Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: January 28, 2010

M. Boucadair
Y. Noisette
France Telecom
A. Allen
Research in Motion (RIM)

July 27, 2009

The atypes media feature tag for Session Initiation Protocol (SIP)
draft-boucadair-dispatch-ipv6-atypes-00

Status of this Memo

Copyright Notice

Abstract

This specification defines a new media feature tag called atypes. This new media feature tag indicates the IP address type capabilities of the UA (User Agent) and can aid the routing process and ease the invocation of required functions when heterogeneous (i.e. IPv4 and IPv6) parties are involved in a given SIP session.

Requirements Language

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 RFC 2119 [RFC2119].

Table of Contents

1. Introduction

Due to IPv4 address exhaustion problem, IPv6 deployment should be accelerated. In this context and especially from a SIP perspective, the IPv4-IPv6 co-existence introduces heterogeneous scenarios with combinations of IPv4 and IPv6 nodes some of which are capable of supporting both IPv4 and IPv6 dual stack (DS) and some of which are capable of supporting only IPv4 or only IPv6. Additionally, some UAs that are dual stack capable are unable to use both interfaces natively at the same time which can mean for example that if a UA has to use IPv6 for signaling it cannot use IPv4 for media even though the UA supports an IPv4 stack. This mainly motivated by restrictions due to available resources such the need to maintain one PDP (packet data protocol) context in case of mobile networks.

Draft-ietf-sipping-ipv6-transition [I-D.ietf-sipping-v6-transition] provides recommendations to solve this issue including recommending Dual Stack (DS) nodes in the core service platform having the signalling and media path traverse these DS elements. While this is viable for big service providers it not viable for smaller ones especially at the earlier stages of IPv6 deployment. Upgrading existing networks to follow all these recommendations requires a large investment.

An interim alternative is to use a SIP Application Level Gateway (ALG) and a Network Address Translation - Protocol Translation(NAT-PT) node to convert between IPv4 and IPv6 addressing. However an ALG and a NAT-PT/NAT64 introduce additional nodes into the signaling and media paths and can result in the so called "trombone" effect with signaling and even more importantly media being unnecessarily routed via an ALG/NAT-PT/NAT64 in a network located at a significant distance from both of the UAs involved in the session. This is particularly significant in mobile networks in roaming scenarios where potentially media then has be routed via multiple hops over international links when a roaming user establishes a session with a user located in the roamed to country. This situation is potentially unavoidable when an ALG/NAT-PT/NAT64 is needed to be inserted in the signaling and the media path because of incompatible IP versions between UAs that require IP address translation. It is highly undesirable to redundantly include ALG/NAT-PT/NAT64 nodes in the path when the UAs can establish sessions without requiring ALG/ NAT-PT nodes in the path.

In order to avoid redundant inclusion of ALG/ NAT-PT/NAT64 nodes in the path, it is necessary for network nodes to be able to determine the connectivity types supported by UAs prior to forwarding session establishment requests. Without such a capability, SIP Proxy Servers have no way to predict a session failure without a ALG/NAT-PT/NAT64

being included in the path even when the ANAT [RFC4091] [RFC4092] or ICE [I-D.ietf-mmusic-ice] mechanisms are also used.

Additionally, when multiple UAs are registered with the same Address of Record (AoR) it is useful to be able to have a UA indicate a preference to contact a UA using the mechanism defined in RFC 3841 [RFC3841] that supports the same IP version in order to avoid the need for NAT-PT/NAT64.

This specification also addresses call routing and optimization mechanisms using the atypes Media Feature Tag to avoid as much as possible invoking SIP ALGs and NAT-PT/NAT64 when establishing a multimedia session between UAs.

2. Justification for atypes

SIP service platforms should be aware of the type of the involved peers before forwarding session establishment requests. If these means are not supported, SIP Proxy Servers have no way to predict a session failure, even if ANAT [RFC4091] or ICE [I-D.ietf-mmusic-ice] procedures are adopted, and also to optimise the invocation of adaptation functions.

