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Research Report on Pokémon Go's Requirements for Mobile Bearer Networks

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Document Description

The document analyzes Pokémon Go, a global-popular game, from two aspects: What are its characteristics when compared with other typical mobile apps? What is its requirement for the mobile bearer network?

Change History

Version	Release Date	Description	Author
1.0	2016-08-15	This is the initial release.	Hu Yan (employee ID: 00247200)

Key Findings

Pokémon Go is now a global phenomenon. Integrating location based service (LBS) and augmented reality (AR) elements, the game offers unprecedented game experience, encouraging players to explore in the outdoor. Players use mobile phones to discover, capture, collect, and train Pokémons, and in the meantime, socialize with other players. It is AR that brings unique interaction and great fun to the game. Mobile terminals become the junction of virtual and real worlds.

What is the difference between Pokémon Go and other typical mobile apps? What is its requirement for the mobile bearer network? To answer the questions, Huawei iLab performed in-depth analysis based on live-network data and comes up with the following key findings:

1. Traffic consumed by Pokémon Go (LBS+AR) is 5 to 10 times that of traditional mobile games. The increasing traffic fills up the network pipelines.
2. Pokémon Go encourages player to go to the outdoor, requiring wider coverage of wireless networks. More base stations need to be deployed and AnyMedia and Small Cell solutions are required to support fast wireless site deployment.
3. Bandwidth and latency requirements for Pokémon Go are similar to other mobile games.
4. As burst traffic generated by each Pokémon Go player is discrete and the effect of time division multiplexing is obvious, overlaying burst traffic is not a big issue even if multiple players are concentrated in one place.
5. Pokémon Go is not a true AR app because it only integrates partial LBS and AR elements. True AR apps are still restricted by processing capability and battery life of mobile terminals. In the future, a large amount of real-time computing and graphics rendering will be put on the cloud, which requires the bearer network to be planned in advance to provide larger bandwidth and shorter latency.

1 Gameplay and Information Exchange

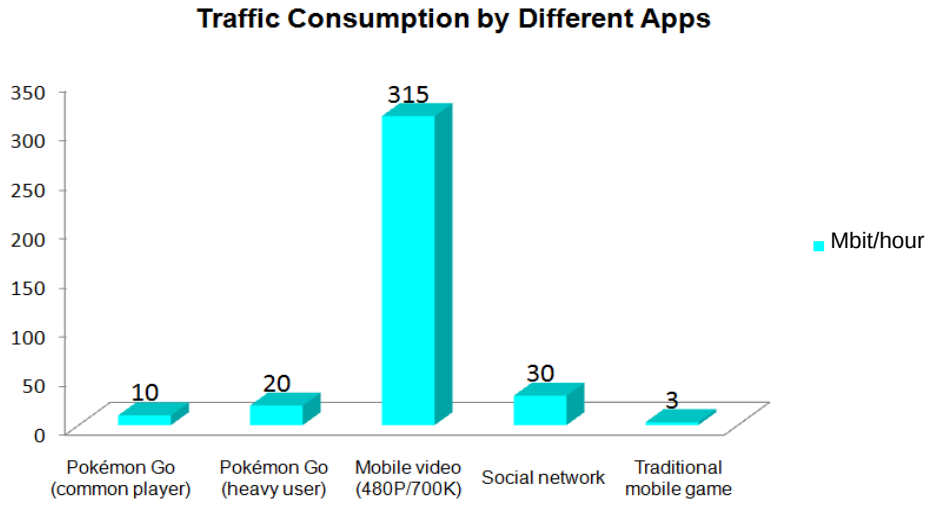
The following table describes gameplay and information exchange of Pokémon Go:

Action	Logging in	Moving	Pokémon Discovery and Capture	Gym Battle
Description	A player can log in using two types of accounts: • Google play • Pokémon trainer club	Players must physically travel to explore the game's map.	If players encounter Pokémons during movement, data of the Pokémons is downloaded. Players throw Pokéballs to capture the Pokémons (the success rate depends on various factors).	Players enter a Pokémon gym to battle (attack, charge, escape).
Information Exchange	The client (user terminal) needs to exchange information with multiple servers: Google account server, game configuration server, game registration server, and map server.	Frequent data exchange between the client and the game server/map server	• Players travel to a position near a Pokémon. • The client sends a request to the game server to obtain nearby Pokémon information. • After a Pokémon is captured, the client sends a request to the server to update the Pokémon ownership information of the player.	• Before the battle, gym and gym owner's information needs to be obtained. • Each user operation during the battle needs to be uploaded. • Small-amount uplink and downlink data exchanges between the client and server are frequent during the battle.
	Each data exchange with the game server generates about 5–10 Kbit traffic. Each data exchange with the map server generates about 10–15 Kbit traffic.			

