

# Ch. 11 Analyzing Playability vis a vis QoS Parameters

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# Two Views

- A **subjective** study on how players perceive quality and their thoughts on “**lag**” and its impact on their performance.
  - Note lag was used as the network QoS as players cant distinguish between jitter, delay and losses. For them it is all an issue of actions not happening, and views not being accurate.
- An **objective** study of QoE using bots to simulate play in a controlled environment
  - Remove the variability of player experience and mood and just focus on how network parameters actually impact game play.

# A subjective study: Lag and Playability

- Results based on an Internet survey
- Leaves the definition of “lag” up to the players - have different views
- Player frustration mostly because they cant identify the root cause of “lag”
- Many players in a previous subjective study indicated that they would not pay more for QoS guarantees
- Also indicated that it would be good for game providers to make available better tools for gamers to assess network conditions so that they can make better decisions

# Main questions

- How do players **perceive** lag?
- What do players **think of the causes (opinion)** of lag?
- How do players **react** to lag?

# Designed a questionnaire

- Posted on Internet forums in Taiwan for three weeks and players were given a monetary incentive to respond to survey. Had 229 respondents.
- Comprised of 4 parts:
  - Player Demographics
  - Perceptions of Lag
  - Reactions to Lag
  - Solutions to Lag

# Player Demographics

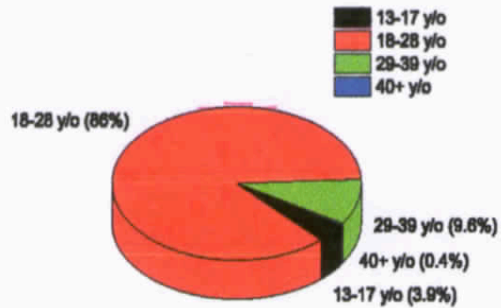
- Player info
  - Player's profile
  - Game play history
  - Game play frequency
  - Playing time
- Network info
  - Access method
  - Network bandwidth

# Player demographics

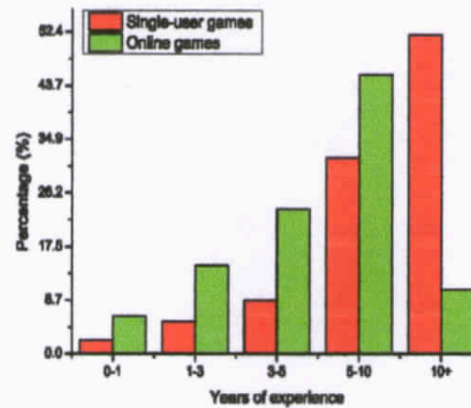
## QUESTIONNAIRE DESIGN

Section 1: Player Demographics	
Q1	<i>What is your gender?</i> (A) Man (B) Woman
Q2	<i>What is your age?</i> (A) 0–12 (B) 13–17 (C) 18–28 (D) 29–39 (E) 40+
Q3	<i>How many years have you played single-player games including PC and video games?</i> (A) 0-1 (B) 1-3 (C) 3-5 (D) 5-10 (E) 10+
Q4	<i>How many years have you played online games such as FPS games and MMORPGs?</i> (A) 0-1 (B) 1-3 (C) 3-5 (D) 5-10 (E) 10+
Q5	<i>Which type of online games do you like to play? (multiple-choices)</i> (A) Role playing (B) Real-time strategy (C) First-person shooter (D) Car racing (E) Casual games
Q6	<i>How often do you play online games?</i> (A) Rarely (B) Intermittently (C) 0–2 hours a day (D) 3–5 hours a day (E) 6+ hours a day
Q7	<i>What time do you usually play online games?</i> (A) before 9 AM (B) 9 AM–12 noon (C) 12 noon–2 PM (D) 2 PM–6 PM (E) 6 PM–10 PM (F) after 10 PM
Q8	<i>What online games do you play now? (Write down their names)</i>
Q9	<i>Which Internet service provider do you use?</i> (A) TANet (B) HiNet (C) SeedNet (D) APTG (E) TFN (F) Others (Write down the names)
Q10	<i>How does your computer connect to the gateway?</i> (A) Ethernet (B) WiFi (C) 3G (D) Don't know
Q11	<i>How does the gateway connect to the Internet?</i> (A) TANet (B) ADSL (C) Cable Modem (D) FTTB (E) 3G (F) Don't know
Q12	<i>What is the downlink and uplink network bandwidth of your Internet access?</i> (A) 2 Mbps / 512 Kbps (B) 4 Mbps / 1 Mbps (C) 8 Mbps / 640 Kbps (D) 3 Mbps / 768 Kbps (E) 10 Mbps / 2 Mbps (F) 20 Mbps / 2 Mbps (G) Don't know (H) Others

