

SEPTEMBER STATUS UPDATE

NETWORK LINK PERFORMANCE PREDICTION

@ W3C WEB AND NETWORK IG

Sept1 – 2020

PRELIMINARY VERSION

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AGENDA

- Quick Recap from W3C Fukuoka meeting
 - Challenges left to solve
- Dev tool: Network Trace Extension and trace lib
- Global LPP service and LPP service lookup
- MPEG/DASH interworking

1. Quick Recap from W3C Fukuoka meeting

Full LPP TPAC-19 presentation:

<https://www.w3.org/2019/09/17-web-networks-lpp.pdf>

WIRELESS NETWORK CHALLENGES – LPP SOLUTION

Networks are better, but variations are larger

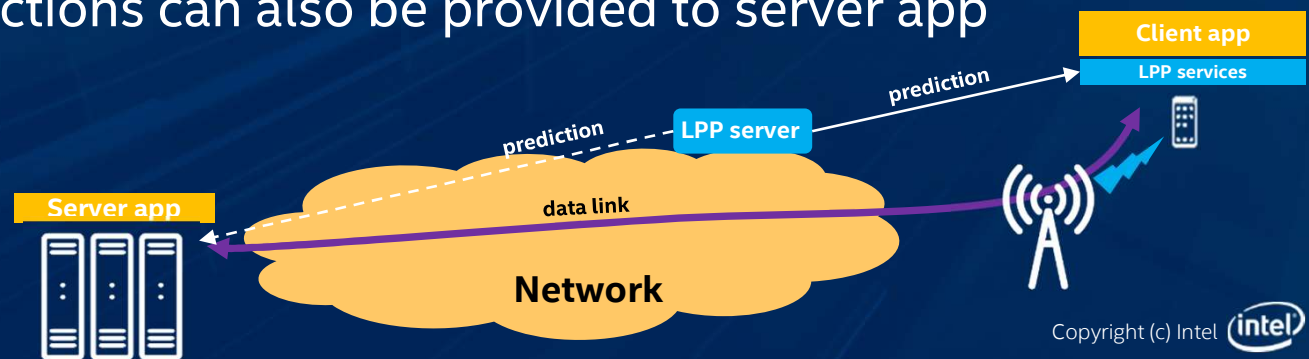
- Large variations in quality **between** networks
- Large variations **within** networks

LPP – Bring network awareness to the application

- Provided as "hints" – application is still in control
- Current and near future link performance
- Multiple parameters: bandwidth, latency, cell load...

INTEL LINK PERFORMANCE PREDICTION (LPP) TECHNOLOGY

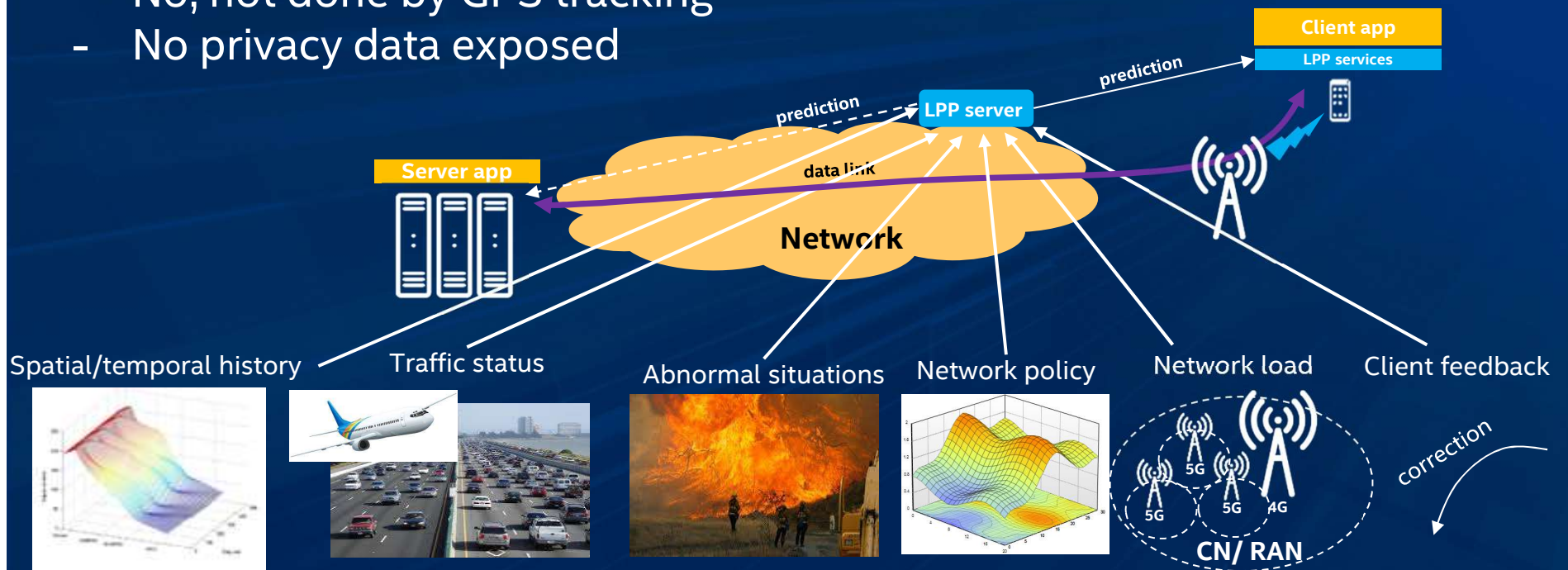
- Client/server connection as normal
 - Agnostic to Cloud, Edge etc.
 - No data is touched or routed through LPP server
- LPP server added to give link performance hints
 - LPP server resides in Operator network
 - Easy to use client service library to enable
 - Optionally predictions can also be provided to server app