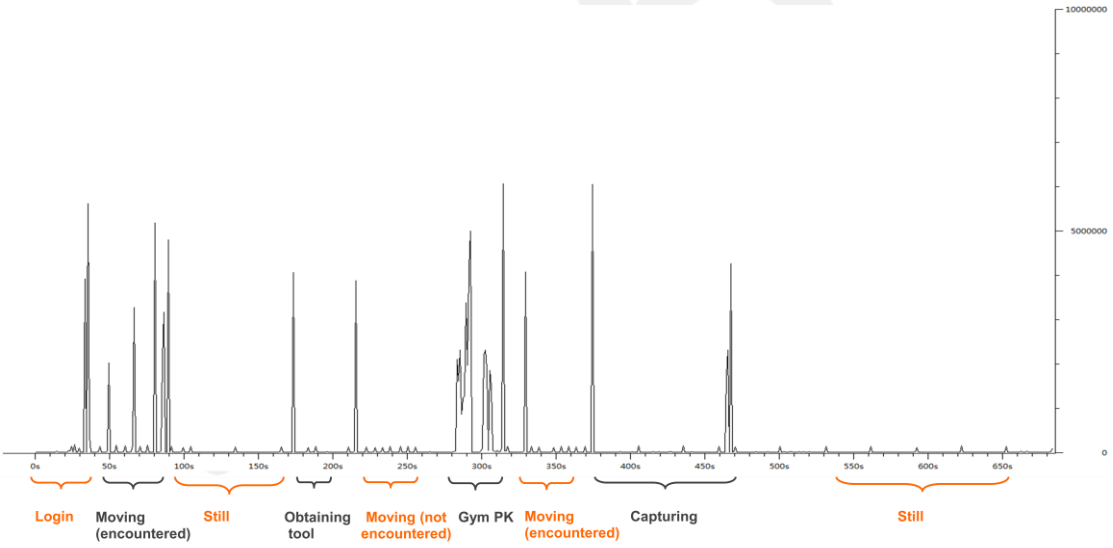
2 Bandwidth Requirement Analysis

6.2 Single-User Bandwidth Requirement

According to packet capture results, peak traffic is generated during login and movement and the peak rate is around 5 Mbit/s. Average traffic consumption of a common user is 10 Mbit per hour. A heavy user may consume 20 Mbit per hour. In contrast, a user only consumes 2–3 Mbit traffic per four in a traditional mobile game. Compared with traditional mobile games, Pokémon Go consumes considerably more traffic, but it consumes less traffic than video and social networking apps. According to statistics conducted by Verizon, Pokémon Go contributes to only 1% of network traffic, but it ranks among the Top 20 apps.

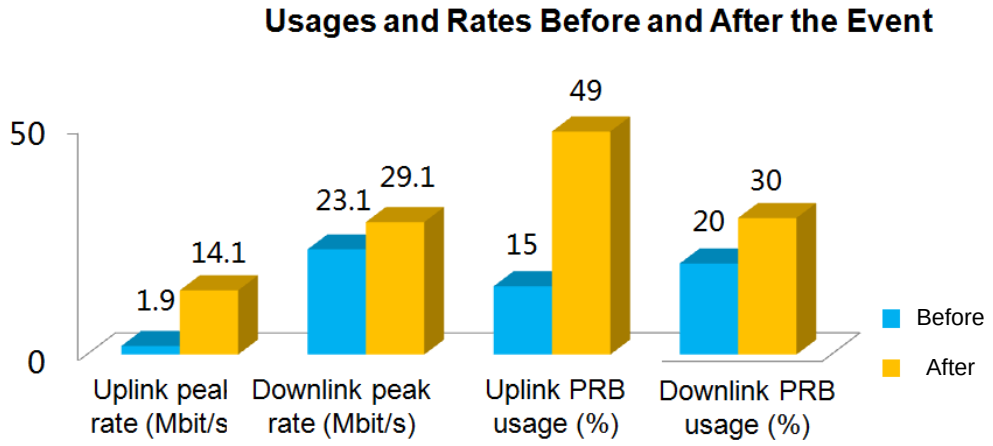


In conclusion, burst traffic generated by each single Pokémon Go player is discrete and the effect of time division multiplexing is obvious.



6.3 Multi-User Bandwidth Requirement

On July 28th, more than 3,000 players met up in Madrid to participate a Pokémon hunt. According to a Huawei VDF MIC report, the number of concurrent online subscribers on a base station reached 613 during peak hours. Then, the base station's uplink and downlink peak rates were 14.1 Mbit/s and 29.1 Mbit/s, respectively.



With 613 subscribers connected, the uplink traffic on the base station increased significantly, but the volume of uplink and downlink traffic was not enough to put the bearer network under pressure. The PRB usage of the base station was 50% or less and the air interfaces were not heavily loaded. In conclusion, multiple-user traffic behavior resembles that of a single user (the effect of time division multiplexing effect is obvious). Existing bearer networks can support concurrent access of multiple users.