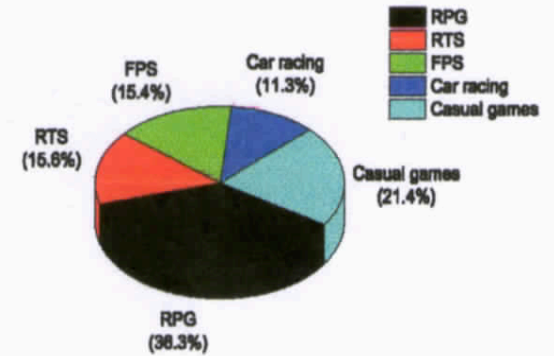
# Player Profile - M 76%, F 24%



(a) Q2: Age of players



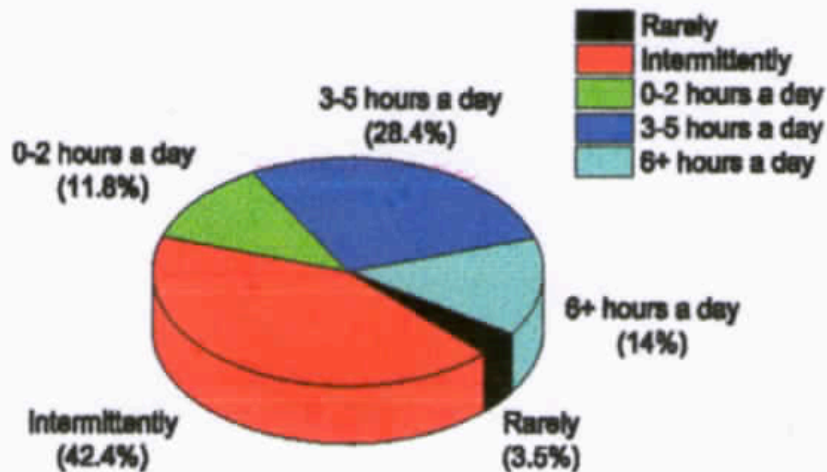
(b) Q3-Q4: Game play experience



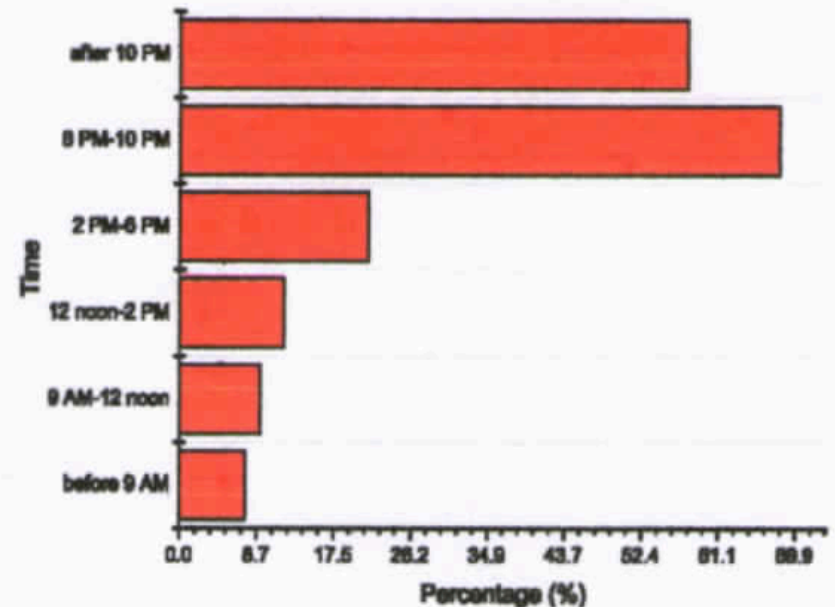
(c) Q5: Preference of games



# Player Game Experience

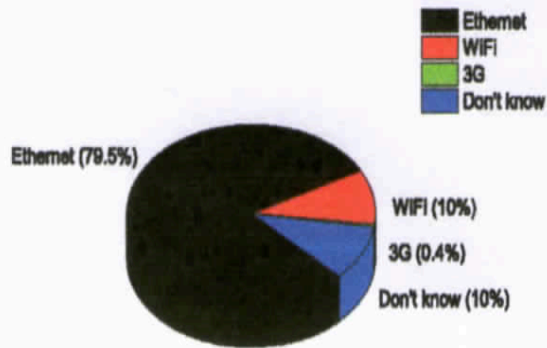


(d) Q6: Game play frequency

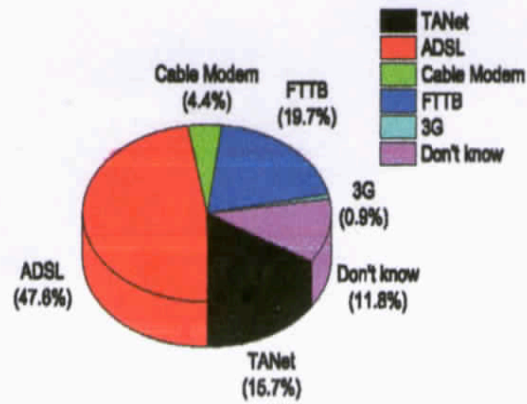


(e) Q7: Game play time

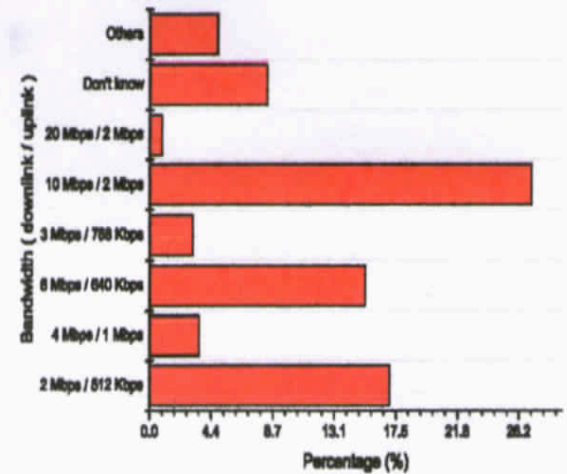
# Network Connection



(g) Q10: Host to gateway access method



(h) Q11: Gateway to Internet access method



(i) Q12: Bandwidth of Internet access

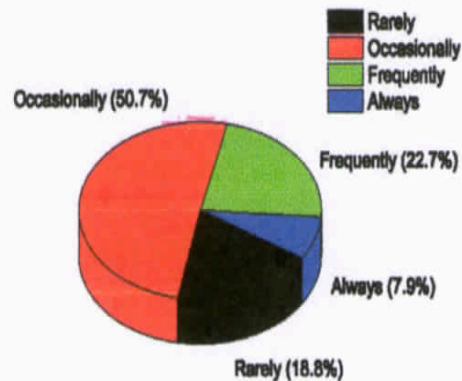
# Perceptions of Lag

- Perception of lag in past gaming experiences
- What do they perceive to be the reasons for lag
- Experience with lag across many games

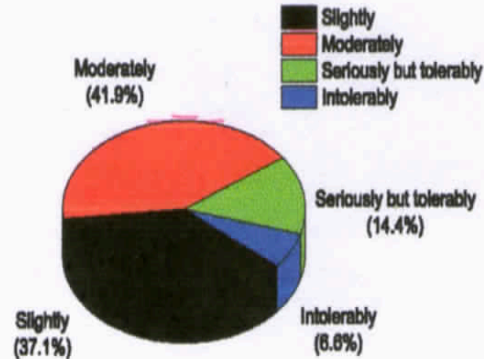
# Perceptions of Lag

Section 2: Perceptions of Lag	
Q13	<i>How often do you encounter lag during game play?</i> (A) Rarely (B) Occasionally (C) Frequently (D) Always
Q14	<i>How serious is the lag in general?</i> (A) Slightly (B) Moderately (C) Seriously but tolerably (D) Intolerably
Q15	<i>How long does the lag last?</i> (A) Instantly (B) In a few seconds (C) In a few minutes (D) Intermittently (E) Constantly
Q16	<i>In your opinion, what causes the lag you encountered? (multiple-choice)</i> (A) Your PC (B) Access link bandwidth of your PC (C) Game client (D) Equipment of game servers (E) Access link bandwidth of game servers (F) Internet core bandwidth (G) Don't know
Q17	<i>To what degree do you feel lag is related to the time of game play?</i> (A) None (B) Weak (C) Moderate (D) Strong
Q18	<i>To what degree do you feel lag is related to the number of avatars on the screen?</i> (A) None (B) Weak (C) Moderate (D) Strong
Q19	<i>Do you play more than one online games?</i> (A) Yes (B) No
Q20	<i>If you play multiple games, to what degree do you feel lag is the consequence of particular game(s)?</i> (A) None (B) Slight (C) Moderate (D) Strong
Q21	<i>In your opinion, what is the most decisive factor making different levels of lag in different games?</i> (A) Game software (B) Equipment of game servers (C) Access link bandwidth of game servers (D) Don't know

