

Playtime's Over

Gaming Lessons Learned
Dealing with Massive Scale
& Terrible Network Infrastructure in China

High Performance Transaction Systems
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Things to think about

- China is big
- China is complex
- China's Internet is big
 - But different
- China loves playing games
- China's games are online, online, & online

China is big

- China is big – size of the U.S.
- China is big – places far apart, 250-500ms
- China is big – 350,000,000 Internet users
- China is big – 300-500 million videos/day
- China is big – 1, 2, 5, 10 Gbps links common
- China is big – 75 cities of 1+ million people
- China is big – Another billion country folk, too

Size matters - Tiny Internet Cafe



China is Complex

- Three 'regions'
 - North
 - South
 - Students
- Single monopoly ISP per region
- Single ISP per province within region
- Poor links between them
- Licensing & regulatory

Where are you ?



Pull the String Tighter



- Bad for phones
- Terrible for multi-player games
- Horrific for playing six-person basketball

BGP, what BGP ?

- China does not really use public BGP
 - No, really !
- Remember those 2-3 regions ?
- Can't usually dual/multi-home
 - Get 2-3 IPs and Policy Route, GeoDNS
- Buy tunnels and proxy out-of-region – Ugh !
- Shard servers physically in regions/provinces
- Pay all your money to the CDNs for backhauls

Bandwidth is Everywhere

- 1-2 Mbps per house x 200 million
- Data Centers with 5, 10, 25 Gbps common
- LAN often bottleneck !

but . . .

- Inter-city bandwidth heavily loaded – video/BT
- Geo-DNS is per province
 - Sucks when 100 million people share 1 DNS zone
 - Can't locate by city, so inter-city links loaded
- Students can't route – where's the potato ?

Latency

- Here, there, and everywhere
- Tied to bandwidth and packet loss
- Tied to regional interconnects
- High latency is painful to games
- Variable latency is death to games
- Most games built assuming no/stable latency
- Re-write when coming to China

Fun with Data Centers



- Everywhere, but very diverse
- 10x Price differences BJ / SH to countryside
- Very small – often old office buildings
- Limited power – 2.5KW, often 10-15 servers per rack
- Poor service, connections & overloading a problem
 - e.g. Shanghai inbound traffic congested at night
- Must understand the city, province, backbone
- Choose your cities, data centers, and links carefully
- Your first server must be in your home city

Mobile is the Future ?

- World's largest mobile market – 500+ million phones
- Already have MMORPGs, ads, other uses
- iPhone 3G launches this week
- Other 3G rolling out now – iStore, Android, BBerry

BUT . . .

- Mobile Data Centers limit bandwidth, so locate servers
- Congestion (think AT&T 3G in U.S.)
- High and variable latency (maybe)
- Compete with video, bit-torrent traffic

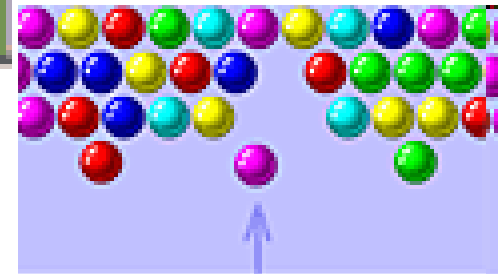
China Loves Games

- All On-Line – few consoles or PC games
- World's largest market, by far – billions of \$\$

- Simple Casual
- Multi-Player Casual
- Simple MMORPG
- FPS MMORPG
- Mobile MMOPRPG
- Hyrbids

Simple Casual Games

- Example: Spil Games (www.spilgames.com)
- Tic-Tac-Toe
- Card Games
- Jungle Shooter
- No skill required
- Usually free, no virtual goods
- Usually Flash or HTML
- Usually single player
- Little/No server communication



Multi-Player Casual

- Example: Radiance
 - (www.Radiance.cn)
- Volleyball
- Basketball
- Car Racing
- Usually free
- Usually virtual goods
- \$1-2/game, \$20-30 for goods – shirt to go 80-> 90% accuracy
- Complexity & Skill often undesirable – K to kill, S to shoot
- Flash or Heavy Client-based
- **Server or P2P-based**
- **Lots of network traffic**
- **Very latency sensitive**



Casual Game Player

- No skill desired
- Use one hand
 - Why ? Smoking !
- Multi-task
 - Game
 - Watch Movie
 - Chat (MSN/QQ)