3 Latency Requirement

The game features discrete small packet transmission where clients establish short-lived, frequent, and concurrent connections with the game server. Huawei iLab simulated the live network environment and measured the impact of RTT on the login duration.

E2E RTT	20 ms	120 ms	220 ms
Interval between the login and complete display of the map	24s	28s	38s

As Pokémon Go players encounter and capture Pokémons independently and do not need to fight with each other for Pokémons, latency affects only the Pokémon information downloading speed. Gym battles are actually performed offline (not real-time) by data exchange between the client and server. There is a minimum interval between battle actions, reducing the game's sensitivity to latency. If the RTT is within 220 ms, battle experience is satisfactory.

According to a mobile game experience analysis report released by iLab in 2015, optimal experience of traditional mobile games requires the unidirectional latency to be within 55 ms. Therefore, Pokémon Go and traditional mobile games have similar latency requirements.

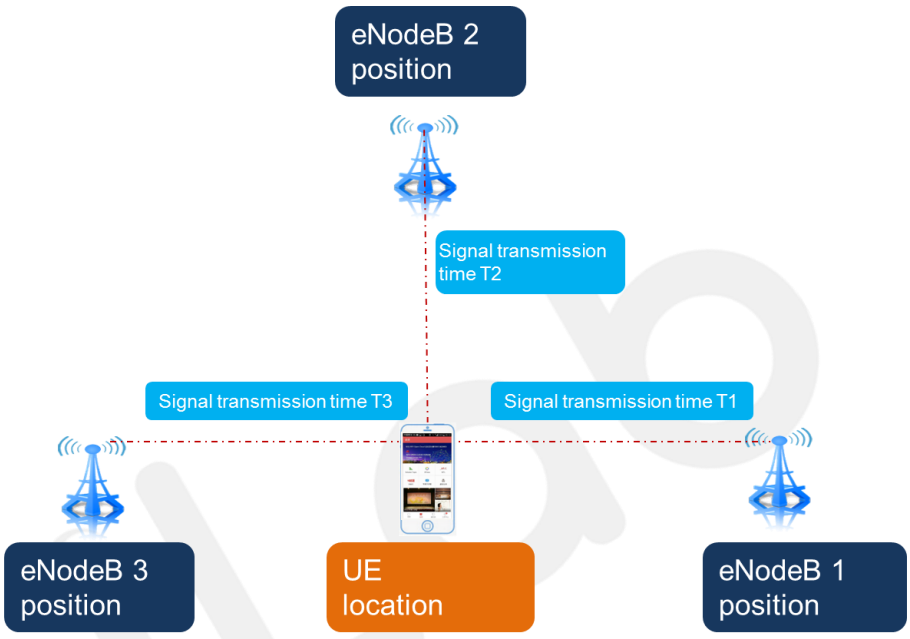
In conclusion, Pokémon Go is not a latency-sensitive game. The basic game experience can be ensured when the RTT is within 220 ms and optimal experience can be provided when the RTT is within 120 ms. Latency optimization can improve login and Pokémon encounter experience.

4 Relationship Between LBS and the Bearer Network

Currently, Pokémon Go is mostly played in the outdoor and the player can be positioned by GPS and base stations. In the indoor environment, although the player can be positioned to the correct building by wireless or Wi-Fi signals, precise positioning is impossible to detect indoor movement.

To implement high-precision positioning in the indoor environment, time difference of arrival (TDOA) can be employed to increase indoor positioning precision to 3–5 m, allowing game developers, merchants, operators to achieve win-win (Pokémon Go is sponsored by local merchants).

In the cross-BBU scenario, TDOA requires 1588v2 time synchronization across BBUs. In this case, the bearer network needs to support time synchronization. However, the indoor cross-BBU scenario is rare on live networks.