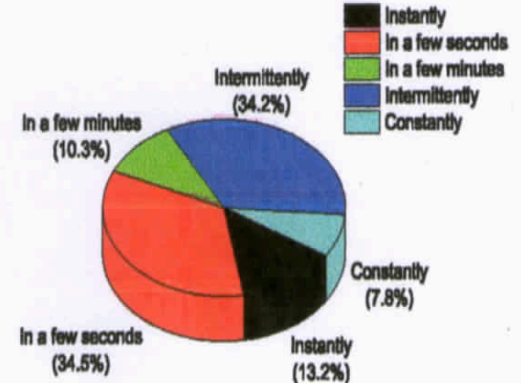
# Perceptions of Lag History



(a) Q13: Frequency of lag

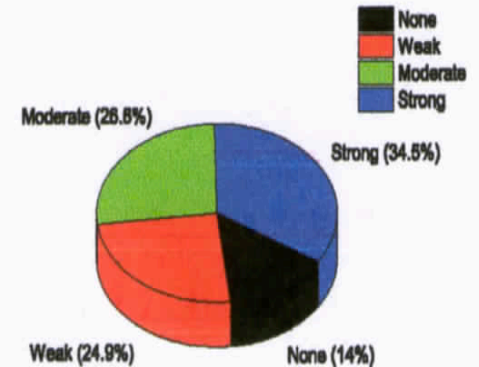
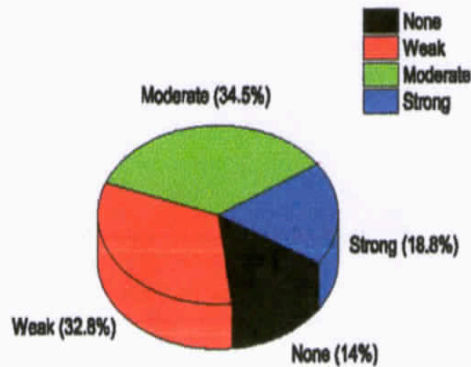
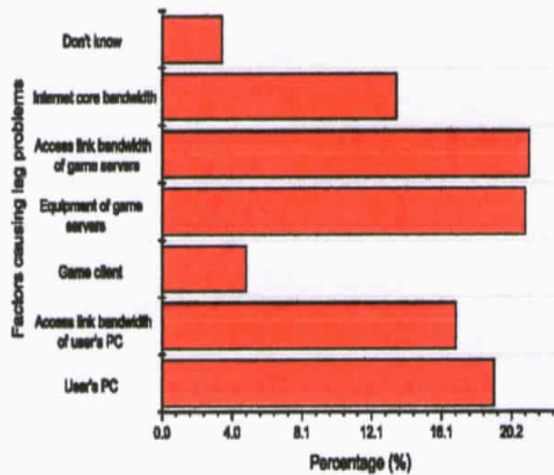


(b) Q14: Significance of lag



(c) Q15: Duration of lag

# Players analysis of lag



- (d) Q16: Players' intuition about root causes of lag (e) Q17: To what degree do players feel lag is related to the time of game play? (f) Q18: To what degree do players feel lag is related to the number of avatars on the screen?

# Reactions to Lag

- How do players react to lag
- How long do they wait between attempts to play
- Who do they complain to when they encounter lag



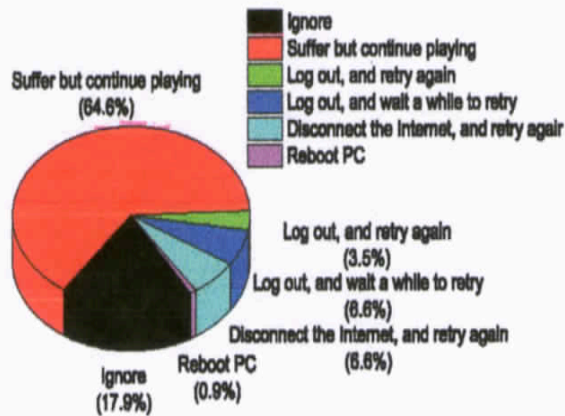
# Reactions to Lag

## Section 3: Reactions to Lag

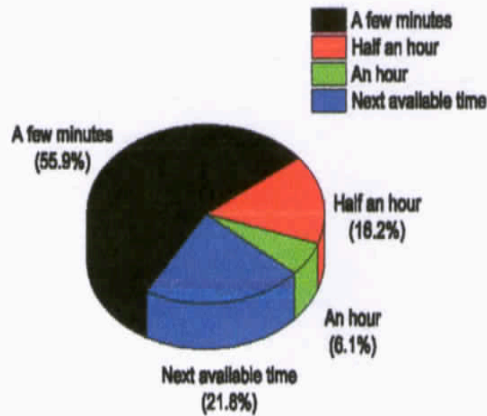
Q22	<i>How do you generally react to lag?</i> (A) Ignore them (B) Suffer and continue playing (C) Log out and retry immediately (D) Log out and retry later (E) Reconnect to the Internet and retry immediately (F) Reboot your PC
Q23	<i>(Following Q22) If you choose to log out and retry later, how long do you wait before retrying?</i> (A) A few minutes (B) Half an hour (C) An hour (D) Next available time
Q24	<i>Do you check with your friends in the game when you encounter lag?</i> (A) Yes (B) No
Q25	<i>When you encounter lag, to what degree do you find your friends in the game also suffer the same problems?</i> (A) None (B) Weak (C) Moderate (D) Strong
Q26	<i>In general, to what degree does lag affect your game play?</i> (A) None (B) Weak (C) Moderate (D) Strong
Q27	<i>When you quit an online game, to what degree do you think lag is the main cause?</i> (A) None (B) Weak (C) Moderate (D) Strong
Q28	<i>Where or to whom do you usually complain about lag? (multiple-choice)</i> (A) Internet forums (B) Your ISP (C) Game company (D) No public/formal complaints (E) Others