The first alternative to notify the service platform about the type of the UA is to send SIP REGISTER message which encloses all available IP addresses. For IPv4-only and IPv6-only UAs, only one single IP address is carried in SIP REGISTER messages. For DS UAs, two IP addresses are enclosed. Upon receipt, of this message, the registrar stores these addresses. Two registration databases may be maintained, one for IPv4 and another one for IPv6. A second alternative is to send several REGISTER request using available connectivity types. In this case, a DS UA sends two REGISTER messages. The first one is sent using its IPv4 connectivity and the second one using its IPv6 ones. Two databases are maintained by the conversational service platform. Consequently, upon receipt of an INVITE, the SIP Proxy Server may question its databases to retrieve the types of the involved parties. SIP ALG is invoked accordingly.

The drawback of this procedure is that it depends on the behaviour of the terminal. A standardised behaviour should be encouraged. To that aim, a new Media Feature Tag is introduced in this document. More details are provided hereafter.

3. Relationship of atypes to ANAT/ICE

ICE [I-D.ietf-mmusic-ice] specification deprecates

[RFC4091][RFC4092]. Like ANAT, ICE can be used to enclose both IPv4 and IPv6 information in a given SDP offer. In the remaining part, ANAT and ICE are used interchangeably since, from IPv4-IPv6 interworking perspective, both provide the same solution.

ANAT/ICE makes it possible for Dual Stack UAs to provide both IPv4 and IPv6 addresses for a single logical media stream. This singularly helps interworking as, whatever the distant UA version is (IPv4/IPv6-only or Dual-Stack), this latter should be able to understand at least one of the offers. In this way the ANAT/ICE semantic provides a first approach to interworking problem, when heterogeneous UAs are involved in the SIP communication. It indeed improves SIP exchanges, in so far as it allows all sessions arising/ coming from Dual Stack UA to lead to successful calls.

This interesting feature needs however to be nuanced, as it unfortunately does not fit all cases. [RFC4091] already lists some cases where, depending on the implementation, recipients of an offer using ANAT might have different behaviours, thus requiring the introduction of the sdp-anat option-tag. ANAT also requires the UA to be Dual Stack, which means it does not cover the case where UAs belong to different and restrictive IP version realms. In other words, the ANAT proposition does not help solving scenarios where mono-stack (i.e. IPv4 or IPv6) UAs are involved. In this latter case, SIP exchanges can only succeed if intermediary nodes or functions (Proxy Servers, ALG, Session Border Controllers (SBCs), etc.) intervene in the signalling path. This intervention, denoted as adaptation function in the rest of this document, is necessary to ensure a successful SIP exchange between these mono-satck UAs. Unfortunately, in these situations, ANAT/ICE does not help SIP servers situated all along the signalling path to take the right decision when IPv4-IPv6 interconnection needs (or should need) to be tackled.

The atypes Media Feature Tag helps to provide a global answer to the interconnection problem, when heterogeneous SIP UAs are involved. Moreover, it aids SIP nodes situated all along the signalling path, to determine when to invoke the adaptation function helping the routing of the call.

The atypes Media Feature Tag makes it possible for SIP Proxy Servers to determine the IP versions supported by the distant and the originating UA, when they process the initial SIP request. This means that, the earlier possible in the exchange, a SIP node becomes aware of the potential interconnection problem due to IP version incompatibility. This also means that this particular node can trigger the invocation of the adaptation function, which will modify the initial SDP offer in order to make this SIP exchange successful.

The atypes Media Feature Tag can therefore aid treatment of all exchange types intervening between mono-stack (IPv4 or IPv6) or Dual Stack UAs (whether they use ANAT or not). Anytime a potential interconnection problem is suspected using the atypes Media Feature Tag, the SIP Proxy will be able to drive the adaptation function invocation and route the SIP exchange accordingly.

The atypes Media Feature Tag can also provide interesting optimisation characteristics. For instance, a service provider might force adaptation function like SIP ALGs to be invoked each time the SIP message leave an IPv4 realm for an IPv6 realm (and vice-versa), in order to modify the SDP offer accordingly. This kind of modifications could happen more than once during the SIP signalling exchanges (and even more than once in a single direction!). In the end, both UAs intervening in the SIP exchange might be of the same type, thus not requiring any change of the SDP offer! Using the atypes Media Feature Tag such situation could be avoided, as the SIP Proxy Server would determine UAs are compatible, thus no modification should be make to SDP offers, even if layer 3 information are modified during the routing of the SIP message.

