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The Application Level Events (ALE) Specification, Version 1.0

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EPCglobal Ratified Specification
Version of September 15, 2005

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12 **Abstract**

13 This document specifies an interface through which clients may obtain filtered,
14 consolidated Electronic Product Code™ (EPC) data from a variety of sources. The
15 design of this interface recognizes that in most EPC processing systems, there is a level
16 of processing that reduces the volume of data that comes directly from EPC data sources
17 such as RFID readers into coarser “events” of interest to applications. It also recognizes
18 that decoupling these applications from the physical layers of infrastructure offers cost
19 and flexibility advantages to technology providers and end-users alike.

20 The processing done at this layer typically involves: (1) *receiving* EPCs from one or more
21 data sources such as readers; (2) *accumulating* data over intervals of time, *filtering* to
22 eliminate duplicate EPCs and EPCs that are not of interest, and *counting* and *grouping*
23 EPCs to reduce the volume of data; and (3) *reporting* in various forms. The interface
24 described herein, and the functionality it implies, is called “Application Level Events,” or
25 ALE.

26 The role of the ALE interface within the EPCglobal Network™ Architecture is to provide
27 independence between the infrastructure components that acquire the raw EPC data, the
28 architectural component(s) that filter & count that data, and the applications that use the
29 data. This allows changes in one without requiring changes in the other, offering
30 significant benefits to both the technology provider and the end-user. The ALE interface
31 described in the present specification achieves this independence through three means:

- 32 • It provides a means for clients to specify, in a high-level, declarative way, what EPC
33 data they are interested in, without dictating an implementation. The interface is
34 designed to give implementations the widest possible latitude in selecting strategies
35 for carrying out client requests; such strategies may be influenced by performance
36 goals, the native abilities of readers which may carry out certain filtering or counting
37 operations at the level of firmware or RF protocol, and so forth.
- 38 • It provides a standardized format for reporting accumulated, filtered EPC data that is
39 largely independent of where the EPC data originated or how it was processed.
- 40 • It abstracts the sources of EPC data into a higher-level notion of “logical reader,”
41 often synonymous with “location,” hiding from clients the details of exactly what
42 physical devices were used to gather EPC data relevant to a particular logical
43 location. This allows changes to occur at the physical layer (for example, replacing a
44 2-port multi-antenna reader at a loading dock door with three “smart antenna”
45 readers) without affecting client applications. Similarly, it abstracts away the fine-
46 grained details of how data is gathered (*e.g.*, how many individual tag read attempts
47 were carried out). These features of abstraction are a consequence of the way the data
48 specification and reporting aspects of the interface are designed.

49 The specification includes a formal processing model, an application programming
50 interface (API) described abstractly via UML, and bindings of the API to a WS-i
51 compliant SOAP protocol with associated bindings of the key data types to XML schema.

52 Implementors may provide other bindings, as well as extensions, as provided by the
53 framework of the specification.

54 **Audience for this document**

55 The target audience for this specification includes:

- 56 • EPC Middleware vendors
- 57 • Reader vendors
- 58 • Application developers
- 59 • System integrators

60 **Status of this document**

61 This section describes the status of this document at the time of its publication. Other
62 documents may supersede this document. The latest status of this document series is
63 maintained at EPCglobal. See www.epcglobalinc.org for more information.

64 This version of the specification was ratified by the EPCglobal Board of Governors on
65 September 23, 2005. It was reviewed and approved by the EPCglobal Business Steering
66 Committee on 14 February 2005 and by the Technical Steering Committee on 2 February
67 2005.

68 Comments on this document should be sent to the EPCglobal Software Action Group
69 Filtering and Collection Working Group mailing list
70 sag_fc@epclinklist.epcglobalinc.org.

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129 **1 Introduction**

130 This document specifies an interface through which clients may obtain filtered,
131 consolidated EPC data from a variety of sources. The design of this interface recognizes
132 that in most EPC processing systems, there is a level of processing that reduces the
133 volume of data that comes directly from EPC data sources such as RFID readers into
134 coarser “events” of interest to applications. It also recognizes that decoupling these
135 applications from the physical layers of infrastructure offers cost and flexibility
136 advantages to technology providers and end-users alike.

137 The processing done at this layer typically involves: (1) *receiving* EPCs from one or more
138 data sources such as readers; (2) *accumulating* data over intervals of time, *filtering* to
139 eliminate duplicate EPCs and EPCs that are not of interest, and *counting* and *grouping*
140 EPCs to reduce the volume of data; and (3) *reporting* in various forms. The interface
141 described herein, and the functionality it implies, is called “Application Level Events,” or
142 ALE.

143 In early versions of the EPCglobal Network Architecture, originating at the Auto-ID
144 Center at the Massachusetts Institute of Technology (MIT), these functions were
145 understood to be part of a specific component termed “Savant.” The term “Savant” has
146 been variously used to refer generically to any software situated between RFID readers
147 and enterprise applications, or more specifically to a particular design for such software
148 as described by an MIT Auto-ID Center document “The Savant Specification Version
149 0.1” [Savant0.1] or to a later effort by the Auto-ID Center Software Action Group
150 [Savant1.0] that outlined a generalized container framework for such software. Owing to
151 the confusion surrounding the term, the word “Savant” has been deprecated by
152 EPCglobal in favor of more definite specifications of particular functionality. The
153 interface described herein is the first such definite specification.

154 The role of the ALE interface within the EPCglobal Network Architecture is to provide
155 independence between the infrastructure components that acquire the raw EPC data, the
156 architectural component(s) that filter & count that data, and the applications that use the
157 data. This allows changes in one without requiring changes in the other, offering
158 significant benefits to both the technology provider and the end-user. The ALE interface
159 described in the present specification achieves this independence through three means:

- 160 • It provides a means for clients to specify, in a high-level, declarative way, what EPC
161 data they are interested in, without dictating an implementation. The interface is
162 designed to give implementations the widest possible latitude in selecting strategies
163 for carrying out client requests; such strategies may be influenced by performance
164 goals, the native abilities of readers which may carry out certain filtering or counting
165 operations at the level of firmware or RF protocol, and so forth.
- 166 • It provides a standardized format for reporting accumulated, filtered EPC data that is
167 largely independent of where the EPC data originated or how it was processed.
- 168 • It abstracts the sources of EPC data into a higher-level notion of “logical reader,”
169 often synonymous with “location,” hiding from clients the details of exactly what
170 physical devices were used to gather EPC data relevant to a particular logical

171 location. This allows changes to occur at the physical layer (for example, replacing a
172 2-port multi-antenna reader at a loading dock door with three “smart antenna”
173 readers) without affecting client applications. Similarly, it abstracts away the fine-
174 grained details of how data is gathered (*e.g.*, how many individual tag read attempts
175 were carried out). These features of abstraction are a consequence of the way the data
176 specification and reporting aspects of the interface are designed.