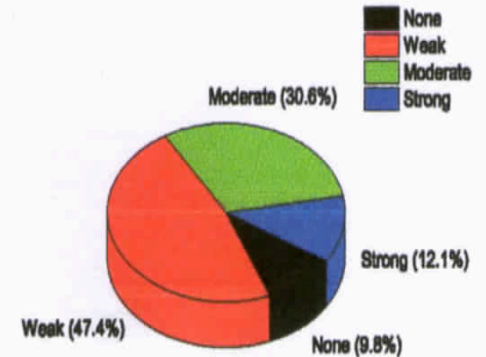
# Reactions to lag



(a) Q22: Reactions to lag

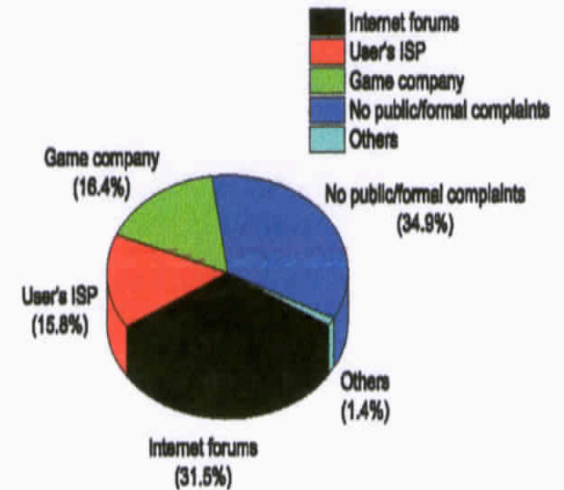
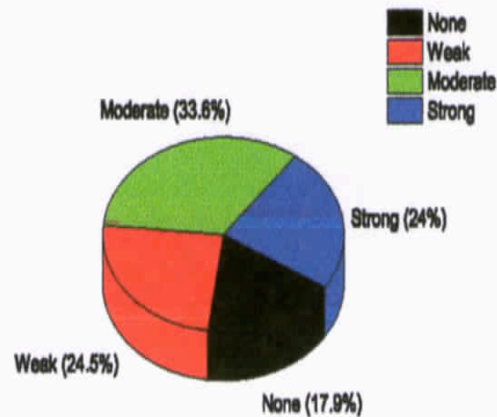
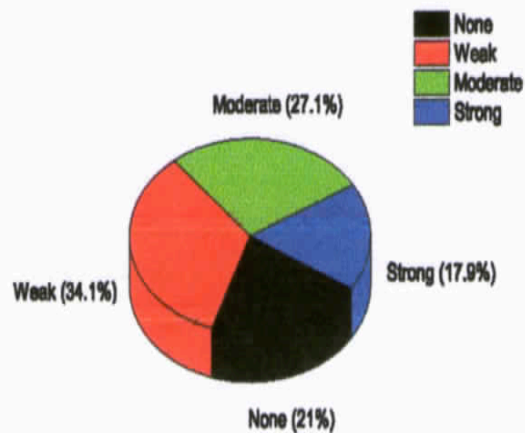


(b) Q23: Interval time between reattempts



(c) Q25: To what degree do players find their friends in game also suffer the same problems?

# Impact on playability



- (d) Q26: To what degree does lag affect players' game play? (e) Q27: To what degree do players think lag is the main cause to quit an online game? (f) Q28: Where or to whom do players usually complain about their lag problems?

# Solutions to Lag

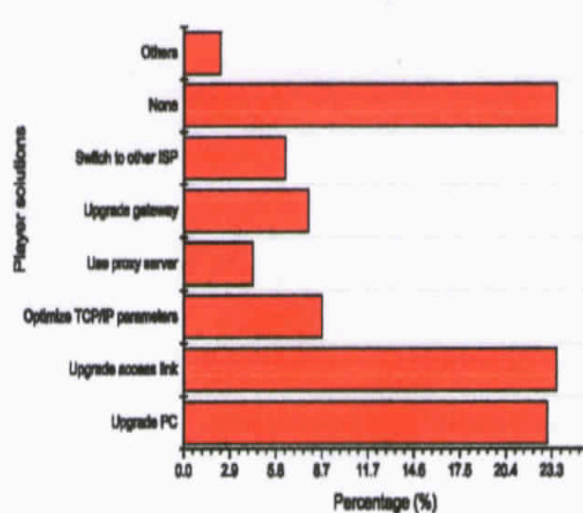
- What do they do when the experience lag
- Willingness to install tools to help solve lag problems
- Is lag really an issue for playability

# Solutions to Lag

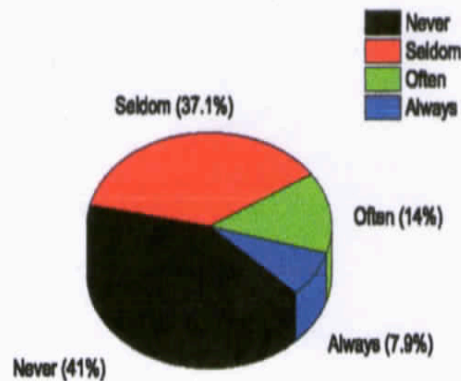
## Section 4: Solutions to Lag

- |     |  |
|-----|--|
| Q29 | <i>Which of the following methods have you ever adopted to solve lag? (multiple-choice)</i><br>(A) Upgrade PC (B) Upgrade access link (C) Optimize TCP/IP parameters (D) Use proxy server (E) Upgrade gateway<br>(F) Switch to other ISP (G) None (H) Others |
| Q30 | <i>Do you use tools such as ping and traceroute to diagnose the root of lag?</i><br>(A) Never (B) Seldom (C) Often (D) Always  |
| Q31 | <i>If there is a software that can diagnose the root cause of lag, would you download and use it? (A) Yes (B) No</i>   |
| Q32 | <i>If there is a software that can mitigate lag, would you download and use it? (A) Yes (B) No</i>   |
| Q33 | <i>In general, is lag an issue to you in online game playing? (A) Yes (B) No</i>   |

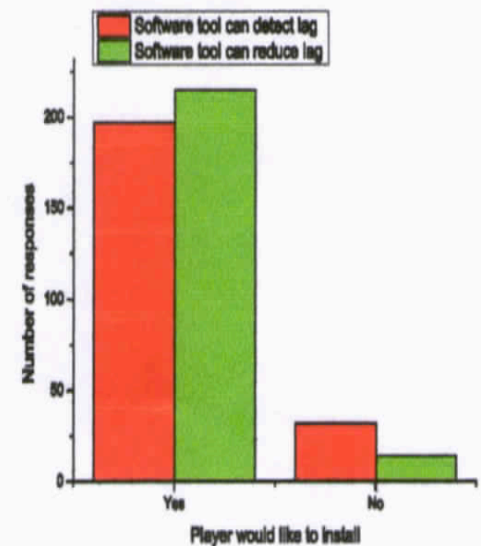
# Player solutions to lag



(a) Q29: Strategies to solve lag



(b) Q30: How often do players adopt network tools to detect the root cause of lag?



(c) Q31–Q32: What kind of tools do players demand to fight lag?

# Survey Results

- Players have no means to fight lag - most don't have the required technical background to deal understand it and deal with it
- Gamers expect the industry to provide the solutions
- Tools to help gamers understand the “lag” problem so that they can figure out its sources and take appropriate action.

# Objective QoE Study

- Correlate network conditions with quality of game play
- Use a synthetic testbed with bots to directly correlate play quality to network QoS parameters
- Results are shown in terms of player scores and number of player actions (kills per minute)
- Conduct many runs of the experiment under different network conditions
- Results not impacted by player experience or environment - unbiased game performance numbers used

# Study parameters

- Client server game model
- Open source Quake III engine
- Client side bot is run on each client and is set to mimic real-user “average good player” behaviour
- Same map was used for all games
- Game mode was set to “death match” - game ends when one player reaches a certain score killing other players
- One hundred different matches were played for each network setting
- To avoid bots from **learning to play more intelligently**, each client was killed after every game and restarted.



# Experiment steps

Every experiments is conducted following these five steps:

1. the server send a START message to each client to connect into the game,
2. the game is played until one client reach a score of 40,
3. the server send a KILL message to each client to disconnect from server and kill the quake client,
4. the server eventually send a CHANGE FILTER message if any client have to modify its emulated network parameters,
5. finally, the server send another START message, and all quake clients will restart and connect to the game server.

# Results - Metric Validation

- The score CCDF when no player is subject to any delay - the match is fair because there is an extremely high probability for each player to score at least 25
- Penalizing one of the players brings the obvious result of a degradation in performance.

