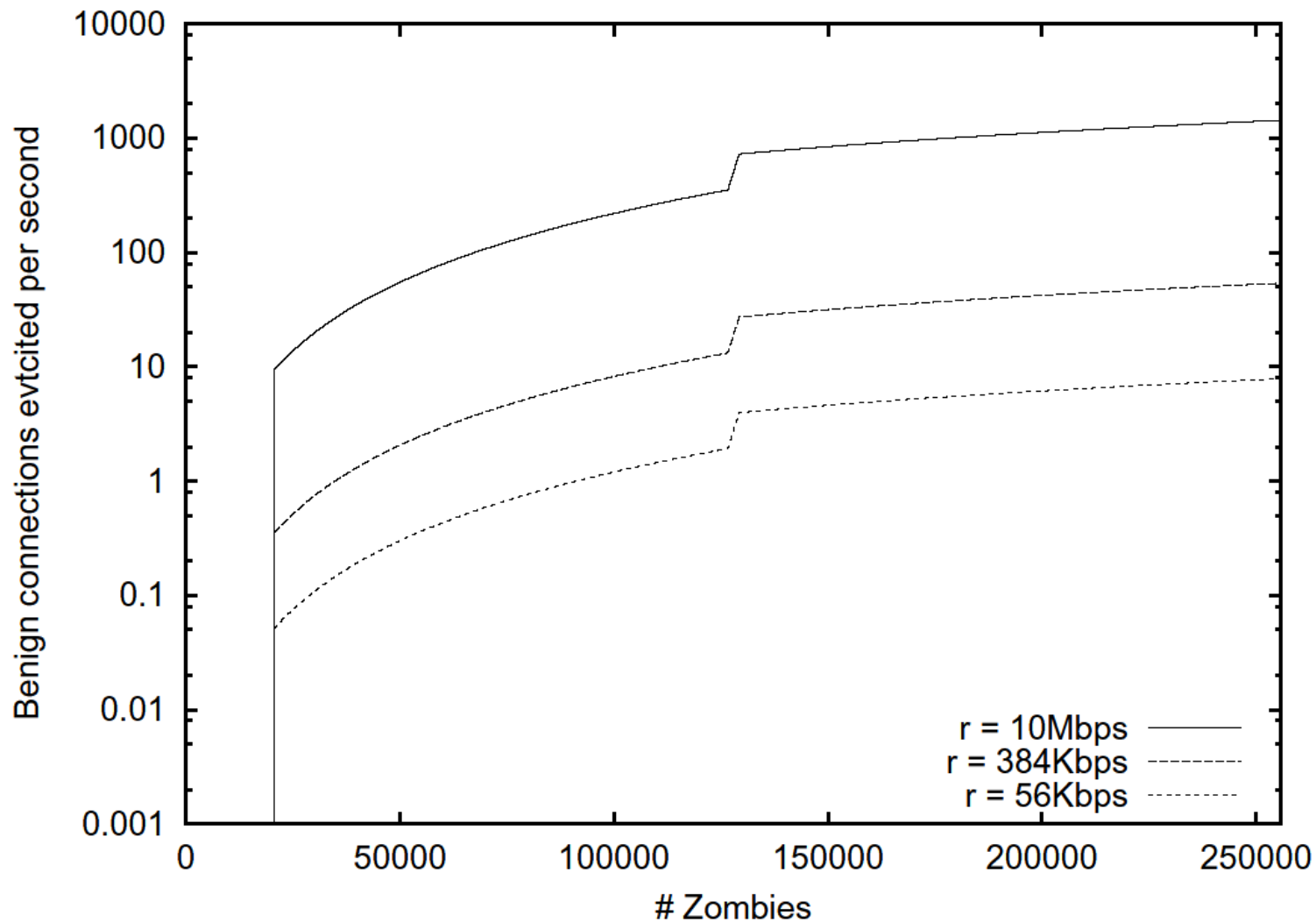


- Adversary can create *multiple* connections to exhaust the buffer!
- **Policy 2:** Do not allow a single host to create two connections with holes

	<i>Univ_{sub}</i>	<i>Univ₁₉</i>	<i>Lab_{lo}</i>	<i>Lab₂</i>	<i>Super</i>	<i>T3</i>	<i>Munich</i>
Fraction of holes that overlap hole on another connection of same <i>external</i> host	0.5%	0.02%	0.06%	0.06%	0%	0.46%	0.02%