The atypes Media Feature Tag can also help in the case where different SIP realms are crossed, where the information from the atypes Media Feature Tag for the distant UA is not available at the originating Proxy Server. In this case, the atypes Media Feature Tag can be included in the SIP request thus enabling the distant SIP Proxy Server, which has the atypes Media Feature Tag information for the remote UA, to determine whether to route the SIP request via its adaptation function.

The atypes Media Feature Tag is not limited to the single IPv4-IPv6 interconnection problem, though this first version of the specification is dedicated to this usage.

Further values of atypes can be defined in future specifications. The atypes Media Feature Tag is also compatible with the parallel usage of ICE or CCAP [I-D.boucadair-mmusic-ccap]..

4. sip.atypes Media Feature Tag

The 'sip.app-subtype' media feature tag is of type token with a case-sensitive equality relationship. It indicates whether a (communications) device supports IPv4 for both signaling and media, IPv6 for both signaling and media, IPv6 for signaling and IPv4 for media simultaneously, IPv4 for signaling and IPv6 for media simultaneously. A plurality of tokens is included for all the supported combinations. Its values include:

- ipv4: The device can support IPv4 addresses for both signaling and media.

- ipv6: The device can support IPv6 addresses for both signaling and media.

- ipv4s-ipv6m: The device can support both IPv4 and IPv6 addresses and use the IPv4 address for signaling and the IPv6 address for media.

- ipv6s-ipv4m: The device can support both IPv4 and IPv6 addresses and use the IPv6 address for signaling and the IPv4 address for media.

Other values of atypes can be defined such as:

- ipv4_via_nat46: When enclosed in a SIP message, a given SIP UA indicates "here is my IPv4 address, it goes through a translator so avoid using it if you can utilize my IPv6 address"

- ipv6_via_nat64: When enclosed in a SIP message, a given SIP UA indicates "here is my IPv6 address, it goes through a translator so avoid using it if you can utilize my IPv4 address"

- ipv4_via_cgn: When enclosed in a SIP message, a given SIP UA indicates "here is my IPv4 address, it goes through a CGN device so avoid using it if you can utilize a public IPv4 or IPv6 address"

When included in the Contact header field of a REGISTER request or an INVITE request, a UAC SHOULD include all atypes values that represent the address type combinations it can currently support. When included in the Contact header field of a response a UAS SHOULD include all atypes values that represent the address type combinations it can currently support.

A UAS that receives an OPTIONS request SHOULD include in the Contact header field an atypes Media Feature Tag containing all atypes values that represent the address type combinations it can currently support.

A given UA MAY restrict its SIP communications to its IPv4-only interface or IPv6-only ones or MAY use all available ones. The selected local restriction is conveyed in the atypes Media Feature Tag. Within this context, an IPv6 interface is judged available only if the scope of this interface is global and not local to the link.

When included in the Accept-Contact or Reject-Contact header field,

it indicates a desire on the part of a UAC to be connected to a UAS which can support, or cannot support respectively, the address types and address type combinations specified.

5. Session Routing Considerations

Based on atypes tag value, the Registrar classifies the UA IP address capabilities for signaling and media.

In order to route calls and to decide the need to invoke a SIP ALG or to alter SIP messages, which leads to a successful call between heterogeneous parties, a SIP Proxy Server MAY act as follows:

a. A first alternative is to interrogate the registration database maintained by the Registrar Server: In this alternative, the SIP Proxy Server asks the Registrar Server about the type of the Called and the Caller parties. The SIP Proxy Server decides to invoke an ALG in case the two involved parties are either IPv4-only or IPv6-only.

b. The second alternative is to examine the atypes Media Feature Tag conveyed in the Contact header field of the INVITE request and the atypes Media Feature Tag values stored by the Registrar Server for the address type of the Called party. In this scenario, the SIP Proxy Server routes the call by comparing the compatibility of the two retrieved atypes values (types of Called and Caller parties).