# Experiment validation - score no delay

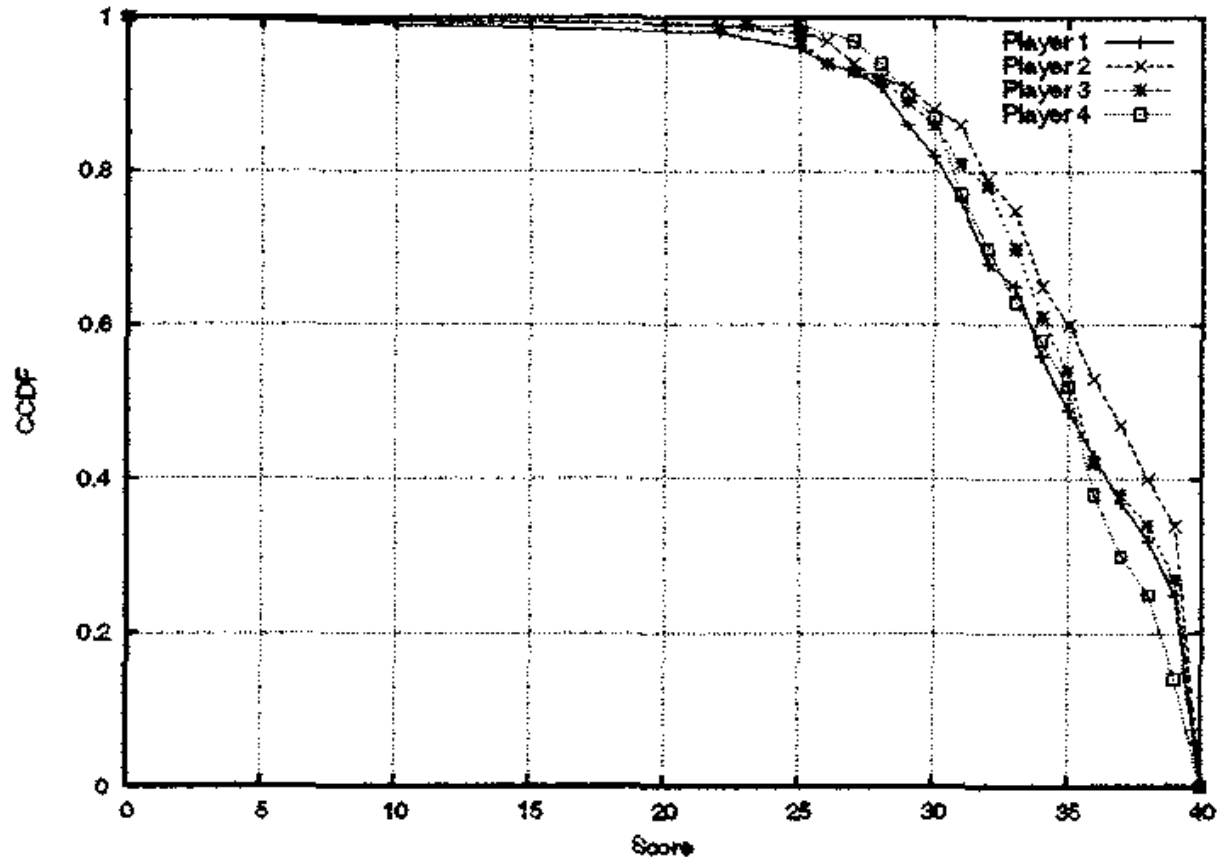


Fig. 1. Final score CCDF with no delay

# Experiment validation - score w delay

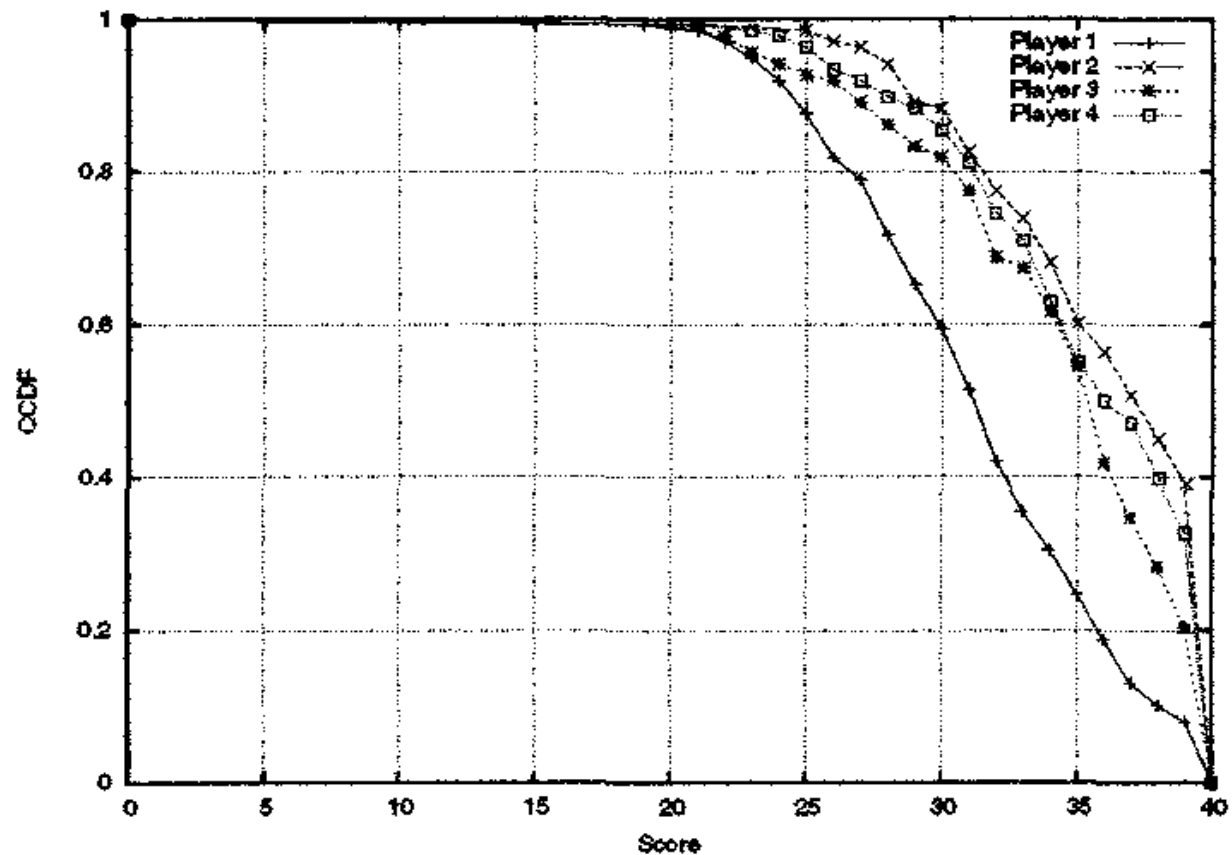


Fig. 2. Final score CCDF with player 1 experiencing 25 ms delay

