Keeping state election infrastructure safe: How Cloudflare and local IXP connectivity helped a small country in Europe

Authors:
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About me

- Programmer by heart
- 7 years ago was asked to be part of the Computer center on the Faculty for Computer Science and Engineering (FCSE)
- Experience in networking for 10+ years
- Started exploring the RIPE Atlas project years ago – RIPE Atlas Ambassador
- Created IXP.mk last year (July 2018) as the first IXP in Macedonia
The problem

- Initial idea started before RIPE SEE4 (Belgrade 2015)
- Previous idea the “famous” MATRIX project – dead in the water for years.
- The faculty has good cooperation with major ISP
- December 2016 – FCSE starts the project “Research platform (testbed) for high availability internet connections”, - multiy year project for cooperation and research of possible ways to improve connectivity to between major ISP and University networks
- December 2016 – First meeting with help from RIPE/ISOC for getting key players on board
- 2017 – Work on the initiative
- 2018 – IXP momentum emerges and IXP.mk is officially born
Initial ideas for the Election Info system

- Use IXP.mk to allow almost unlimited bandwidth for Macedonian ISPs (minimal connectivity is 1G per ISP) which will feed info into the Election system
- (Try to) Use Cloudflare for “international” access via a special dedicated link (initial link was 300Mbit and service was not stable)
- Virtualize all servers
Cloudflare steps in

- We contacted Cloudflare since they have project “Athenian” which allows election comities to use the service for free
- Although the service was designed for USA – we got on boarded in less than 24h
- We started to experiment and saw problem we need to resolve in the Election Information system with the vendor producing the system
Redesign of the Election Information system

- Application was monolithic – One Application server and One Database server;
- Cloudflare caching was useless since the whole HTML needed to be rebuild every 5 minutes
- Application was split into modular architecture – with dynamic data as JSON file per electoral region (around 4000 JSON files)
Results

**Fewer Servers Needed**
- 50%
  - Use Page Rules to cut costs and improve performance.

**Bandwidth Saved**
- 83%
  - 174.42 GB saved
  - 209.6 GB total bandwidth

**Content Type Breakdown**
- JSON 34%
- CSS 27%
- Text 18%
- Empty 17%
- Other 21%
Results

<table>
<thead>
<tr>
<th>Type</th>
<th>Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>json</td>
<td>6,401,040</td>
</tr>
<tr>
<td>empty</td>
<td>3,974,729</td>
</tr>
<tr>
<td>html</td>
<td>2,182,641</td>
</tr>
<tr>
<td>css</td>
<td>1,360,099</td>
</tr>
<tr>
<td>javascript</td>
<td>1,302,801</td>
</tr>
<tr>
<td>jpeg</td>
<td>1,243,632</td>
</tr>
<tr>
<td>png</td>
<td>1,108,576</td>
</tr>
<tr>
<td>other</td>
<td>1,055,482</td>
</tr>
<tr>
<td>svg</td>
<td>158,764</td>
</tr>
<tr>
<td>gif</td>
<td>1,847</td>
</tr>
<tr>
<td>plain</td>
<td>968</td>
</tr>
<tr>
<td>xml</td>
<td>19</td>
</tr>
<tr>
<td>x-shockwave-flash</td>
<td>5</td>
</tr>
</tbody>
</table>

Top Traffic Countries / Regions
Last 24 hours

<table>
<thead>
<tr>
<th>Country / Region</th>
<th>Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macedonia, The Former Yugoslav Republic of</td>
<td>16,842,095</td>
</tr>
<tr>
<td>Germany</td>
<td>348,995</td>
</tr>
<tr>
<td>United States</td>
<td>156,869</td>
</tr>
<tr>
<td>Switzerland</td>
<td>154,875</td>
</tr>
<tr>
<td>Slovenia</td>
<td>104,164</td>
</tr>
</tbody>
</table>
Results

Requests Through Cloudflare

<table>
<thead>
<tr>
<th>Type</th>
<th>Last 24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Requests</td>
<td>18,790,603</td>
</tr>
<tr>
<td>Cached Requests</td>
<td>9,381,222</td>
</tr>
<tr>
<td>Uncached Requests</td>
<td>9,409,381</td>
</tr>
</tbody>
</table>
Results

- **Unique Visitors**: 83,447
- **Total Requests**: 18,790,603
- **Percent Cached**: 83.22%
- **Total Data Served**: 210 GB
- **Data Cached**: 174 GB
Results (closure of polling booths)

Requests Through Cloudflare

<table>
<thead>
<tr>
<th></th>
<th>Total Requests</th>
<th>Cached Requests</th>
<th>Uncached Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last 6 hours</td>
<td>11,685,044</td>
<td>5,342,982</td>
<td>6,342,062</td>
</tr>
</tbody>
</table>

Graph showing the number of requests through Cloudflare over time.
Conclusion

- Election system was online 100%
- Input of result data was going over the IXP so it was independent of ISP uplink and ISP connectivity
- All DDOS attacks were stopped by Cloudflare and the link never went over 100 Mbit
- Trust into the Election system
Future work

- Get more ISP to come to IXP.mk
- Get CDN into IXP.mk (Google? Facebook? Akamai? Others?)
- Get root dns server instances
- IXP.mk is ready – we have new Quanta switches (thanks ISOC) we have 10G and 40G optics (thanks Flexoptix) we are running Ixpmanager 5.3.0 (updated over the weekend)

😊
Questions?

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