6. Examples of atypes tag usages

These sections provide a set of examples of SIP messages when atypes media feature tag is used.

6.1. IPv4-only UA

Let consider an IPv4-only UA denoted A. Its IP address is 192.165.25.2. This UA has been provisioned with required contact information to contact its Registrar (RS). In this example, a FQDN is provided: rs.test.com. Means that have been used to provision the UA are out of scope of this document.

(1) A sends this REGISTER message to its Registrar Server RS:

```
REGISTER sip:rs.test.com SIP/2.0
Via: SIP/2.0/UDP 192.165.25.2:5062;branch=z9hG4bK00e31d6ed
Max-Forwards: 70
Content-Length: 0
To: A <sip:A@test.com>
From: A <sip:A@test.com>;tag=ed3833bd7363e68
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746364 REGISTER
Contact: A <sip:A@192.165.25.2:5062>
         ;atypes="ipv4";expires=900
```

(2) RS answers to A with a 200 OK message as follows:

```
SIP/2.0 200 OK
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746365 REGISTER
From: A <sip:A@test.com>;tag=ed3833bd7363e68
To: A <sip:A@test.com>;tag=3ab7fe89d998709
Via:SIP/2.0/UDP 192.165.25.2:5062;branch=z9hG4bK00e31d6ed
Content-Length: 0
Contact: A <sip:A@192.165.25.2:5062>
         ;atypes="ipv4";expires=900
```

6.2. IPv6-only UA

Let consider an IPv6-only UA called B which IP address is 2001:688:1ffb:ff80::2. Its attached Registrar Server is identified by this FQDN: r6.test.com.

(1) B sends to its Registrar Server the following message:

```
REGISTER sip:r6.test.com SIP/2.0
Via: SIP/2.0/UDP
[2001:688:1ffb:ff80::2]:5060;branch=z9hG4bK00e31d6ed
Max-Forwards: 70
Content-Length: 0
To: B <sip:B@test.com>
From: B <sip:B@test.com>;tag=ed3833bd7363e68
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746364 REGISTER
Contact: B <sip:B@[2001:688:1ffb:ff80::2]:5060>
         ;atypes="ipv6";expires=900
```

(2) The Registrar Server answers with the following 200 OK message:

```
SIP/2.0 200 OK
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746365 REGISTER
From: B <sip: B@test.com>;tag=ed3833bd7363e68
To: B <sip: B@test.com>;tag=3ab7fe89d998709
Via:SIP/2.0/UDP[2001:688:1ffb:ff80::2]:5060;branch=z9hG4bK00e31d6ed
Content-Length: 0
Contact: B <sip:B@[2001:688:1ffb:ff80::2]:5060>
         ;atypes="ipv6";expires=900
```

One IP address MAY be enclosed in the Contact header field of a dual stack registration message. The type of the contact address MAY be distinct from the value of atypes. For instance:

- an IPv4 address may be enclosed in the Contact header field even if the assigned atypes value is equal to "ipv6",
- or only one IP address may be carried in the Contact header field even if the atypes value is set to "ipv6,ipv4".

The IP address in the Contact header field MAY be used by intermediary proxies when contacting the UA.

6.3. Dual Stack REGISTER with one IP address in Contact header field

Let consider a dual-stack UA (DS) which IP addresses are 2001:688:1ffb:ff80::2 and 192.168.25.5 which does not support IPv4 and IPv6 simultaneously. The FQDN of the Register Server is rs.test.com.