# Experiment validation - fragging no delay

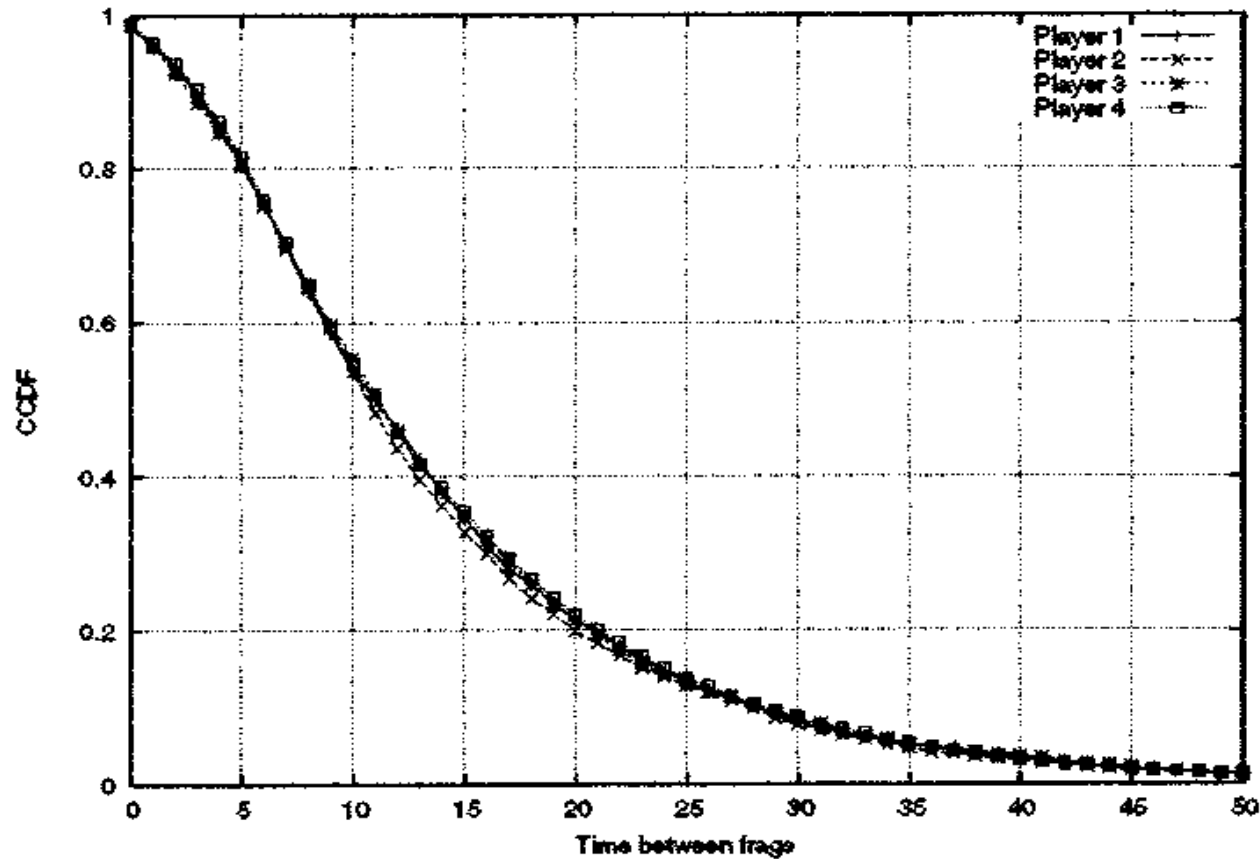


Fig. 4. Fragging CCDF with no delay

# Experiment validation - fragging w delay

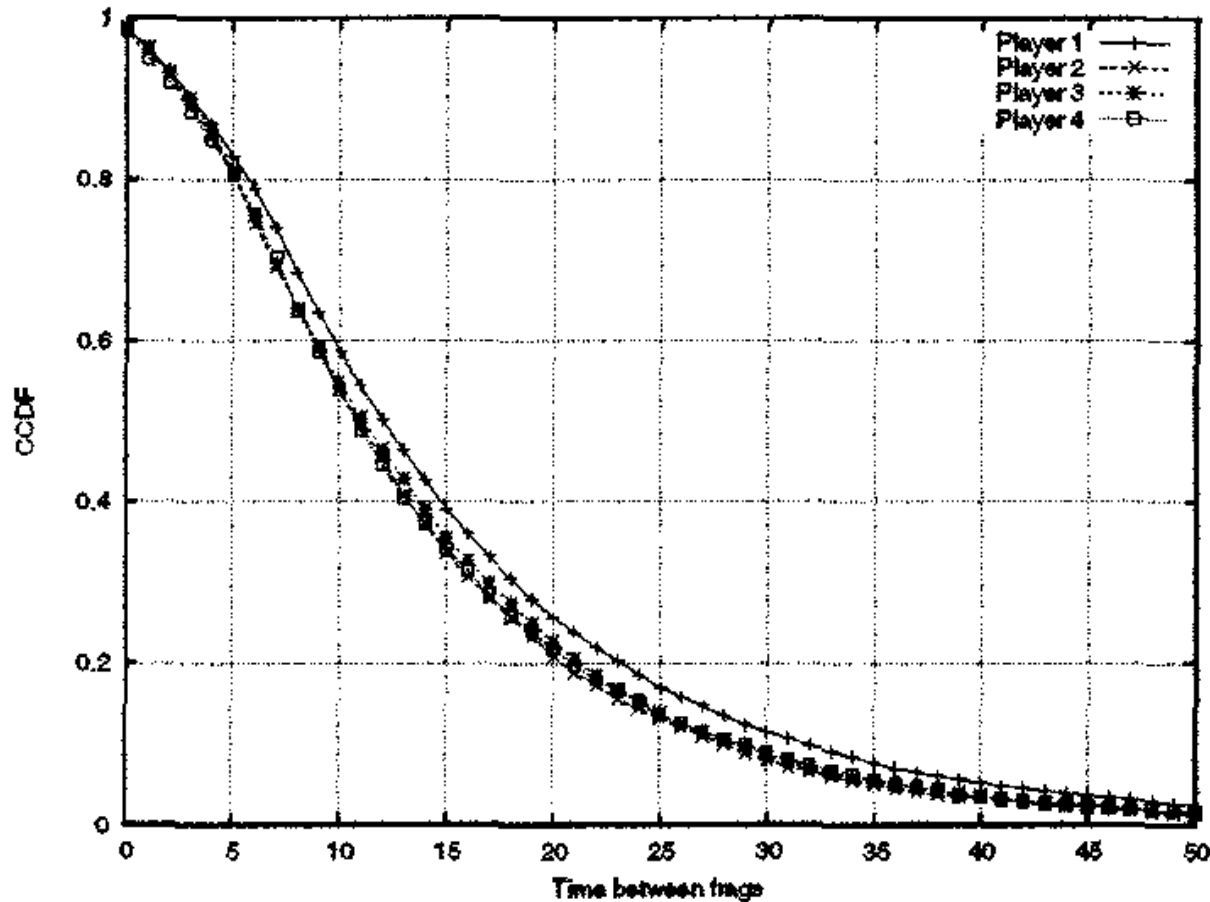


Fig. 5. Fragging CCDF with player 1 is experiencing 25 ms delay