177 Unlike the earlier MIT “Savant Version 0.1” effort, the present specification does *not*
178 specify a particular implementation strategy, or internal interfaces within a specific body
179 of software. Instead, this specification focuses exclusively on one external interface,
180 admitting a wide variety of possible implementations so long as they fulfill the contract
181 of the interface. For example, it is possible to envision an implementation of this
182 interface as an independent piece of software that speaks to RFID readers using their
183 network wireline protocols. It is equally possible, however, to envision another
184 implementation in which the software implementing the interface is part of the reader
185 device itself.

186 **2 Role Within the EPCglobal Network Architecture**

187 EPC technology, especially when implemented using RFID, generates a very large
188 number of object reads throughout the supply chain and eventually into consumer usage.
189 Many of those reads represent non-actionable “noise.” To balance the cost and
190 performance of this with the need for clear accountability and interoperability of the
191 various parts, the design of the EPCglobal Network Architecture seeks to:

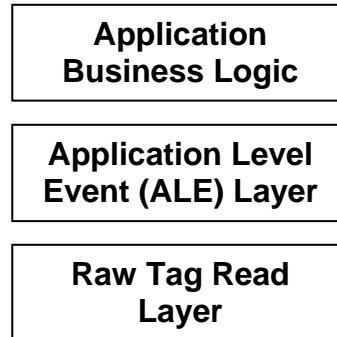
- 192 1. Drive as much filtering and counting of reads as low in the architecture as possible
193 (*i.e.*, in first preference to readers, then to “middleware”, and as a last resort to
194 “applications”), while meeting application and cost needs;
- 195 2. At the same time, minimize the amount of “business logic” embedded in the Tags,
196 Readers and middleware, where business logic is either data or processing logic that
197 is particular to an individual product, product category, industry or business process.

198 The Application Level Events (ALE) interface specified herein is intended to facilitate
199 these objectives by providing a flexible interface to a standard set of accumulation,
200 filtering, and counting operations that produce “reports” in response to client “requests.”
201 The client will be responsible for interpreting and acting on the meaning of the report
202 (*i.e.*, the “business logic”). The client of the ALE interface may be a traditional
203 “enterprise application,” or it may be new software designed expressly to carry out an
204 EPC-enabled business process but which operates at a higher level than the “middleware”
205 that implements the ALE interface. Hence, the term “Application Level Events” should
206 not be misconstrued to mean that the client of the ALE interface is necessarily a
207 traditional “enterprise application.”

208 The ALE interface revolves around client requests and the corresponding reports that are
209 produced. Requests can either be: (1) *immediate*, in which information is reported on a
210 one-time basis at the time of the request; or (2) *recurring*, in which information is
211 reported repeatedly whenever an event is detected or at a specified time interval. The

212 results reported in response to a request can be directed back to the requesting client or to
213 a “third party” specified by the requestor.

214 This reporting API can be viewed as the interface to a
215 layer of functionality that sits between raw EPC
216 detection events (RFID tag reads or otherwise) and
217 application business logic. We refer to this layer as
218 the Application Level Event (ALE) layer. Note that
219 this document does not specify where ALE-level
220 processing takes place: it could take place within
221 independent software “middleware,” within a suitably
222 capable reader, or some combination, though always
223 with the ALE interface serving as a point of interface
224 to the client. Even when implemented as software
225 middleware, the filtering, counting, and other
226 processing requested by a client may be carried out within the software, or pushed into
227 the readers or other devices. This aspect of the ALE specification is intended explicitly
228 to give freedom to implementers, and to provide a way to take full advantage of a range
229 of reader capabilities (while at the same time avoiding clients from needing to understand
230 the details of those capabilities).



231 In many cases, the client of ALE will be software that incorporates the EPC Information
232 Service (EPCIS), or other business processing software. Since EPCIS is another
233 component of the EPCglobal Network Architecture that deals with higher-level EPC
234 events, it is helpful to understand how ALE differs from EPCIS and other software at
235 higher levels of the architecture. The principal differences are:

- 236 • The ALE interface is exclusively oriented towards real-time processing of EPC data,
237 with no persistent storage of EPC data required by the interface (though
238 implementations may employ persistent storage to provide resilience to failures).
239 Business applications, in contrast, typically deal explicitly with historical data and
240 hence are inherently persistent in nature.
- 241 • The events communicated through the ALE interface are pure statements of “what,
242 where, and when,” with no business semantics expressed. Business applications, and
243 typically EPCIS-level data, does embed business semantics at some level. For
244 example, at the ALE level, there might be an event that says “at location L, in the
245 time interval T1–T2, the following 100 case-level EPCs and one pallet-level EPC
246 were read.” Within a business application, the corresponding statement might be “at
247 location L, at time T2, it was confirmed that the following 100 cases were aggregated
248 onto the following pallet.” The business-level event, while containing essentially the
249 same EPC data as the ALE event, is at a semantically higher level because it
250 incorporates an understanding of the business process in which the EPC data were
251 obtained.

252 The distinction between the ALE and EPCIS/business layers is useful because it separates
253 concerns. The ALE layer is concerned with dealing with the mechanics of data
254 gathering, and of filtering down to meaningful events that are a suitable starting point for
255 interpretation by business logic. Business layers are concerned with business process,

256 and recording events that can serve as the basis for a wide variety of enterprise-level
257 information processing tasks. Within this general framework, there is room for many
258 different approaches to designing systems to meet particular business goals, and it is
259 expected that there will not necessarily be one “right” way to construct systems. Thus,
260 the focus in this specification is not on a particular system architecture, but on creating a
261 very well defined interface that will be useful within a variety of designs.

262 ➤ A reference to the EPCglobal Network Architecture document should be inserted
263 when EPCglobal publishes such a document.

264 **3 Terminology and Typographical Conventions**

265 Within this specification, the terms SHALL, SHALL NOT, SHOULD, SHOULD NOT,
266 MAY, NEED NOT, CAN, and CANNOT are to be interpreted as specified in Annex G of
267 the ISO/IEC Directives, Part 2, 2001, 4th edition [ISODir2]. When used in this way,
268 these terms will always be shown in ALL CAPS; when these words appear in ordinary
269 typeface they are intended to have their ordinary English meaning.

270 All sections of this document, with the exception of Section 1 and Section 2, are
271 normative, except where explicitly noted as non-normative.

272 The following typographical conventions are used throughout the document:

- 273 • ALL CAPS type is used for the special terms from [ISODir2] enumerated above.
- 274 • Monospace type is used to denote programming language, UML, and XML
275 identifiers, as well as for the text of XML documents.
- 276 ➤ Placeholders for changes that need to be made to this document prior to its reaching
277 the final stage of approved EPCglobal specification are prefixed by a rightward-
278 facing arrowhead, as this paragraph is.