(1) DS sends a REGISTER message to its Registrar Server as follows:

```
REGISTER sip:rs.test.com SIP/2.0
Via: SIP/2.0/UDP 192.168.25.5:5060;branch=z9hG4bK00e31d6ed
Max-Forwards: 70
Content-Length: 0
To: DS <sip:DS@test.com>
From: DS <sip:DS@test.com>;tag=ed3833bd7363e68
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746364 REGISTER
Contact: DS <sip:DS@192.168.25.5:5060>
         ;atypes="ipv4,ipv6";expires=900
```

(2) The Registrar Server answers with a 200 OK message as shown below:

```
SIP/2.0 200 OK
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746365 REGISTER
From: DS <sip: DS@test.com>;tag=ed3833bd7363e68
To: DS <sip:DS@test.com>;tag=3ab7fe89d998709
Via:SIP/2.0/UDP 192.168.25.5:5060;branch=z9hG4bK00e31d6ed
Content-Length: 0
Contact: DS <sip:DS@192.168.25.5:5060>
         ;atypes="ipv4,ipv6";expires=900
```

6.4. Dual Stack REGISTER with two IP addresses in Contact header field

Let consider a dual-stack UA (DS) which IP addresses are 2001:688:1ffb:ff80::2 and 192.168.25.5 which does not support IPv4 and IPv6 simultaneously on each interface. The FQDN of the Register Server is rs.test.com.

(1) DS sends a REGISTER message to its Registrar Server as follows:

```
REGISTER sip:rs.test.com SIP/2.0
Via: SIP/2.0/UDP 192.168.25.5:5060;branch=z9hG4bK00e31d6ed
Max-Forwards: 70
Content-Length: 0
To: DS <sip:DS@test.com>
From: DS <sip:DS@test.com>;tag=ed3833bd7363e68
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746364 REGISTER
Contact: DS1 <sip:DS1@192.168.25.5:5060>
         ;atypes="ipv4";expires=900
Contact: DS2 <sip:DS2@[2001:688:1ffb:ff80::2]:5063>
         ;atypes="ipv6";expires=900
```

(2) The Registrar Server answers with a 200 OK message as shown below:

```
SIP/2.0 200 OK
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746365 REGISTER
From: DS <sip: DS@test.com>;tag=ed3833bd7363e68
To: DS <sip:DS@test.com>;tag=3ab7fe89d998709
Via:SIP/2.0/UDP 192.168.25.5:5060;branch=z9hG4bK00e31d6ed
Content-Length: 0
Contact: DS1 <sip:DS1@192.168.25.5:5060>
         ;atypes="ipv4,ipv6";expires=900
Contact: DS2 <sip:DS2@[2001:688:1ffb:ff80::2]:5063>
         ;atypes="ipv4,ipv6";expires=900
```

6.5. **Dual Stack REGISTER with one IPv4-mapped IPv6** address in the Contact header field

Let consider a dual-stack UA (DS) which the IPv4 address 192.168.25.5 is mapped to the IPV6 address ::ffff:192.168.25.5 and which does support simultaneous use of IPv4 and IPv6. The FQDN of the Register Server is rs.test.com.

(1) DS sends a REGISTER message to its Registrar Server as follows:

```
REGISTER sip:rs.test.com SIP/2.0
Via: SIP/2.0/UDP 192.168.25.5:5062;branch=z9hG4bK00e31d6ed
Max-Forwards: 70
Content-Length: 0
To: DS <sip:DS@test.com>
From: DS <sip:DS@test.com>;tag=ed3833bd7363e68
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746364 REGISTER
Contact: DS <sip:DS@[::ffff:192.168.25.5]>
         ;atypes="ipv6,ipv6s-ipv4m";expires=900
```

(2) The Registrar Server answers with a 200 OK message as shown below:

```
SIP/2.0 200 OK
Call-ID: a8a83b610ae5d242289dfc1c78b7f1d8@test.com
CSeq: 1830746365 REGISTER
From: DS <sip: DS@test.com>;tag=ed3833bd7363e68
To: DS <sip:DS@test.com>;tag=3ab7fe89d998709
Via:SIP/2.0/UDP 192.168.25.5:5062;branch=z9hG4bK00e31d6ed
Content-Length: 0
Contact: DS <sip:DS@[::ffff:192.168.25.5]>
         ;atypes="ipv6,ipv6s-ipv4m";expires=900
```

7. IANA Considerations

This specification adds a new media feature tag to the SIP Media Feature Tag Registration Tree defined in RFC 3840 [RFC3840].