# Results - Impact of Delay on Score

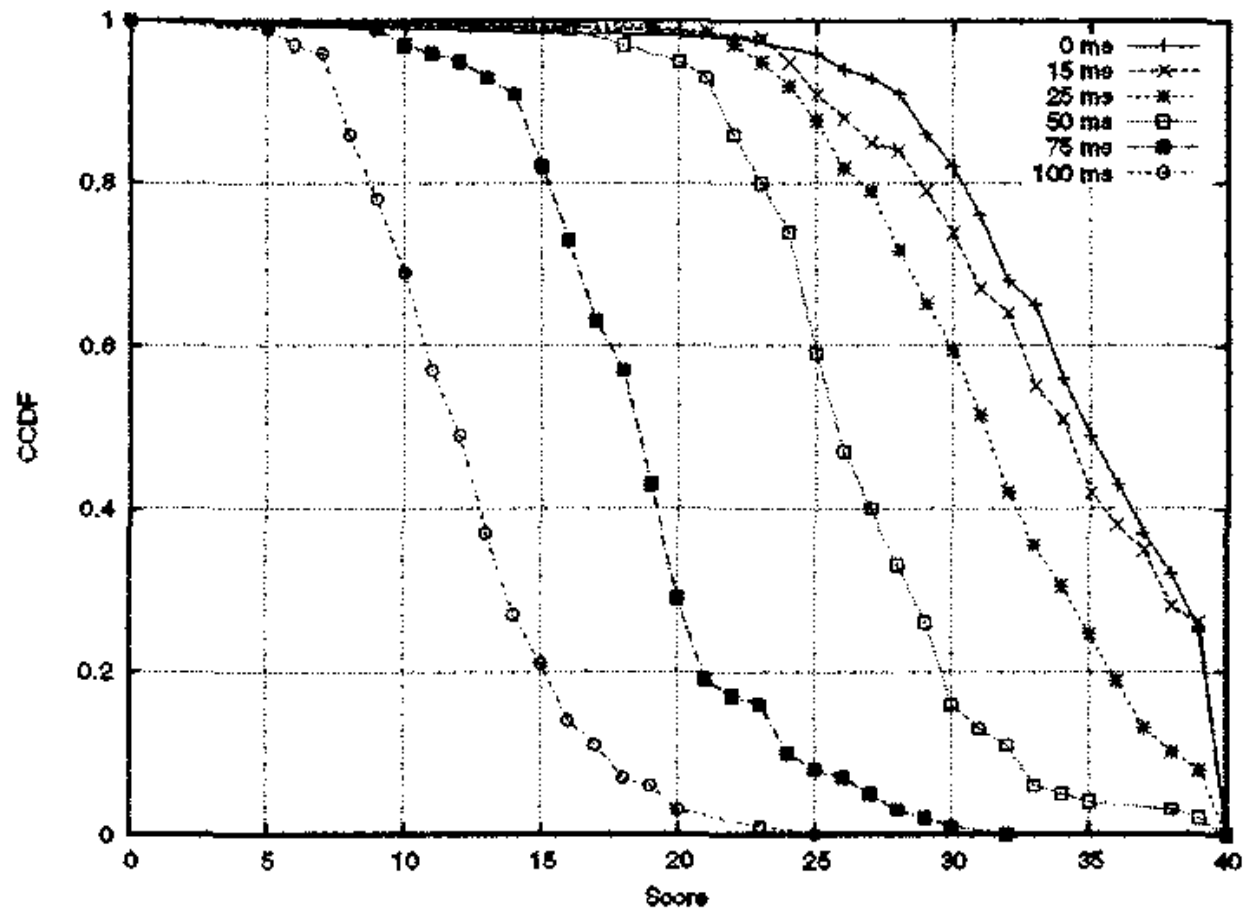


Fig. 3. Score performance degradation based on player's delay

# Results - Impact of Delay on Fragging

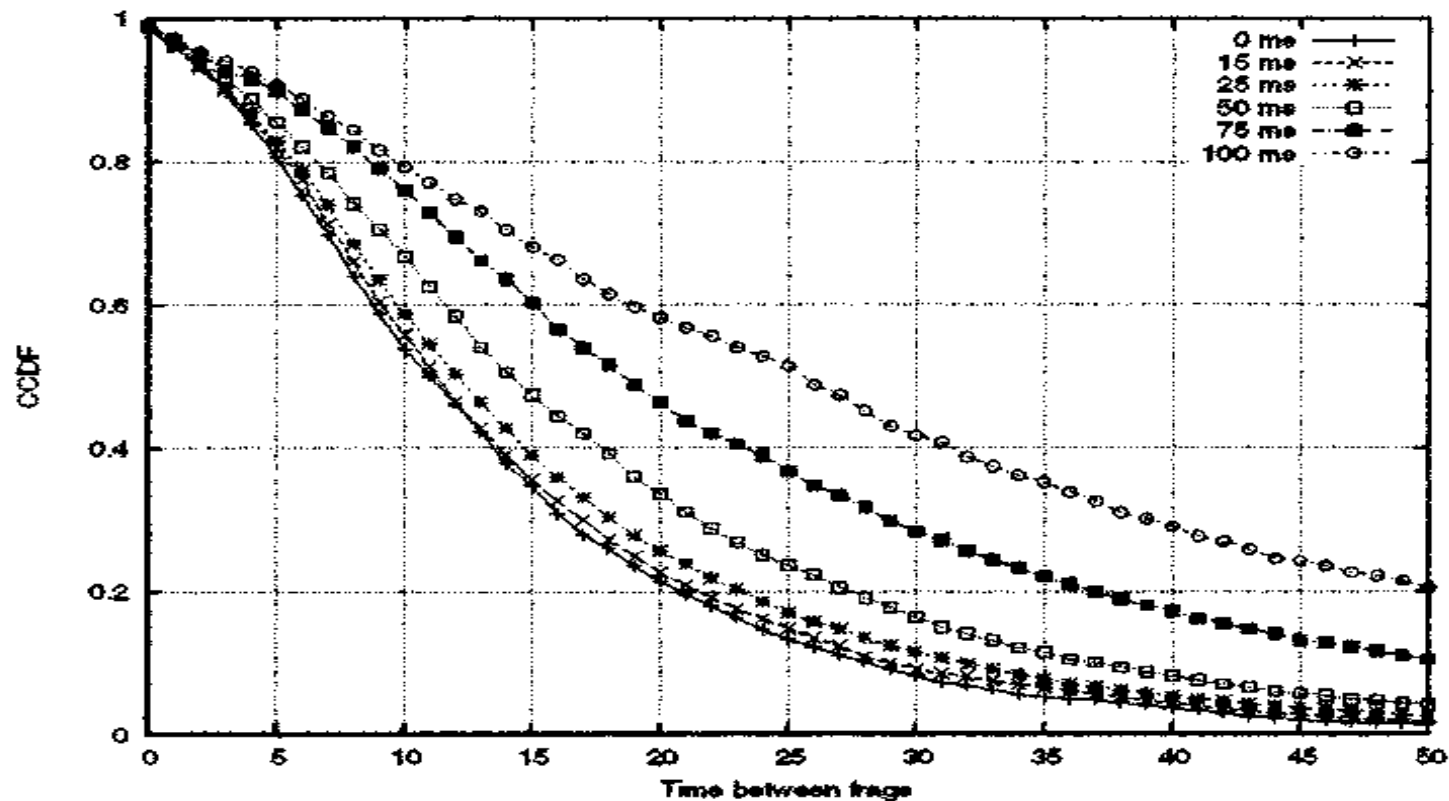


Fig. 6. Fragging performance degradation based on player's delay



