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S. Kushwaha
Oracle Corporation

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# Cursor-Based Pagination for Multi-Valued Attributes in SCIM 2.0
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## Abstract

The System for Cross-domain Identity Management (SCIM) 2.0 specification (RFC 7644) defines pagination mechanisms at the resource level. However, it does not provide a standardized method for paginating large multi-valued attributes within a resource.

This limitation creates scalability and performance challenges in modern identity systems, particularly for attributes such as group memberships, roles, and entitlements.

This document proposes a cursor-based pagination mechanism for multi-valued attributes in SCIM resources. The proposal introduces attribute-level pagination parameters and response metadata, including total count, to improve performance, consistency, and usability in large-scale deployments.



## 1. Introduction

SCIM 2.0 (RFC 7644) provides a standardized protocol for identity provisioning and management across domains. It supports pagination for collections of resources using parameters such as "startIndex" and "count".

However, SCIM does not define pagination for multi-valued attributes within a resource. Examples include:

- group.members
- user.roles
- user.entitlements

In large-scale identity systems, these attributes can contain thousands or tens of thousands of entries, resulting in large payloads and degraded performance.

This document proposes a standardized, cursor-based approach for paginating such attributes.

## 2. Problem Statement

Consider the following request:

GET /Groups/{id}

A SCIM server may return all members of a group in a single response. For large groups, this can lead to:

- Excessive response payload size
- Increased latency
- High memory consumption on clients and servers

Offset-based pagination is not suitable for multi-valued attributes in dynamic systems because membership data may change between requests, resulting in skipped or duplicated entries.

There is currently no standard mechanism in SCIM to paginate multi-valued attributes within a resource.

## 3. Proposed Solution

### 3.1 Attribute-Level Cursor Pagination

This document introduces cursor-based pagination for multi-valued attributes.

Clients MAY request partial results for a multi-valued attribute using the following query parameters:

- attributeCursor: an opaque continuation token issued by the server
- attributeCount: the maximum number of items to return

Example (initial request):

GET /Groups/{id}?attributes=members&attributeCount=100

Example (subsequent request):

GET /Groups/{id}?attributes=members&attributeCursor=eyJjdXJzb3IiOiIxMDAifQ==&attributeCount=100

The cursor is opaque and MUST NOT be interpreted by the client.

### 3.2 Response Structure

The server returns a subset of the multi-valued attribute along with pagination metadata.

Example response:

```
{
  "id": "group-123",
  "members": [
```

```
      {
        "value": "2819c223-7f76-453a-919d-413861904646",
        "$ref": "../Users/2819c223-7f76-453a-919d-413861904646",
        "display": "Babs Jensen"
      }
    ],
    "membersPagination": {
      "totalResults": 5000,
      "itemsPerPage": 100,
      "nextCursor": "eyJjdXJzb3IiOiIxMDAifQ==",
      "hasMore": true
    }
  }
```

### 3.3 Rationale

Cursor-based pagination avoids inconsistencies caused by concurrent updates, scales efficiently for large datasets, and aligns with modern API design practices.

### 3.4 Backward Compatibility

Servers MAY implement attribute-level pagination optionally. Existing SCIM clients remain unaffected.

## 4. Security Considerations

Servers MUST enforce access control for all returned data. Cursor tokens SHOULD be tamper-resistant and scoped appropriately.

## 5. Implementation Considerations

Clients SHOULD treat cursors as opaque values. Servers SHOULD optimize backend queries for partial retrieval.

## 6. Future Work

Future extensions may include filtering, sorting, and schema standardization.

## 7. IANA Considerations

This document makes no requests of IANA.

## 8. Disclaimer

This document represents the personal views of the author and does not necessarily reflect the views of Oracle Corporation.

## 9. References

[RFC7644] Hunt, P., et al., "System for Cross-domain Identity Management: Protocol", RFC 7644, September 2015.

## Author’s Address

Saurabh Kushwaha
Oracle Corporation
Email: saurabhkushwaha123@gmail.com