INTEL LINK PERFORMANCE PREDICTION (LPP) TECHNOLOGY

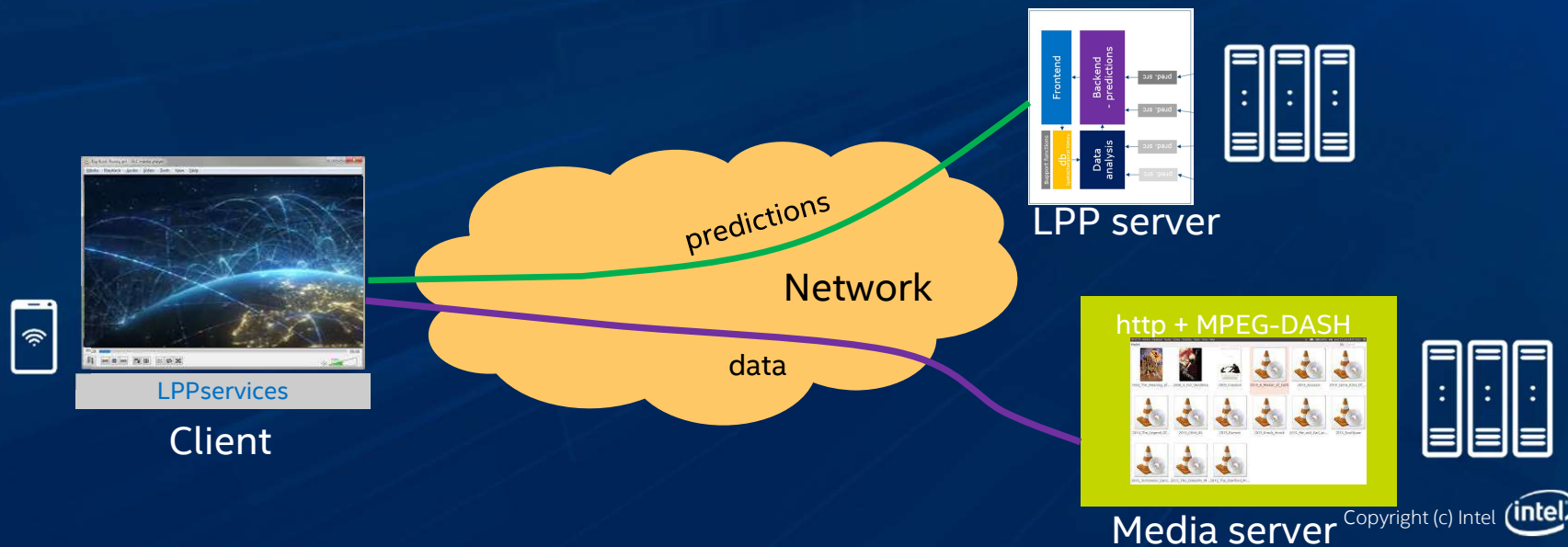
Predictions generated from a number of inputs...