279 **4 ALE Formal Model**

280 Within this specification, the term “Reader” is used to refer to a source of raw EPC data
281 events. An extremely common type of source, of course, is an actual RFID reader, which
282 generates EPC data by using an RF protocol to read EPC codes from RFID tags. But a
283 Reader could just as easily be an EPC-compatible bar code reader, or even a person
284 typing on a keyboard. Moreover, Readers as used in this specification may not
285 necessarily be in one-to-one correspondence with hardware devices; this is explored in
286 more depth in Section 7. Hence, the term “Reader” is just a convenient shorthand for
287 “raw EPC data event source.” When used in this special sense, the word Reader will
288 always be capitalized. For purposes of discussion, it will sometimes be necessary to
289 speak of tags moving within the detection zone of a Reader; while this terminology is
290 directly germane to RFID readers, it should be obvious what the corresponding meaning
291 would be for other types of Readers.

292 A *read cycle* is the smallest unit of interaction with a Reader. The result of a read cycle
293 is a set of EPCs. In the case of an RFID reader antenna, the EPCs in a read cycle are
294 sometimes those obtained in a single operation of the reader’s RF protocol, though this is

295 not necessarily the case. The output of a read cycle is the input to the ALE layer; *i.e.*, it is
296 the interface between the Raw Tag Read Layer and the ALE Layer in the diagram of
297 Section 2. As was noted earlier, this interface could be an actual software or network
298 interface between a reader device and a middleware implementation, but this is not
299 necessarily the case. From the ALE perspective, a read cycle is a single event containing
300 a set of EPCs, with nothing more implied.

301 An *event cycle* is one or more read cycles, from one or more Readers that are to be
302 treated as a unit from a client perspective. It is the smallest unit of interaction between
303 the ALE interface and a client. Referring to the diagram of Section 2, clients in the
304 Application Business Logic Layer specify the boundaries of event cycles to the ALE
305 layer as part of a request for a report.

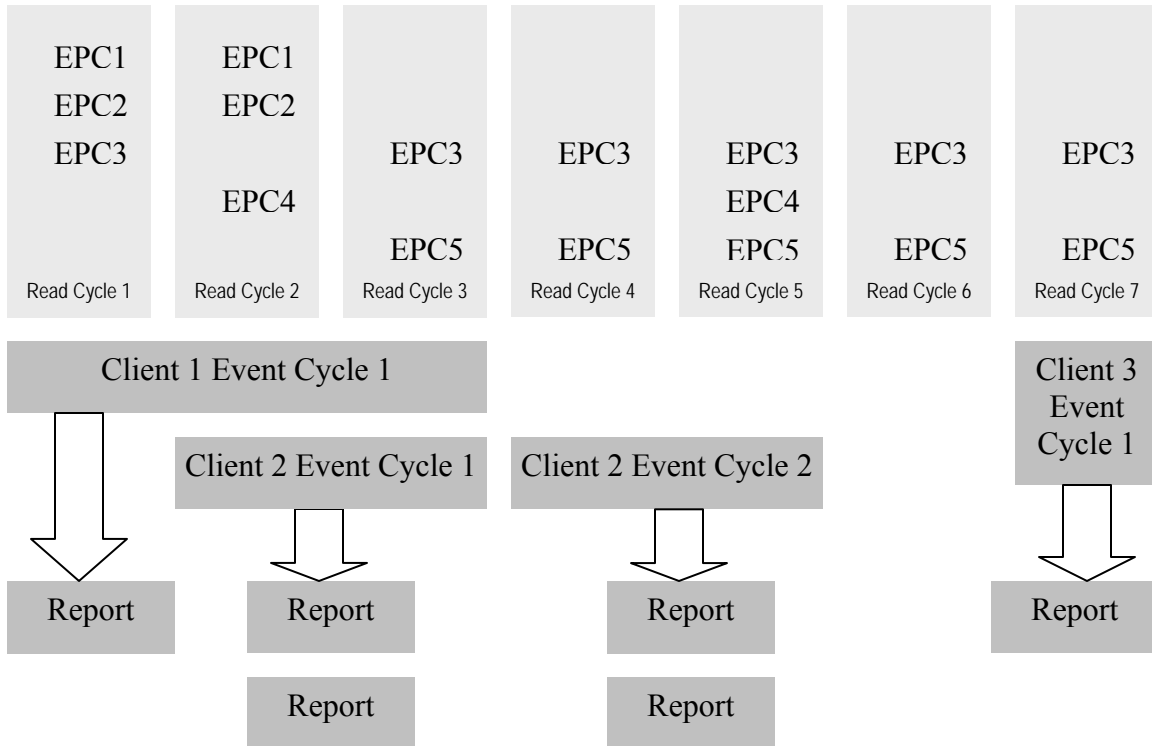
306 A *report* is data about an event cycle communicated from the ALE implementation to a
307 client. The report is the output of the ALE layer, communicated to the Application
308 Business Logic Layer.

309 As tags or other carriers of EPC data move in and out of the detection zone of a Reader,
310 the EPCs reported in each read cycle change. Within an event cycle, the same tag may be
311 read several times (if the tag remains within the detection zone of any of the Readers
312 specified for that event cycle). Section 8.2.1 specifies how event cycle boundaries may:

- 313 • Extend for a specified duration (interval of real time); *e.g.*, accumulate reads into
314 five-second intervals.
- 315 • Occur periodically; *e.g.*, report only every 30 minutes, regardless of the read cycle.
- 316 • Be triggered by external events; *e.g.*, an event cycle starts when a pallet on a conveyer
317 triggers an electric eye upstream of a portal, and ends when it crosses a second
318 electric eye downstream of a portal.
- 319 • Be delimited when no new EPCs are detected by any Reader specified for that event
320 cycle for a specified interval of time.
- 321 • Simply be every read cycle. (This possibility is not provided for in Section 8.2, but
322 may be available through vendor extensions.)

323 A client must specify one of these methods when requesting a report. (The complete set
324 of available options is described normatively in Section 8.2.1.)

325 The net picture looks something like this:



326

327 While the diagram shows read cycles arising from a single Reader, in practice a given
 328 event cycle may collect read cycles from more than one Reader. As the diagram
 329 suggests, there may be more than one active event cycle at any point in time. Multiple
 330 active event cycles may start and end with different read cycles, and may overlap in
 331 arbitrary ways. They may gather data from the same Readers, from different Readers, or
 332 from arbitrarily overlapping sets of Readers. Multiple active event cycles could arise
 333 from one client making several simultaneous requests, or from independent clients. In all
 334 cases, however, the same read cycles are shared by all active event cycles that request
 335 data from a given Reader.

336 The set of EPCs in a given read cycle from a given Reader is denoted by S . In the picture
 337 above, $S_1 = \{EPC1, EPC2, EPC3\}$ and $S_2 = \{EPC1, EPC2, EPC4\}$.

