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**IMIX Genome: Specification of variable packet sizes for additional  
testing  
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**Abstract**

Benchmarking Methodologies have always relied on test conditions with constant packet sizes, with the goal of understanding what network device capability has been tested. Tests with constant packet size reveal device capabilities but differ significantly from the conditions encountered in operational deployment, and so additional tests are sometimes conducted with a mixture of packet sizes, or "IMIX". The mixture of sizes a networking device will encounter is highly variable and depends on many factors. An IMIX suited for one networking device and deployment will not be appropriate for another. However, the mix of sizes may be known and the tester may be asked to augment the fixed size tests. To address this need, and the perpetual goal of specifying repeatable test conditions, this draft defines a way to specify the exact repeating sequence of packet sizes from the usual set of fixed sizes, and other forms of mixed size specification.

**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](#)].

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## 1. Introduction

This memo defines a method to unambiguously specify the sequence of packet sizes used in a load test.

Benchmarking Methodologies [[RFC2544](#)] have always relied on test conditions with constant packet sizes, with the goal of understanding what network device capability has been tested. Tests with the smallest size stress the header processing capacity, and tests with the largest size stress the overall bit processing capacity. Tests with sizes in-between may determine the transition between these two capacities.

Streams of constant packet size differ significantly from the conditions encountered in operational deployment, and so additional tests are sometimes conducted with a mixture of packet sizes. The set of sizes used is often called an Internet Mix, or "IMIX" [[Spirent](#)], [[IXIA](#)], [[Agilent](#)].

The mixture of sizes a networking device will encounter is highly variable and depends on many factors. An IMIX suited for one networking device and deployment will not be appropriate for another. However, the mix of sizes may be known and the tester may be asked to augment the fixed size tests. The references above cite the original studies and their methodologies - similar methods can be used to determine new size mixes.

To address this need, and the perpetual goal of specifying repeatable test conditions, this draft proposes a way to specify the exact repeating sequence of packet sizes from the usual set of fixed sizes: the IMIX Genome. Other, less exact forms of size specification are also recommended for extremely complicated or customized size mixes.

This memo takes the position that it cannot be proven for all circumstances that the sequence of packet sizes does not affect the test result, thus a standardized specification of sequence is valuable.

## 2. Scope and Goals

This memo defines a method to unambiguously specify the sequence of packet sizes that have been used in a load test, assuming that a relevant mix of sizes is known to the tester and the length of the repeating sequence is not very long (<100 packets).

The IMIX Genome will allow an exact sequence of packet sizes to be communicated as a single-line name, resolving the current ambiguity

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with results that simply refer to "IMIX".

While documentation of the exact sequence is ideal, the memo also covers the case where the sequence of sizes is very long or may be generated by a pseudo-random process.

It is a colossal non-goal to standardize one or more versions of the IMIX. This topic has been discussed on many occasions on the `bmwg-list[IMIXonList]`. The goal is to enable customization with minimal constraints while fostering repeatable testing once the fixed size testing is complete.

### 3. Specification of the IMIX Genome

The IMIX Genome is specified in the following format:

IMIX - 123456...[X](#)

where each number is replaced by the letter corresponding to the size of the packet at that position in the sequence. The following table gives the letter encoding for the [RFC2544](#) standard sizes (64, 128, 256, 512, 1024, 1280, and 1518 bytes) and "jumbo" sizes (2112, 9000, 16000). Note that the 4 octet Ethernet frame check sequence may fail to detect bit errors in the larger jumbo frames, see [\[jumbo\]](#).

Size, bytes	Genome Code Letter
64	a
128	b
256	c
512	d
1024	e
1280	f
1518	g
2112	h
9000	i
16000	j
MTU	z

For example: a five packet sequence with sizes 64,64,64,1280,1518 would be designated:

IMIX - aaafg

While this approach allows some flexibility, there are also





constraints.

- o Non-RFC2544 packet sizes would need to be approximated by those available in the table.
- o The Genome for very long sequences can become undecipherable by humans.
- o z=MTU is seen as valuable, so MTU MUST be specified if used.
- o Whether more tabulated packet sizes would be useful is TBD, and "jumbo" sizes were added in this version.

