Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: March 23, 2017

P. Thatcher
H. Zhang
T. Brandstetter
Google

September 19, 2016

ICE Network Cost: Dynamically selecting ICE candidate pairs based on relative cost of network interfaces draft-thatcher-ice-network-cost-01

Abstract

This document describes an extension to the Interactive Connectivity Establishment (ICE) that enables ICE agents to exchange information about the relative cost of network interfaces and dynamically choose the selected ICE candidate pair based on the cost of both the local and remote network interfaces. For example, if a cellular network interface has a higher cost than a Wi-Fi network interface, the ICE agents can use that information to prefer candidate pairs with Wi-Fi rather than cellular when possible, and only use cellular when necessary.

This document additionally describes a second piece of information, network ID, that goes along with the network cost and can be used to know when a network interface has changed, even if two network interfaces have the same network cost.

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1. Introduction

In certain network conditions, ICE agents may prefer to use a network interface with a lower cost (for a definition of cost chosen by the ICE agent, which need not be directly related to monetary costs). If the controlling side has such a preference, it can unilaterally nominate a candidate pair with the network interface with lower cost, but if either the controlling side has no such preference, or it would like to take the controlled side's preference into account, it cannot do so unless the controlled side provides information about its network cost.

Additionally, if the network interface of the controlled side changes (such as by using TURN mobility), the controlling side needs updated information from the controlled side.

The controlling side may also wish to select candidate pairs not only based on the relative cost between candidate pairs, but also the cost relative to the quality of the network path. For example, if Wi-Fi

has a much higher cost, but cellular is much higher quality, the controlling side may select cellular even though it's higher cost. To do so, the controlled side must provide information about the network cost relative to the network quality. For example, if a network cost 10 is equivalent to 100ms network RTT, a Wi-Fi with cost 0 and RTT 150ms will have equal preference to a cellular with cost 10 and RTT 50ms.

Although the controlled side already communicates an ICE candidate priority, that candidate attribute doesn't meet the needs of this situation for the following reasons:

- Candidate priority affects ICE check ordering as well as candidate pair preference, which is undesirable in this situation, where the ICE check order should be maintained, but the candidate pair preference should be changed.

- Candidate priority cannot change when the network interface changes (such as by using TURN mobility)

- Candidate priority is only defined relative to other priorities, and can't be compared against network quality in a meaningful way.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

This specification makes use of all terminology defined by the protocol for Interactive Connectivity Establishment in [RFC5245].

Network Cost A value indicating how much an ICE agent would prefer to not use a given network interface. This may be, but need not be related to monetary costs of using the network interface.

Network ID An ID that uniquely identifies a network interface.

3. Choosing a value for network cost and network ID

Network cost is an integer in the range 0-999, where larger values indicate a stronger preference for not using that network interface.

Each network interface SHOULD have a unique network ID, in the range of 0 to (2^16)-1.

4. Signaling network cost and network ID

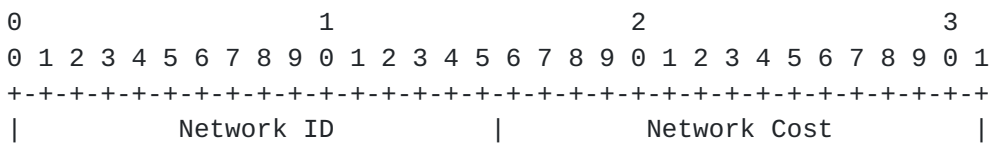
ICE agents MUST signal network cost on each ICE candidate if the cost is non-zero. ICE agents MUST signal network ID on each ICE candidate.

For example, in an SDP candidate line, the attributes could be signaled as "network-cost 100 network-id 1".

5. STUN attribute for network cost and network ID

To communicate a change in network cost or to communicate network cost for peer reflexive candidates, the following STUN attribute is defined:

A 32-bit integer where the first 16 bits are the network ID and the second 16 bits are network cost:



In the initial ICE checks, ICE agents MUST communicate a network cost and network ID if either is non-zero. The ICE agent MUST communicate new values in subsequent ICE checks if the network cost or network ID changes.

6. Interpreting network cost and network ID

If network cost is communicated via either signaling or STUN attribute, the controlling side SHOULD use the network cost of the controlled side as part of the criteria to determine which candidate pair to select. It SHOULD use network cost before using candidate priorities (network cost takes precedence over candidate priority), and it SHOULD NOT change the ICE check order based on network cost.

If the controlling side chooses to balance network cost against network quality, it is RECOMMENDED to treat a difference in network cost of 10 as equivalent of a change in network RTT of 100ms.

Any time the controlling side sees a change in the network cost from the controlled side, it MUST recalculate which candidate pair to select and nominate the newly selected candidate pair, if it has changed.

7. IANA Considerations

This specification requests no actions from IANA.

8. Security Considerations

TODO

9. Acknowledgements

TODO

10. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC5245] Rosenberg, J., "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols", RFC 5245, DOI 10.17487/RFC5245, April 2010, <http://www.rfc-editor.org/info/rfc5245>.

Authors' Addresses

Peter Thatcher
Google
747 6th St S
Kirkland, WA 98033
USA

Email: pthatcher@google.com

Honghai Zhang
Google
747 6th St S
Kirkland, WA 98033
USA

Email: honghaiz@google.com

Taylor Brandstetter
Google
747 6th St S
Kirkland, WA 98033
USA

Email: deadbeef@google.com