338 An event cycle is treated as a unit by clients, so clients do not see any of the internal
 339 structure of the event cycle. All that is relevant, therefore, is the complete set of EPCs
 340 occurring in any of the read cycles that make up the event cycle, from any of the Readers
 341 in the set specified for the event cycle, with duplicates removed. This is simply the union
 342 of the read cycle sets: $E = S_1 \cup S_2 \cup \dots$. In the example above for Client 1 Event
 343 Cycle 1 we have $E_{1.1} = \{EPC1, EPC2, EPC3, EPC4, EPC5\}$.

344 Clients get information about event cycles through reports. A report is specified by a
 345 combination of these three parameters:

- 346
- What set R to report, which may be
- 347
- The *complete* set from the current event cycle $R = E_{cur}$; or

- 348 • The *differential* set that only includes differences of the current event cycle
349 relative to the previous one (assuming the same event cycle boundaries). This can
350 be the set of additions $R = (E_{cur} - E_{prev})$ or the set of deletions $R = (E_{prev} -$
351 $E_{cur})$, where ‘-’ denotes the set difference operator.
- 352 • An optional filter $F(R)$ to apply, including as part of the standard ALE interface:
 - 353 • One or more object types derived from the “filter bits” of the EPC Tag Data
354 Standard [TDS1.1], including “product” objects (*e.g.*, pallet, case, *etc.*) as well as
355 “location” objects (*e.g.*, warehouse slots, trucks, retail shelves, *etc.*, that contain
356 embedded EPC tags)
 - 357 • A specific list of EPCs
 - 358 • A range of EPCs
- 359 • Whether to report
 - 360 • The members of the set, $F(R)$ (*i.e.*, the EPCs themselves), possibly grouped as
361 described in Section 5, and in what format (*e.g.*, pure identity URI, tag URI, raw
362 binary, *etc.*);
 - 363 • The quantity, or cardinality, of the set $|F(R)|$, or of the groups making up the set as
364 described in Section 5.

365 The available options are described normatively in Section 8.2.

366 A client may require more than one report from a given event cycle; *e.g.*, a smart shelf
367 application may require both an additions report and a deletions report.

368 This all adds up to an ALE Layer API in which the primary interaction involves: (1) a
369 client specifying: (a) one or more Readers (this is done indirectly, as explained in
370 Section 7) (b) event cycle boundaries as enumerated above, and (c) a set of reports as
371 defined above; and (2) the ALE Layer responding by returning the information implied
372 by that report specification for one or more event cycles. This may be done in a “pull”
373 mode, where the client asks for a report or reports (also specifying how the event cycle is
374 to be delimited) and the ALE Layer in turn initiates or waits for read events, filters/counts
375 the data, and returns the report(s). It may also be done in a “push” mode, where the client
376 registers a subscription with a report set and event cycle boundary specification, and
377 thereafter the ALE Layer asynchronously sends reports to the client when event cycles
378 complete. The complete details of the API, the information required to specify an event
379 cycle, and the information returned to the client when an event cycle completes are
380 spelled out in Sections 8.1, 8.2, and 8.3, respectively. Examples of an event cycle
381 specification and event cycle reports in XML are given in Section 10.

382 Note that because the filtering operations commute with the set union and difference
383 operations, there is a great deal of freedom in how an ALE implementation actually
384 carries out the task of fulfilling a report request. For example, in one implementation,
385 there may be a Reader that is capable of doing filtering directly within the Reader, while
386 in a second implementation the Reader may not be capable of filtering and so software
387 implementing the ALE API must do it. But the ALE API itself need not change – the

388 client specifies the reports, and the implementation of the API decides where best to carry
389 out the requested filtering.

390 **5 Group Reports**

391 Sometimes it is useful to group EPCs read during an event cycle based on portions of the
392 EPC or attributes of the objects identified by the EPCs. For example, in a shipment
393 receipt verification application, it is useful to know the quantity of each type of case (*i.e.*,
394 each distinct case GTIN), but not necessarily the serial number of each case. This
395 requires slightly more complex processing, based on the notion of a grouping operator.

396 A *grouping operator* is a function G that maps an EPC code into some sort of group
397 code g . For example, a grouping operator might map an EPC code into a GTIN group, or
398 simply into the upper bits (manufacturer and product) of the EPC. Other grouping
399 operators might be based on other information available on an EPC tag, such as the filter
400 code that implies the type of object (*i.e.*, pallet, case, item, *etc.*).

401 The notation $S \downarrow g$ means the subset of EPCs $s1, s2, \dots$ in the set S that belong to group g .
402 That is, $S \downarrow g \equiv \{ s \text{ in } S \mid G(s) = g \}$.

403 A *group membership report* for grouping operator G is a set of pairs, where the first
404 element in each pair is a group name g , and the second element is the list of EPCs that
405 fall into that group, *i.e.*, $S \downarrow g$.

406 A *group cardinality report* is similar, but instead of enumerating the EPCs in each group,
407 the group cardinality report just reports how many of each there are. That is, the group
408 cardinality report for grouping operator G is a set of pairs, where the first element in each
409 pair is a group name g , and the second element is the number of EPCs that fall into that
410 group, *i.e.*, $|S \downarrow g|$.

411 Formally, then, the reporting options from the last section are:

- 412 • Whether to report
- 413 • A group membership (group list) report for one or more specified grouping
414 operators G_i , which may include, and may possibly be limited to, the default
415 (unnamed) group. In mathematical notation: $\{ (g, F(R) \downarrow g) \mid F(R) \downarrow g \text{ is non-empty} \}$.
416
 - 417 • A group cardinality (group count) report for one or more specified grouping
418 operators G_i , which may include, and may possibly be limited to, the default
419 (unnamed) group. In mathematical notation: $\{ (g, |F(R) \downarrow g|) \mid F(R) \downarrow g \text{ is non-} \}$.
420 empty

421 **6 Read Cycle Timing**

422 The ALE API is intentionally silent about the timing of read cycles. Clients may specify
423 the boundaries of event cycles, which accumulate data from one or more underlying read
424 cycles, but the API does not provide a client with explicit control over the frequency at
425 which read cycles are completed. There are several reasons for this:

- 426 • A client or clients may make simultaneous requests for event cycle reports that may
427 have differing event cycle boundaries and different report specifications. In this case,
428 clients must necessarily share a common view of when and how frequently read
429 cycles take place. Specifying the read cycle frequency outside of any event cycle
430 request insures that clients cannot make contradictory demands on read cycles.
- 431 • In cases where there are many readers in physical proximity (perhaps communicating
432 to different ALE implementations), the read cycle frequency must be carefully tuned
433 and coordinated to avoid reader interference. This coordination generally requires
434 physical-level information that generally would be (and should be) unknown to a
435 client operating at the ALE level.
- 436 • The ALE API is designed to provide access to data from a wide variety of “Reader”
437 sources, which may have very divergent operating principles. If the ALE API were to
438 provide explicit control over read cycle timing, it would necessarily make
439 assumptions about the source of read cycle data that would limit its applicability. For
440 example, if the ALE API were to provide a parameter to clients to set the frequency
441 of read cycles, it would assume that every Reader provides data on a fixed, regular
442 schedule.