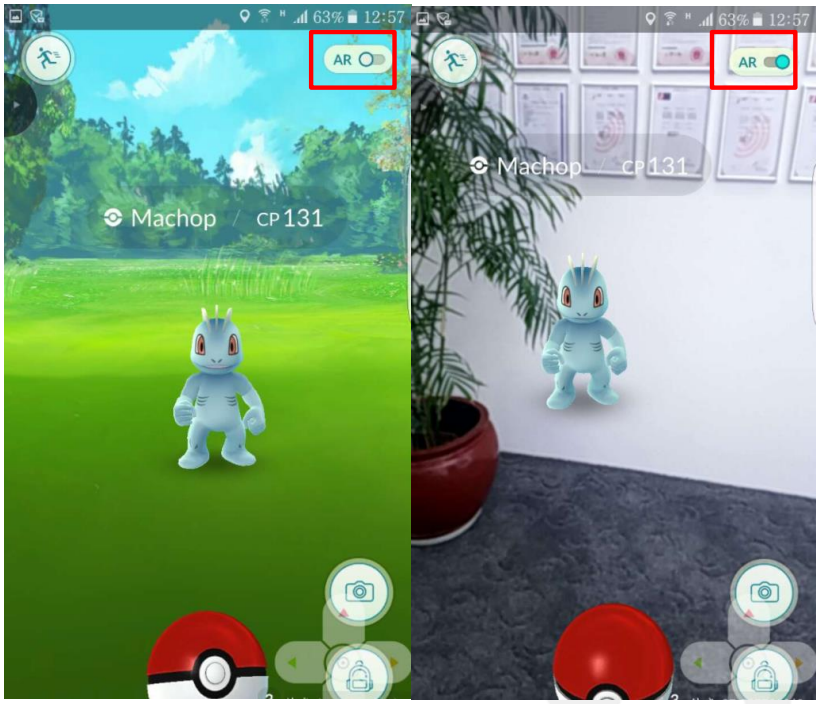


Location=GetLocation ([Position1,T1], [Position2,T2], [Position3,T3])

5 Requirements for the Bearer Network in AR Mode

When a player encounters a Pokémon, they may view it either in AR mode or the generic background. In AR mode, the image of a Pokémon is displayed as though it were in the real world. Traffic consumption in the two display modes is nearly the same. It can be inferred that graphics processing is performed locally in AR mode and graphics data is not exchanged between the client and server.

AR Enabled and Disabled

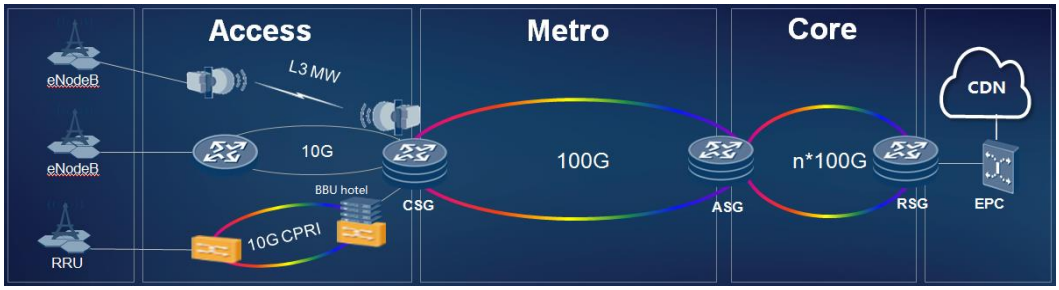


6 Opportunities and Challenges Facing the Bearer Network

6.1 AnyMedia Avails Fast Wireless Site Deployment

As mentioned before, existing mobile bearer networks can provide satisfactory game experience for Pokémon Go in terms with acceptable bandwidth and latency specifications.

Because the game encourages players to go to the outdoor, it generates considerably more wireless traffic than traditional mobile games, stimulating sales of wireless data plans. For example, T-Mobile has announced a free data plan for Pokémon Go to attract subscribers. Growing wireless traffic will drive coverage and capacity expansion of wireless networks. The Huawei AnyMedia solution supports multi-media access to the mobile bearer network including 10GE IPRAN, microwave, and CPRI-Haul, facilitating fast deployment of wireless sites.



6.2 Foresight into AR Games and Cloud-based Rendering

Based on LBS and AR, Pokémon Go requires long-term GPS connection, screen-on, and local graphics processing. It has encountered a bottleneck in battery life (battery of an iPhone can survive three hours in the game). As estimated by Goldman, AR apps need a whole-day battery life to ensure mobility. To improve AR experience, more complex real-time computing and image rendering are required, challenging the CPU processing capability and battery life of mobile terminals. A solution is to migrating real-time computing and image rendering to the cloud.
Cloud-based real-time computing imposes stricter requirements for the network latency. Cloud-based image rendering also needs larger network bandwidth and shorter latency. Network requirements of some could-based games are listed as follows:

1. Sony PlayStation Now: 5 Mbit/s or larger bandwidth
2. First person shooters (FPS):
   - UDP protocol
   - Packet loss tolerance
   - Low latency (FPS response time is usually less than 50 ms)
   - High packet rate (compared with traditional games)
   - Regular packet size
   - Regular packet arrival interval

(Cited from IETF 87, Berlin, August 1st, 2013, Transport Area Open Meeting)

The heat of Pokémon Go will accelerate AR popularization. Smart phones and AR glasses will become extension to human sensory systems. Real-time information exchange and cloud-based graphics processing impose great challenges for the bandwidth and latency of existing mobile bearer networks. Changes are inevitable.

The analysis result of this report may be inaccurate due to data source, game version, and research methodology limitations. If you have better suggestions, feel free to contact us.