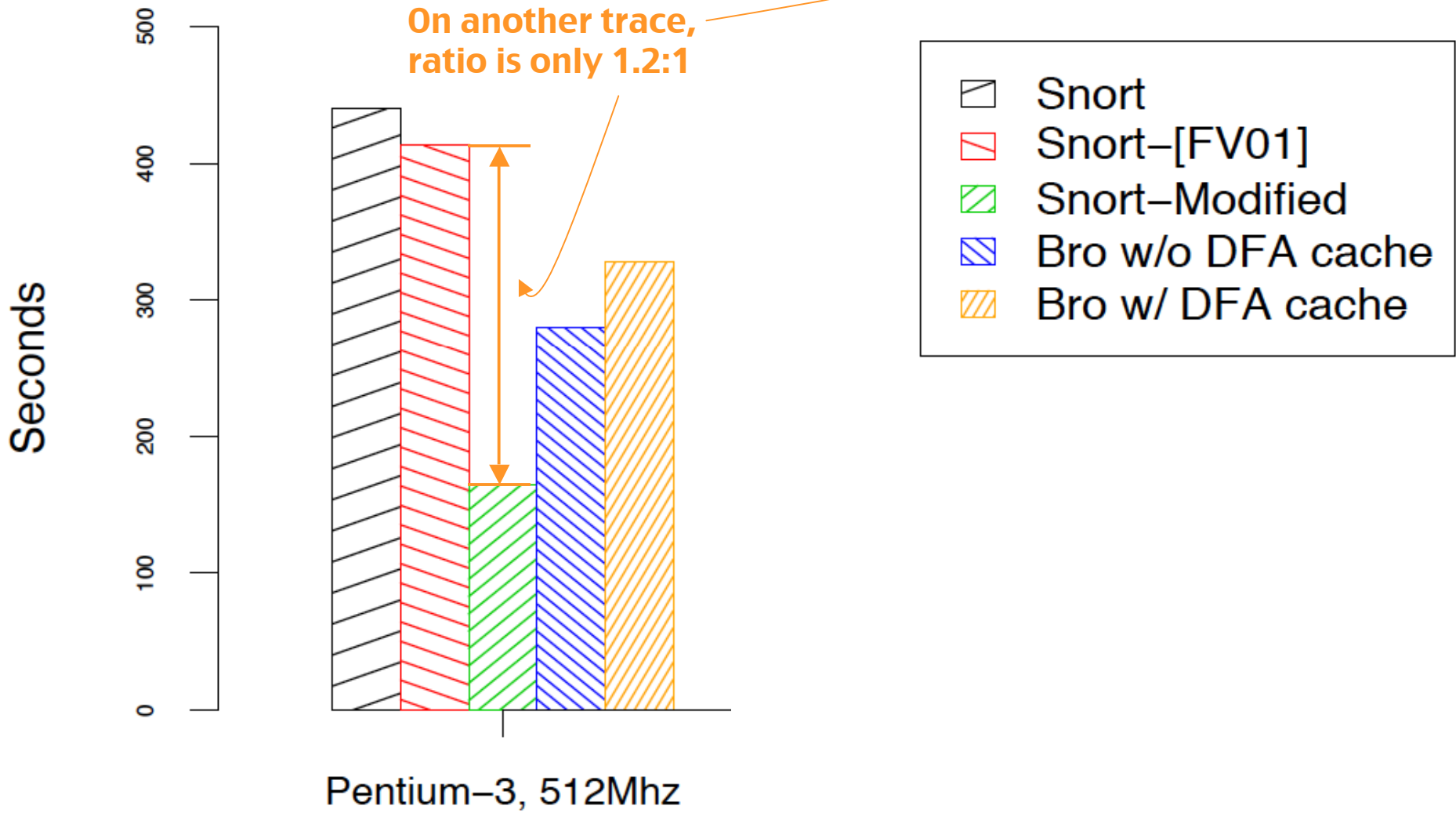
- Adversary attacks from distributed hosts! (*zombies*)
 - No connection can be isolated as adversary's... all of them look good
- **Policy 3:** Upon buffer exhaustion ...
 - ... Evict one buffer page **randomly** and reallocate it to new packet
 - **Kill** the connection of the evicted page (mod details)
- If the buffer is **large**, then *most evicted connections belong to the adversary*
 - They fight an uphill battle!

- Suppose total 512 MB, 2KB page, 25KB/conn



Avg. Legitimate Buffer = 30 KB

Run-times on Web trace



Run-times on Web trace