443 In light of these considerations, there is no standard way provided by ALE for clients to
444 control read cycle timing. Implementations of ALE may provide different means for this,
445 *e.g.*, configuration files, administrative interfaces, and so forth.

446 Regardless of how a given ALE implementation provides for the configuration of read
447 cycle timing, the ALE implementation always has the freedom to suspend Reader activity
448 during periods when no event cycles requiring data from a given Reader are active.

449 **7 Logical Reader Names**

450 In specifying an event cycle, an ALE client names one or more Readers of interest. This
451 is usually necessary, as an ALE implementation may manage many readers that are used
452 for unrelated purposes. For example, in a large warehouse, there may be ten loading
453 dock doors each having three RFID readers; in such a case, a typical ALE request may be
454 directed at the three readers for a particular door, but it is unlikely that an application
455 tracking the flow of goods into trucks would want the reads from all 30 readers to be
456 combined into a single event cycle.

457 This raises the question of how ALE clients specify which reader devices are to be used
458 for a given event cycle. One possibility is to use identities associated with the reader
459 devices themselves, *e.g.*, a unique name, serial number, EPC, IP address, *etc.* This is
460 undesirable for several reasons:

- 461 • The exact identities of reader devices deployed in the field are likely to be unknown
462 at the time an application is authored and configured.
- 463 • If a reader device is replaced, this unique reader device identity will change, forcing
464 the application configuration to be changed.

- 465 • If the number of reader devices must change – *e.g.*, because it is discovered that four
466 reader devices are required instead of three to obtain adequate coverage of a
467 particular loading dock door – then the application must be changed.

468 To avoid these problems, ALE introduces the notion of a “logical reader.” Logical
469 readers are abstract names that a client uses to refer to one or more Readers that have a
470 single logical purpose; *e.g.*, `DockDoor42`. Within the implementation of ALE, an
471 association is maintained between logical names such as `DockDoor42` and the physical
472 reader devices assigned to fulfill that purpose. Any ALE event cycle specification that
473 refers to `DockDoor42` is understood by the ALE implementation to refer to the physical
474 reader (or readers) associated with that name.

475 Logical names may also be used to refer to sources of raw EPC events that are
476 synthesized from various sources. For example, one vendor may have a technology for
477 discriminating the physical location of tags by triangulating the results from several
478 reader devices. This could be exposed in ALE by assigning a synthetic logical reader
479 name for each discernable location.

480 Different ALE implementations may provide different ways of mapping logical names to
481 physical reader devices, synthetic readers, and other sources of EPC events. This is a key
482 extensibility point. At a minimum, however, all ALE implementations SHOULD provide
483 a straightforward way to map a logical name to a list of read event sources, and where
484 physical readers allow for independent control over multiple antennas and multiple tag
485 protocols, each combination of (reader, antenna, protocol) should be treated as a separate
486 read event source for this purpose. To illustrate, an ALE implementation may maintain a
487 table like this:

Logical Reader Name	Physical Reader Devices		
	Reader Name	Antenna	Protocol
DockDoor42	Acme42926	0	UHF
	Acme42926	1	UHF
	Acme43629	0	UHF
DockDoor43	Acme44926	0	UHF
	Acme44926	1	UHF
	Acme49256	0	UHF

488

489 (It must be emphasized that the table above is meant to be illustrative of the kind of
490 configuration data an ALE implementation might maintain, *not* a normative specification
491 of what configuration data an ALE implementation must maintain.)

492 More elaborate implementations of ALE, such as those that provide synthesized logical
493 readers such as the triangulation example above, will require more elaborate
494 configuration data. Tables of this kind may be established through static configuration,

495 or through more dynamic discovery mechanisms. The method for establishing and
496 maintaining configuration of this kind is outside the scope of this specification.

497 To summarize, the definition of ALE relies upon several related concepts:

- 498 • A *logical reader* is a name that an ALE client uses to refer to one or more, raw EPC
499 data event sources (“Readers”). In terms of the formal model of Section 3, an event
500 cycle aggregates read cycle data from all of the Readers that are associated with the
501 set of logical readers the ALE client specifies in its request.
- 502 • A *Reader* is a raw EPC data event source. A Reader provides EPC data to an ALE
503 implementation in a series of read cycles, each containing a list of EPCs. A Reader
504 may map into physical devices in a variety of ways, including:
 - 505 • A Reader may map directly to a single physical device; *e.g.*, a one-antenna RFID
506 reader, a bar code scanner, or a multi-antenna RFID reader where data from all
507 antennas is always combined.
 - 508 • Several Readers may map to the same physical device; *e.g.*, a multi-antenna RFID
509 reader where each antenna is treated as an independent source (in which case
510 there would be a separate Reader for each antenna).
 - 511 • A Reader may map to more than one physical device; *e.g.*, several RFID devices
512 are used to triangulate location information to create synthesized read cycles for
513 virtual “Readers” associated with different spatial zones.

514 **8 ALE API**

515 This section defines normatively the programmatic interface to ALE. The external
516 interface is defined by the ALE class (Section 8.1). This interface makes use of a number
517 of complex data types that are documented in the sections following Section 8.1.

518 Implementations may expose the ALE interface via a wire protocol, or via a direct API in
519 which clients call directly into code that implements ALE. This section of the document
520 does not define the concrete wire protocol or programming language-specific API, but
521 instead defines only the abstract syntax. Section 11 of the document specifies the
522 required binding of the API to a WS-i compliant SOAP protocol. Section 10 specifies the
523 standard way in which the two major data types in this API, the Event Cycle
524 Specification and the Event Cycle Report, are rendered in XML. Implementations may
525 provide additional bindings of the API, including bindings to particular programming
526 languages, and of the data types.

527 The general interaction model is that there are one or more clients that make method calls
528 to the ALE interface defined in Section 8.1. Each method call is a request, which causes
529 the ALE implementation to take some action and return results. Thus, methods of the
530 ALE interface are synchronous.

531 The ALE interface also provides a way for clients to subscribe to events that are delivered
532 asynchronously. This is done through methods that take a `notificationURI` as an
533 argument. Such methods return immediately, but subsequently the ALE implementation
534 may asynchronously deliver information to the consumer denoted by the

535 notificationURI. Different ALE implementations MAY provide a variety of
536 available notification means (e.g., JMS, MQ-Series, TIBCO, e-mail, SOAP, etc.); this is
537 intended to be a point of extensibility. Section 9 specifies notification means that are
538 standardized, and specifies the conformance requirement (MAY, SHOULD, SHALL) for
539 each.