- No, not done by GPS tracking
- No privacy data exposed



EXAMPLE USE-CASE: MEDIA STREAMING WITH LPP

- LPP server at location A
- Media played over standard MPEG-DASH media server at location B
- Client running web-browser with js-media player



CHALLENGES LEFT TO SOLVE

A) Get wider traction – “chicken and egg” situation:

- How do we get further operator deployment without users of service?
- How do we get users of service without wide operator deployment?

B) How do we know what LPP server to connect to?

2. Dev tool: Network Trace Extension and trace lib

NETWORK TRACE TOOLS

A set of browser app dev tools intended to emulate different networks:

1. Browser extension to emulate network behavior over time from trace file
2. Trace files for different wireless* networks around the world
3. Trace file specification
4. Trace collection tool to gather/create trace files

Intel is looking for feedback on interest in opening this to the wider community

*Could also be wired, but less important as they have more static behavior

NETWORK TRACE – EMULATE CONDITIONS

- Controls overall browser network connection – works with "any" site
- Replays a trace file with time/parameters, eg. bandwidth, latency...
- Provides "look ahead" predictions for LPP style link prediction

The screenshot shows a browser window with the Network Trace tool active. The main content is a video player for "From Sand to Silicon: The Making of a Microchip | Intel". The Network Trace panel is open, displaying a bandwidth graph for a file named "subwaytrace.txt". The graph shows bandwidth over time, with a vertical line indicating the current time. Below the graph, the current download rate is 33669 kbps. The LPP (Link Prediction) section shows a prediction window of 250 seconds and a list of predicted bandwidths at various time intervals.

Time (sec)	Bandwidth (kbps)
24	31011
67	34552
159	45169
187	10583
191	30926
249	49312

Current time

Current bandwidth

LPP predictions

NETWORK TRACE FILE

- JSON based file format

Adopted HAR look and feel:

<https://w3c.github.io/web-performance/specs/HAR/Overview.html>

- Simple Header: version, description, client info
- Set of trace events, time/date + parameter fields:
 - Network information
 - DL/UL bandwidth
 - Latency
 - GPS position and accuracy

NETWORK TRACE CAPTURE TOOL

Intel® LPP Network Trace Tool

Description:

Client model:

Client name:

Note:

DL BW test interval (sec):

Debug

Browser name = Chrome
Full version = 84.0.4147.135
Major version = 84
navigator.appName = Netscape
navigator.userAgent = Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/84.0.4147.135 Safari/537.36
navigator.connection: SUPPORTED
navigator.permissions: SUPPORTED
navigator.geolocation: SUPPORTED

Status: running...

Measured DL BW: 9013 kpbs

Downlink Speed/bandwidth estimate: 1638.4 kpbs

Network: undefined (ECT: 4g)

Position:
- latitude: 51.919438
- longitude: 19.145136
- accuracy: 240385

some IP/URL



```
{
  "version": 1,
  "description": "Trip from A to B",
  "clientModel": "SM-S390",
  "clientName": "Samsung",
  "entries": [
    {
      "entryNo": 1,
      "dateTime": "2020-08-25T09:22:48.339Z",
      "dlBw": 27122,
      "gpsCoordinates": {
        "latitude": 51.919438,
        "longitude": 19.145136,
        "accuracy": 240385
      },
      "network": "undefined (ECT: 4g)"
    },
    {
      "entryNo": 2,
      "dateTime": "2020-08-25T09:22:57.803Z",
      "dlBw": 8800,
      "gpsCoordinates": {
        "latitude": 51.919438,
        "longitude": 19.145136,
        "accuracy": 240385
      },
      "network": "undefined (ECT: 4g)"
    },
    {
      "entryNo": 3,
      "dateTime": "2020-08-25T09:23:07.782Z",
      "dlBw": 9093,
      "gpsCoordinates": {
        "latitude": 51.919438,
        "longitude": 19.145136,
        "accuracy": 240385
      },
      "network": "undefined (ECT: 4g)"
    },
    {
      "entryNo": 4,
      "dateTime": "2020-08-25T09:23:17.954Z",
      "dlBw": 9582,
      "gpsCoordinates": {
        "latitude": 51.919438,
        "longitude": 19.145136,
        "accuracy": 240385
      },
      "network": "undefined (ECT: 4g)"
    }
  ]
}
```