# Results - Impact of Jitter on Fragging

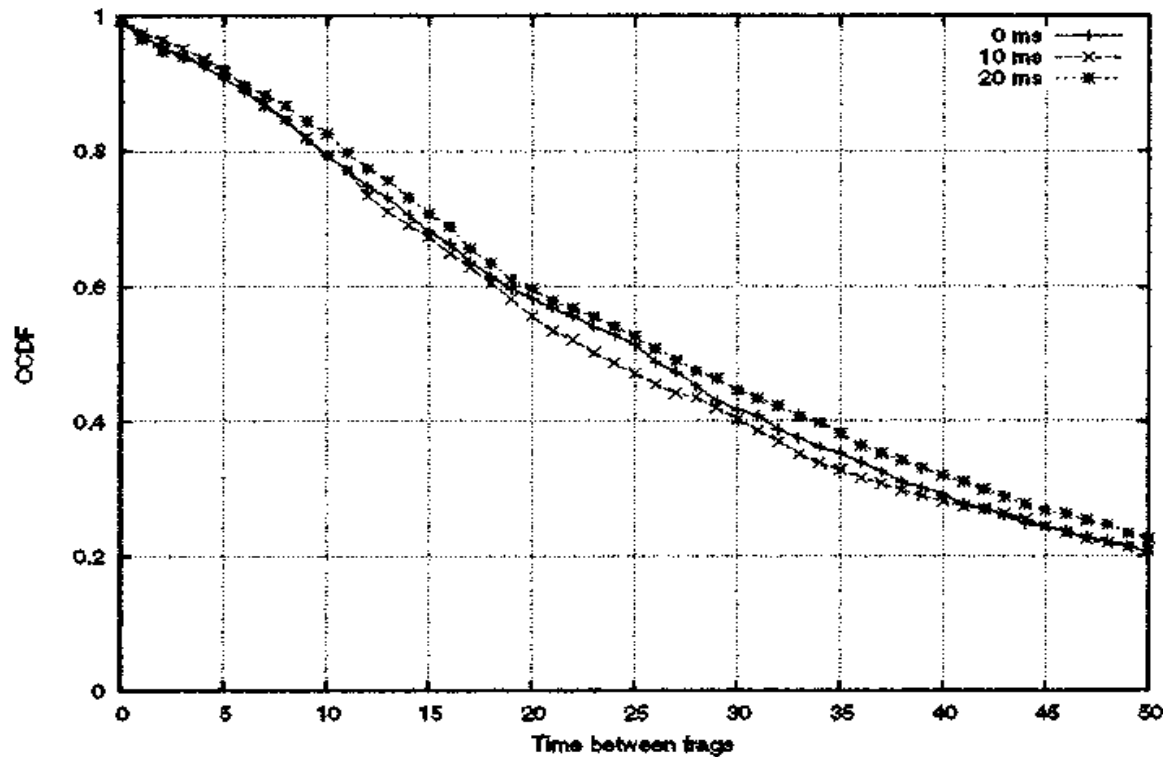


Fig. 7. Fragging performance degradation based on jitter with 100 ms delay

# Results - Impact of Loss on Fragging

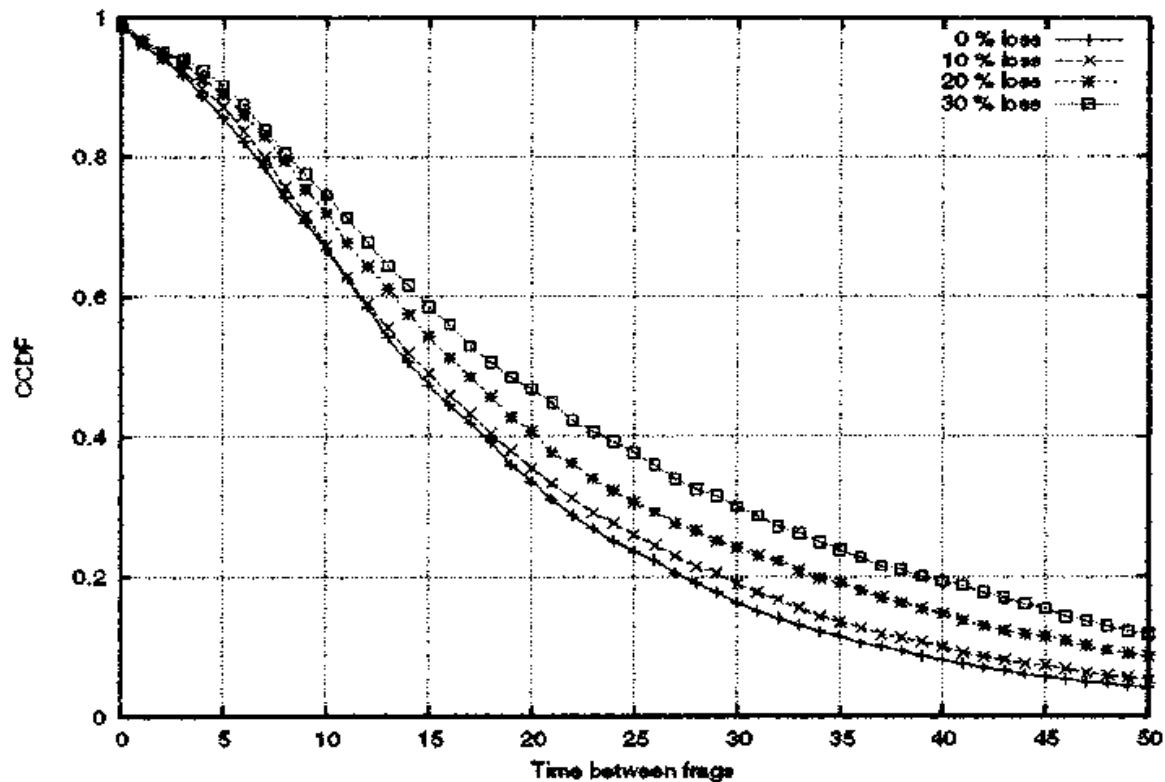


Fig. 8. Fragging performance degradation based on packet loss with 50 ms delay