540 In the sections below, the API is described using UML class diagram notation, like so:

```
541 dataMember1 : Type1  
542 dataMember2 : Type2  
543 ---  
544 method1 (ArgName:ArgType, ArgName:ArgType, ...) : ReturnType  
545 method2 (ArgName:ArgType, ArgName:ArgType, ...) : ReturnType
```

546 Within the UML descriptions, the notation <<extension point>> identifies a place
547 where implementations SHALL provide for extensibility through the addition of new
548 data members and/or methods. Extensibility mechanisms SHALL provide for both
549 proprietary extensions by vendors of ALE-compliant products, and for extensions defined
550 by EPCglobal through future versions of this specification or through new specifications.

551 In the case of the standard XML bindings for ECSpec and ECReports, the extension
552 points are implemented within the XML schema following the methodology described in
553 Section 10.1. In the case of the standard SOAP binding for the ALE interface, the
554 extension point is implemented simply by adding new operations to the WSDL.

555 8.1 ALE – Main API Class

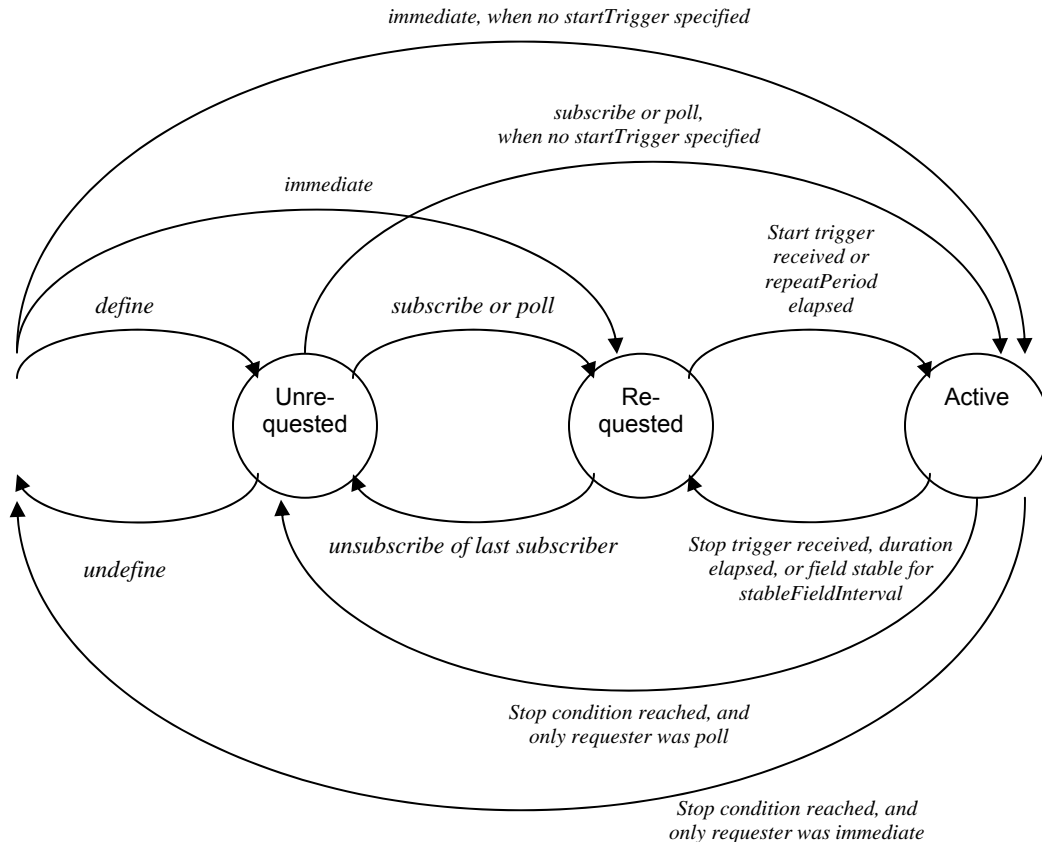
```
556 ---
557 define(specName:string, spec:ECSpec) : void
558 undefine(specName:string) : void
559 getECSpec(specName:string) : ECTSpec
560 getECSpecNames() : List // returns a list of specNames as
561 strings
562 subscribe(specName:string, notificationURI:string) : void
563 unsubscribe(specName:string, notificationURI:string) : void
564 poll(specName:string) : ECReports
565 immediate(spec:ECSpec) : ECReports
566 getSubscribers(specName:String) : List // of notification
567 URIs
568 getStandardVersion() : string
569 getVendorVersion() : string
570 <<extension point>>
```

571 An `ECSpec` is a complex type that defines how an event cycle is to be calculated. There
572 are two ways to cause event cycles to occur. A standing `ECSpec` may be posted using
573 the `define` method. Subsequently, one or more clients may subscribe to that `ECSpec`
574 using the `subscribe` method. The `ECSpec` will generate event cycles as long as there
575 is at least one subscriber. A `poll` call is like subscribing then unsubscribing
576 immediately after one event cycle is generated (except that the results are returned from
577 `poll` instead of being sent to a `notificationURI`). The second way is that an
578 `ECSpec` can be posted for immediate execution using the `immediate` method. This is
579 equivalent to defining an `ECSpec`, performing a single `poll` operation, and then
580 undefining it.

581 The execution of `ECSpecs` is defined formally as follows. An `ECSpec` is said to be
582 *requested* if any of the following is true:

- 583 • It has previously been defined using `define`, it has not yet been undefined, and
584 there has been at least one `subscribe` call for which there has not yet been a
585 corresponding `unsubscribe` call.
- 586 • It has previously been defined using `define`, it has not yet been undefined, a
587 `poll` call has been made, and the first event cycle since the `poll` was received has
588 not yet been completed.
- 589 • It was defined using the `immediate` method, and the first event cycle has not yet
590 been completed.

591 Once requested, an ECSpec is said to be *active* if reads are currently being accumulated
 592 into an event cycle based on the ECSpec. Standing ECSpecs that are requested using
 593 `subscribe` may transition between active and inactive multiple times. ECSpecs that
 594 are requested using `poll` or created using `immediate` will transition between active
 595 and inactive just once (though in the case of `poll`, the ECSpec remains defined
 596 afterward so that it could be subsequently polled again or subscribed to).
 597 This description is summarized in the state diagram below.