3. Global LPP service and LPP service lookup

CHALLENGES LEFT TO SOLVE – LPP SERVICE AVAILABILITY

If LPP style service is too infrequently accessible it won't even be tried

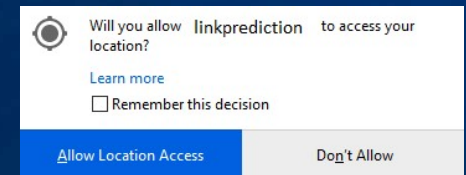
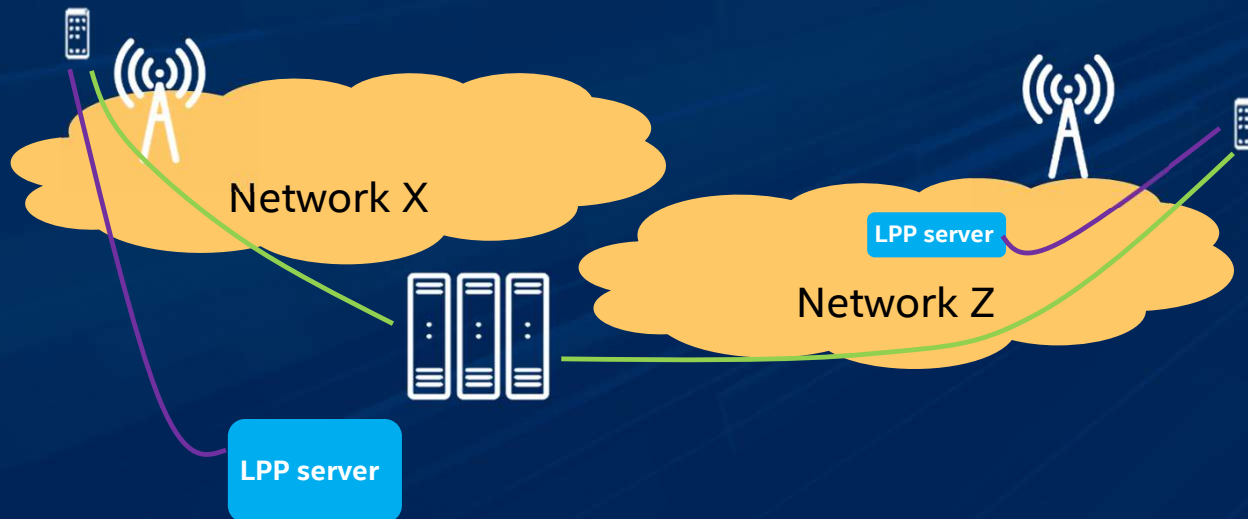
How can we ensure some level of LPP service is always available for application?



"BACKUP" OR "GLOBAL" LPP SERVICE

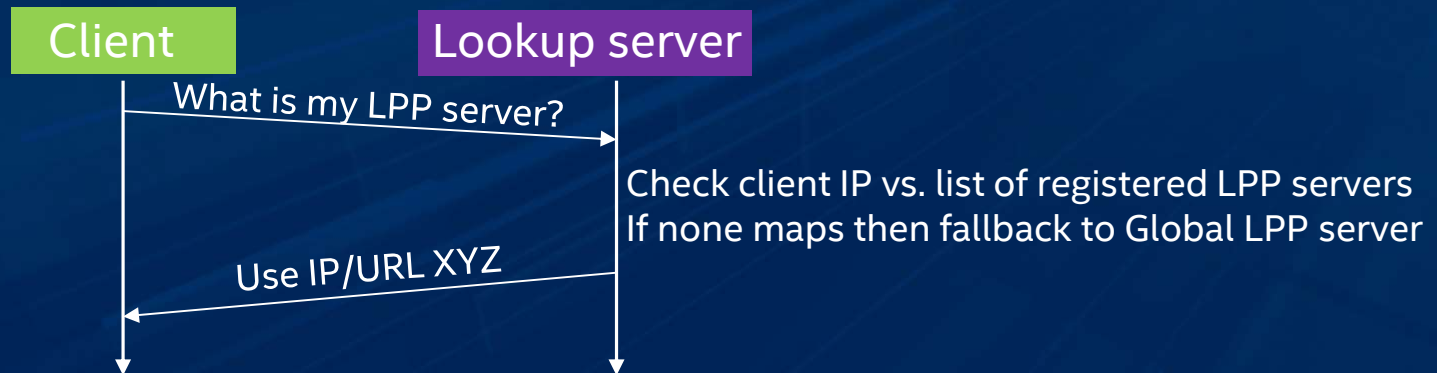
A "Global" LPP service would provide service for networks that does not carry its own LPP service