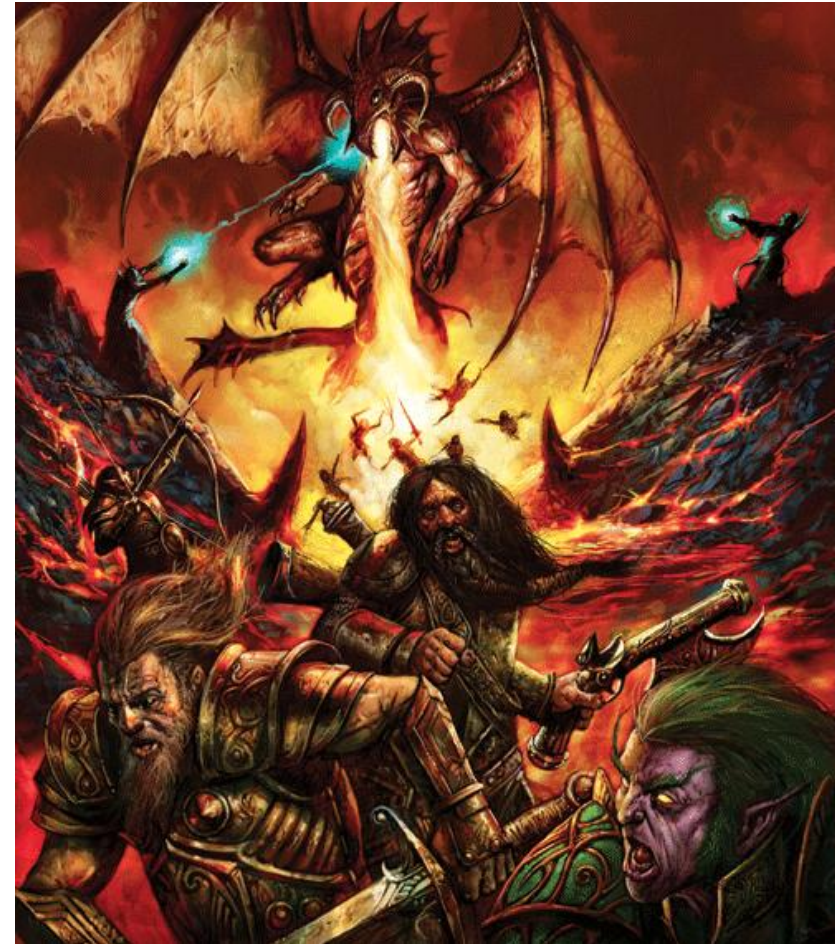


Multi-tasking



MMORPG

- Example: World-of-WarCraft
- Often pay-to-play
- Huge clients – MB/GB
- Heavy network traffic
- Heavy server loads
- Latency sensitive



MMO Traffic

- Related to many things
- Number of on-line users
 - Log in/out
 - Chat
 - Buying items
- Number of interacting users, per place
- Number of objects in use by each user
- Reaches Gbps quickly to server
 - Have a model for 50Gbps at 1 million users

Results ?

- Very challenging game play
- Worst for multi-player sports
 - BBall, VBall, racing, tennis
 - Latency 300-3,000ms
 - No ball or 2 balls
- Locality is almost everything
- P2P not much better
- Many strategies required



General Strategies

- Cluster users by region / server
 - Self vs. Auto-Select
 - Eject slowpokes
 - But, players want to go where the action is
- Measure & sort by real-time speed
- Reduce chatter, cut bandwidth needs
- Predict motion to reduce messages

Some Strategies

- Choose server location / links carefully
- Buy links to North / South / Students
- Cache everywhere (Client, CDN, Region, Cafe)
 - Traffic & Assets are huge
- Build for variable latency
- Retry, a lot, again
- Find experienced operations people

More Strategies

- Gather players
- Measure them
- Let players evict slow ones
- If P2P controller disconnects, game dies
 - Simple, but painful
- Pre-install; 1GB download, lost on reboot
 - 1GB download/100MB updates monthly

Lessons Learned



- The network hates you
- The only certainty is uncertainty
 - Especially latency & basic availability
- If P2P, test users & use servers wisely
- Know where users are, if you can
 - Manage them to zones & locality
- Measure & reduce bandwidth
- CDN everything possible
- Know the network, ideally in real-time

Summary

- China an exciting place, on many levels
- Internet challenging & fairly complex
- Truly massive game audience
- Innovative compensation for infrastructure



谢谢 - Thank You

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