598
 599 The primary data types associated with the ALE API are the ECSpec, which specifies
 600 how an event cycle is to be calculated, and the ECRports, which contains one or more
 601 reports generated from one activation of an ECSpec. ECRports instances are both
 602 returned from the `poll` and `immediate` methods, and also sent to `notificationURIs`
 603 when ECSpecs are subscribed to using the `subscribe` method. The next two sections,
 604 Section 8.2 and Section 8.3, specify the ECSpec and ECRports data types in full
 605 detail.
 606 The two methods `getStandardVersion` and `getVendorVersion` may be used
 607 by ALE clients to ascertain with what version of the ALE specification an
 608 implementation complies. The method `getStandardVersion` returns a string that
 609 identifies what version of the specification this implementation complies with. The
 610 possible values for this string are defined by EPCglobal. An implementation SHALL

611 return a string corresponding to a version of this specification to which the
612 implementation fully complies, and SHOULD return the string corresponding to the latest
613 version to which it complies. To indicate compliance with this Version 1.0 of the ALE
614 specification, the implementation SHALL return the string 1 . 0. The method
615 `getVendorVersion` returns a string that identifies what vendor extensions this
616 implementation provides. The possible values of this string and their meanings are
617 vendor-defined, except that the empty string SHALL indicate that the implementation
618 implements only standard functionality with no vendor extensions. When an
619 implementation chooses to return a non-empty string, the value returned SHALL be a
620 URI where the vendor is the owning authority. For example, this may be an HTTP URL
621 whose authority portion is a domain name owned by the vendor, a URN having a URN
622 namespace identifier issued to the vendor by IANA, an OID URN whose initial path is a
623 Private Enterprise Number assigned to the vendor, etc.

624 **8.1.1 Error Conditions**

625 Methods of the ALE API signal error conditions to the client by means of exceptions.
626 The following exceptions are defined. All the exception types in the following table are
627 extensions of a common `ALEException` base type, which contains one string element
628 giving the reason for the exception.

Exception Name	Meaning
<code>SecurityException</code>	The operation was not permitted due to an access control violation or other security concern. The specific circumstances that may cause this exception are implementation-specific, and outside the scope of this specification.
<code>DuplicateNameException</code>	The specified ECSpec name already exists.
<code>ECSpecValidationException</code>	The specified ECSpec is invalid; <i>e.g.</i> , it specifies both a start trigger and a repeat period. The complete list of rules for generating this exception are specified in Section 8.2.11.
<code>InvalidURIException</code>	The URI specified for a subscriber cannot be parsed, does not name a scheme recognized by the implementation, or violates rules imposed by a particular scheme.
<code>NoSuchNameException</code>	The specified ECSpec name does not exist.
<code>NoSuchSubscriberException</code>	The specified subscriber does not exist.

Exception Name	Meaning
DuplicateSubscriptionException	The specified ECSpec name and subscriber URI is identical to a previous subscription that was created and not yet unsubscribed.
ImplementationException	A generic exception thrown by the implementation for reasons that are implementation-specific. This exception contains one additional element: a severity member whose values are either ERROR or SEVERE. ERROR indicates that the ALE implementation is left in the same state it had before the operation was attempted. SEVERE indicates that the ALE implementation is left in an indeterminate state.

629

630 The exceptions that may be thrown by each ALE method are indicated in the table below:

ALE Method	Exceptions
define	DuplicateNameException ECSpecValidationException SecurityException ImplementationException
undefine	NoSuchNameException SecurityException ImplementationException
getECSpec	NoSuchNameException SecurityException ImplementationException
getECSpecNames	SecurityException ImplementationException
subscribe	NoSuchNameException InvalidURIException DuplicateSubscriptionException SecurityException ImplementationException
unsubscribe	NoSuchNameException NoSuchSubscriberException InvalidURIException SecurityException ImplementationException

ALE Method	Exceptions
poll	NoSuchNameException SecurityException ImplementationException
immediate	ECSpecValidationException SecurityException ImplementationException
getSubscribers	NoSuchNameException SecurityException ImplementationException

631

632 **8.2 ECSpec**

633 An `ECSpec` describes an event cycle and one or more reports that are to be generated
634 from it. It contains a list of logical Readers whose read cycles are to be included in the
635 event cycle, a specification of how the boundaries of event cycles are to be determined,
636 and a list of specifications each of which describes a report to be generated from this
637 event cycle.

```

638 readers : List // List of logical reader names
639 boundaries : ECBoundarySpec
640 reportSpecs : List // List of one or more ECReportSpec
641 // instances
642 includeSpecInReports : boolean
643 <<extension point>>
644 ---

```

645 If the `readers` parameter is null, omitted, is an empty list, or contains any logical
646 reader names that are not known to the implementation, then the `define` and
647 `immediate` methods SHALL raise an `ECSpecValidationException`.

648 If the `boundaries` parameter is null or omitted, then the `define` and `immediate`
649 methods SHALL raise an `ECSpecValidationException`.

650 If the `reportSpecs` parameter is null or omitted or contains an empty list, or if the list
651 contains two `ECReportSpec` instances with the same `reportName`, then the
652 `define` and `immediate` methods SHALL raise an
653 `ECSpecValidationException`.

654 If an `ECSpec` has `includeSpecInReports` set to true, then the ALE
655 implementation SHALL include the complete `ECSpec` as part of every `ECReports`
656 instance generated by this `ECSpec`.

657 **8.2.1 ECBoundarySpec**

658 An ECBoundarySpec specifies how the beginning and end of event cycles are to be
659 determined.

```
660 startTrigger : ECTrigger
661 repeatPeriod : ECTime
662 stopTrigger : ECTrigger
663 duration : ECTime
664 stableSetInterval : ECTime
665 <<extension point>>
666 ---
```

667 The ECTime values duration, repeatPeriod, and stableSetInterval must
668 be non-negative; otherwise, the define and immediate methods SHALL raise an
669 ECSpecValidationException. Zero means “unspecified.”

670 The startTrigger and stopTrigger parameters are optional. For each of these
671 two parameters, if the parameter is null, omitted, or is an empty string it is considered
672 “unspecified.”

673 The startTrigger and repeatPeriod parameters are mutually exclusive. If
674 startTrigger and repeatPeriod are both specified, then the define and
675 immediate methods SHALL raise an ECSpecValidationException.

676 The conditions under which an event cycle is started depends on the settings for
677 startTrigger and repeatPeriod:

- 678 • If startTrigger is specified and repeatPeriod is not specified, an event
679 cycle is started when:
 - 680 • The ECSpec is in the *requested* state and the specified start trigger is received.
- 681 • If startTrigger is not specified and repeatPeriod is specified, an event
682 cycle is started when:
 - 683 • The ECSpec transitions from the *unrequested* state to the *requested* state; or
 - 684 • The repeatPeriod has elapsed from the start of the last event cycle, and in
685 that interval the ECSpec has never transitioned to the *unrequested* state.
- 686 • If neither startTrigger nor repeatPeriod are specified, an event cycle is
687 started when:
 - 688 • The ECSpec transitions from the *unrequested* state to the *requested* state; or
 - 689 • Immediately after the previous event cycle, if the ECSpec is in the *requested*
690 state.