Media feature tag name: sip.atypes

ASN.1 Identifier: TBD

Summary of the media feature indicated by this tag: The sip.atypes media feature tag indicates whether a communications device supports IPv4 for both signaling and media, IPv6 for both signaling and media, IPv6 for signaling and IPv4 for media simultaneously, IPv4 for

signaling and IPv6 for media simultaneously. A plurality of tokens is included for all the supported combinations.

Values appropriate for use with this feature tag: Token with an equality relationship.

Typical values include:

ipv4: The device can support IPv4 addresses for both signaling and media.

ipv6: The device can support IPv6 addresses for both signaling and media.

ipv4s-ipv6m: The device can support both IPv4 and IPv6 addresses and use the IPv4 address for signaling and the IPv6 address for media.

ipv6s-ipv4m: The device can support both IPv4 and IPv6 addresses and use the IPv6 address for signaling and the IPv4 address for media.

The feature tag is intended primarily for use in the following applications, protocols, services, or negotiation mechanisms: This feature tag is most useful in a communications application, for describing the capabilities of a device, such as a phone or PDA.

Examples of typical use: Optimally routing a session and ensuring compatibility between IP versions to successfully establish sessions.

Related standards or documents: RFC XXXX [[Note to IANA: Please replace XXXX with the RFC number of this specification.]].

Security Considerations: Security considerations for this media feature tag are discussed in Section 7 of RFC XXXX . [[Note to IANA: Please replace XXXX with the RFC number of this specification.]]

8. Security Considerations

When present in a SIP request or response, this media feature tag may be used to determine whether a session is routed via a ALG/NAT-PT/NAT64 in order to successfully establish a session. If the values of the atypes Media Feature Tags are modified by an intermediary then it is possible that a session would fail to be established if the modified values caused the network proxies to not insert a ALG/NAT-PT/NAT64 when they are needed. However if the contact address itself is also modified this could also prevent a session being established. Integrity protection for the Contact header field should be provided.

9. Acknowledgements

TBC.

10. References

10.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3840] Rosenberg, J., Schulzrinne, H., and P. Kyzivat, "Indicating User Agent Capabilities in the Session Initiation Protocol (SIP)", RFC 3840, August 2004.

10.2. Informative References

[I-D.boucadair-mmusic-ccap]
Boucadair, M. and H. Kaplan, "Session Description Protocol (SDP) Connectivity Capability (CCAP) Attribute", draft-boucadair-mmusic-ccap-00 (work in progress), July 2009.

[I-D.ietf-mmusic-ice]
Rosenberg, J., "Interactive Connectivity Establishment (ICE): A Protocol for Network Address Translator (NAT) Traversal for Offer/Answer Protocols", draft-ietf-mmusic-ice-19 (work in progress), October 2007.

[I-D.ietf-sipping-v6-transition]
Camarillo, G., "IPv6 Transition in the Session Initiation Protocol (SIP)", draft-ietf-sipping-v6-transition-07 (work in progress), August 2007.

[RFC3841] Rosenberg, J., Schulzrinne, H., and P. Kyzivat, "Caller Preferences for the Session Initiation Protocol (SIP)", RFC 3841, August 2004.

[RFC4091] Camarillo, G. and J. Rosenberg, "The Alternative Network Address Types (ANAT) Semantics for the Session Description Protocol (SDP) Grouping Framework", RFC 4091, June 2005.

[RFC4092] Camarillo, G. and J. Rosenberg, "Usage of the Session Description Protocol (SDP) Alternative Network Address Types (ANAT) Semantics in the Session Initiation Protocol (SIP)", RFC 4092, June 2005.

Authors' Addresses

Mohamed Boucadair
France Telecom
3, av Francois Chateau
Rennes 35000
France

Email: mohamed.boucadair@orange-ftgroup.com

Yoann Noisette
France Telecom

Email: yoann.noisette@orange-ftgroup.com

Andrew Allen
Research in Motion (RIM)
300 Knightsbridge Parkway, Suite 360
Lincolnshire, Illinois 60069
USA

Email: aallen@rim.com