- Rely on e.g. GPS, network ID and field feedback
- Less prediction accuracy can be expected as input is less exact
- Privacy implications – user can always deny sharing, as normal with location



LPP SERVER ASSIGNMENT METHODOLOGY

- How do we know what LPP server to connect to?
 - DHCP, DNS, WPAD, Anycast, IP/URL override, etc. concepts were considered but they did not fit well
 - Proposal, at least initially, is a simple central lookup service based on client src IP which is set at API init

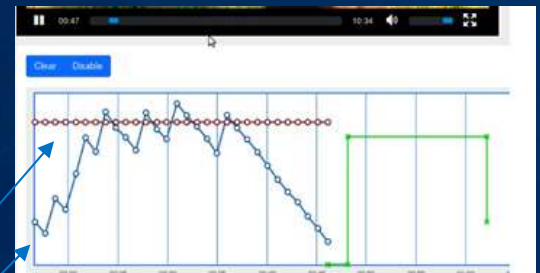


4. MPEG/DASH interworking with LPP

MPEG/DASH AND LPP – WHAT WE HAVE DONE

- Modified Dash ref lib/player, version 3.0.0.
 - <https://github.com/Dash-Industry-Forum/dash.js>
 - <http://reference.dashif.org/dash.js/v3.0.0/samples/dash-if-reference-player/index.html>
 - Tests has been done both on mods in ref lib and directly in player, both works with some respective pros/cons.

- LPP changes tunes the bufferTarget
 - `src/streaming/rules/scheduling/BufferLevelRule.js`

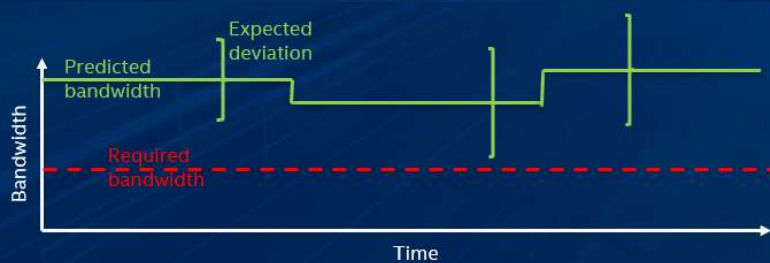


Target buffer level
- based on prediction

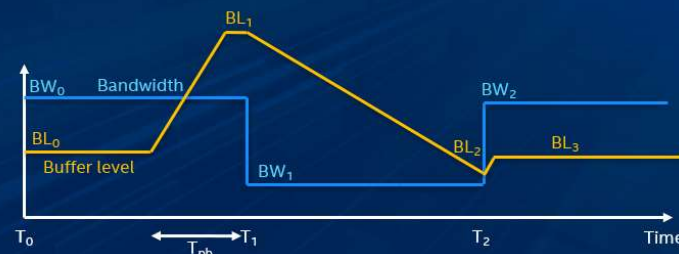
Actual buffer level

STREAM BEHAVIOR CONFIG

- Different behaviors / strategies to apply vs. desired behavior
 - Stream specific parameters: min/max buffer, quality, etc.
 - What behaviors should be active
 - How aggressive should each behavior be
- Streaming strategy config
 - Manifest file as a way to config different behavior profile
 - Also consider in-band and out-of-band events to feed predictions



Exampe A: Minimize buffer with good network

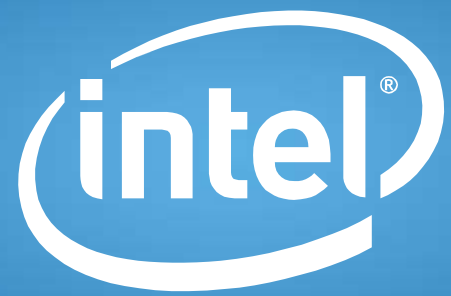


Example B: Pre-buffer to cover contention/gaps

HOW APPLICATION PERCEIVES NETWORK

- LPP predictions are tuned and improved based on application feedback
- Different application perceives network differently
 - Bandwidth for large vs. small datatransfers
- Proposal is to leverage DASHs per chunk statistics as feedback loop





WEB NETWORK TOOLS TODAY