Some questions testers must ask and answer when using the IMIX Genome are:

1. Multiple Source-Destination Address Pairs: is the IMIX sequence applicable to each pair, across multiple pairs in sets, or across all pairs?
2. Multiple Tester Ports: is the IMIX sequence applicable to each port, across multiple ports in sets, or across all ports?

The chosen configuration would be expressed the following general form:

Source	Destination	Corresponding
Address/Port/Blade	Address/Port/Blade	IMIX
x.x.x.x Blade2	y.y.y.y Blade3	IMIX - aaafg

where testers can specify the IMIX used between any two entities in the test architecture.

#### **4. Specification of a Custom IMIX**

The Custom IMIX is specified in the following format:

CUSTOM IMIX - 123456...[X](#)

where each number is replaced by the letter corresponding to the size of the packet at that position in the sequence. The tester MUST complete the following table, giving the letter encoding for each size used, where each set of three lower-case letters would be replaced by the integer size in octets.

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Size, bytes	Custom Code Letter
aaa	A
bbb	B
ccc	C
ddd	D
eee	E
fff	F
ggg	G
etc.	up to Z

For example: a five packet sequence with sizes aaa,aaa,aaa,ggg,ggg would be designated:

CUSTOM IMIX - AAAGG

## 5. Reporting Long or Pseudo-Random Packet Sequences

When the IMIX-Genome cannot be used (when the sheer length of the sequence would make the genome unmanageable), two options are possible. When a sequence can be decomposed into a series of short repeating sequences, then a run-length encoding approach MAY be used as shown below:

Count of Repeating Sequences	Packet Size Sequence
20	abcd
5	ggga
10	dcba

When the sequence is designed to vary within some proportional constraints, a table simply giving the proportions of each size MAY be used instead.



+-----+-----+-----+			
IP Length		Percentage of Total	Other Length(s)
+-----+-----+-----+			
64		23	82
128		67	146
1000		10	1018
+-----+-----+-----+			

Note that the table of proportions also allows non-standard packet sizes, but trades the short genome specification and ability to specify the exact sequence for other flexibilities.

## 6. Security Considerations

Benchmarking activities as described in this memo are limited to technology characterization using controlled stimuli in a laboratory environment, with dedicated address space and the other constraints [[RFC2544](#)].

The benchmarking network topology will be an independent test setup and MUST NOT be connected to devices that may forward the test traffic into a production network, or misroute traffic to the test management network.

Further, benchmarking is performed on a "black-box" basis, relying solely on measurements observable external to the DUT/SUT.

Special capabilities SHOULD NOT exist in the DUT/SUT specifically for benchmarking purposes. Any implications for network security arising from the DUT/SUT SHOULD be identical in the lab and in production networks.

## 7. IANA Considerations

This memo makes no requests of IANA, and hopes that IANA will leave it alone as well.

## 8. Acknowledgements

Thanks to Sarah Banks, Aamer Akhter, and Steve Maxwell for their review and comments. Ilya Varlashkin suggested the run-length coding approach in [Section 5](#).

## 9. References



### **9.1. Normative References**

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2544] Bradner, S. and J. McQuaid, "Benchmarking Methodology for Network Interconnect Devices", [RFC 2544](#), March 1999.

### **9.2. Informative References**

- [Agilent] [http://www.ixiacom.com/pdfs/test\\_plans/agilent\\_journal\\_of\\_internet\\_test\\_methodologies.pdf](http://www.ixiacom.com/pdfs/test_plans/agilent_journal_of_internet_test_methodologies.pdf), "The Journal of Internet Test Methodologies", 2007.
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- [jumbo] <http://www.ietf.org/mail-archive/web/bmwg/current/msg00691.html>, "Discussion of Jumbo Packets and FCS Failure, see <http://sd.wareonearth.com/~phil/jumbo.html> and <http://staff.psc.edu/mathis/MTU/arguments.html#crc>".

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