691 An event cycle, once started, extends until one of the following is true:

- 692 • The `duration`, when specified, expires.
- 693 • When the `stableSetInterval` is specified, no *new* EPCs are reported by any
694 Reader for the specified interval (*i.e.*, the set of EPCs being accumulated by the event
695 cycle is stable for the specified interval). In this context, “new” is to be interpreted
696 collectively among Readers contributing to this event cycle. For example, suppose a
697 given event cycle is accumulating data from Readers A and B. If Reader A completes
698 a read cycle containing EPC X, then subsequently Reader B completes a different
699 read cycle containing the same EPC X, then the occurrence of EPC X in B’s read
700 cycle is not considered “new” for the purposes of evaluating the
701 `stableSetInterval`. Note that in the context of the `stableSetInterval`,
702 the term “stable” only implies that no *new* EPCs are detected; it does not imply that
703 previously detected EPCs must continue to be detected. That is, only *additions*, and
704 not *deletions*, are considered in determining that the EPC set is “stable.”

- 705 • The `stopTrigger`, when specified, is received.

- 706 • The `ECSpec` transitions to the *unrequested* state.

707 Note that the first of these conditions to become true terminates the event cycle. For
708 example, if both `duration` and `stableSetInterval` are specified, then the event
709 cycle terminates when the `duration` expires, even if the reader field has not been stable
710 for the `stableSetInterval`. But if the set of EPCs is stable for
711 `stableSetInterval`, the event cycle terminates even if the total time is shorter than
712 the specified `duration`.

713 Note that if the `repeatPeriod` expires while an event cycle is in progress, it does not
714 terminate the event cycle. The event cycle terminates only when one of the four
715 conditions specified above becomes true. If, by that time, the `ECSpec` has not
716 transitioned to the *unrequested* state, then a new event cycle will start immediately,
717 following the second rule for `repeatPeriod` (because the `repeatPeriod` has
718 expired, the start condition is immediately fulfilled).

719 If no event cycle termination condition is specified in the `ECBoundarySpec` – that is,
720 `stopTrigger`, `duration`, and `stableSetInterval` are all unspecified, and
721 there is no vendor extension termination condition specified – then the `define` and
722 `immediate` methods SHALL raise an `ECSpecValidationException`.

723 In all the descriptions above, note that an `ECSpec` presented via the `immediate` method
724 means that the `ECSpec` transitions from *unrequested* to *requested* immediately upon
725 calling `immediate`, and transitions from *requested* to *unrequested* immediately after
726 completion of the event cycle.

727 The `ECTrigger` values `startTrigger` and `stopTrigger`, if specified, must
728 conform to URI syntax as defined by [RFC2396], and must be supported by the ALE
729 implementation; otherwise, the `define` and `immediate` methods SHALL raise an
730 `ECSpecValidationException`.

731 **8.2.2 ECTime**

732 ECTime denotes a span of time measured in physical time units.

```
733 duration : long
734 unit : ECTimeUnit
735 ---
```

736 **8.2.3 ECTimeUnit**

737 ECTimeUnit is an enumerated type denoting different units of physical time that may
738 be used in an ECBoundarySpec.

```
739 <<Enumerated Type>>
740 MS // Milliseconds
```

741 **8.2.4 ECTrigger**

742 ECTrigger denotes a URI that is used to specify a start or stop trigger for an event
743 cycle (see Section 8.2.1 for explanation of start and stop triggers). The interpretation of
744 this URI is determined by the ALE implementation; the kinds and means of triggers
745 supported is intended to be a point of extensibility.

746 **8.2.5 ECReportSpec**

747 An ECReportSpec specifies one report to be returned from executing an event cycle.
748 An ECSpec contains a list of one or more ECReportSpec instances.

```
749 reportName : string
750 reportSet : ECReportSetSpec
751 filter : ECFilterSpec
752 group : ECGroupSpec
753 output : ECReportOutputSpec
754 reportIfEmpty : boolean
755 reportOnlyOnChange : boolean
756 <<extension point>>
757 ---
```

758 The ECReportSetSpec specifies what set of EPCs is considered for reporting: all
759 currently read, additions from the previous event cycle, or deletions from the previous
760 event cycle.

761 The filter parameter (of type ECFilterSpec) specifies how the raw EPCs are
762 filtered before inclusion in the report. If any of the specified filters does not conform to

763 the EPC URI pattern syntax specified in [TDS1.1], then the `define` and `immediate`
764 methods SHALL raise an `ECSpecValidationException`.

765 The `group` parameter (of type `ECGroupSpec`) specifies how the filtered EPCs are
766 grouped together for reporting. If any of the grouping patterns does not conform to the
767 syntax for grouping patterns specified in Section 8.2.9, or if any two grouping patterns
768 are determined to be non-disjoint as defined in Section 8.2.9, then the `define` and
769 `immediate` methods SHALL raise an `ECSpecValidationException`.

770 The `output` parameter (of type `ECReportOutputSpec`) specifies whether to return
771 the EPC groups themselves or a count of each group, or both. These parameter types are
772 discussed at length in Sections 4 and 5.

773 If an `ECReportSpec` has `reportIfEmpty` set to `false`, then the corresponding
774 `ECReport` instance SHALL be omitted from the `ECReports` for this event cycle if the
775 final, filtered set of EPCs is empty (i.e., if the final EPC list would be empty, or if the
776 final count would be zero).

777 If an `ECReportSpec` has `reportOnlyOnChange` set to `true`, then the corresponding
778 `ECReport` instance SHALL be omitted from the `ECReports` for this event cycle if the
779 filtered set of EPCs is identical to the previously filtered set of EPCs. This comparison
780 takes place before the filtered set has been modified based on `reportSet` or `output`
781 parameters. The comparison also disregards whether the previous `ECReports` was
782 actually sent due to the effect of this boolean, or the `reportIfEmpty` boolean.

783 When the processing of `reportIfEmpty` and `reportOnlyOnChange` results in *all*
784 `ECReport` instances being omitted from an `ECReports` for an event cycle, then the
785 notification of subscribers SHALL be suppressed altogether. That is, a notification
786 consisting of an `ECReports` having zero contained `ECReport` instances SHALL NOT
787 be sent to a subscriber. (Because an `ECSpec` must contain at least one
788 `ECReportSpec`, this can only arise as a result of `reportIfEmpty` or
789 `reportOnlyOnChange` processing.) This rule only applies to subscribers (event cycle
790 requestors that were registered by use of the `subscribe` method); an `ECReports`
791 instance SHALL always be returned to the caller of `immediate` or `poll` at the end of
792 an event cycle, even if that `ECReports` instance contains zero `ECReport` instances.

793 The `reportName` parameter is an arbitrary string that is copied to the `ECReport`
794 instance created when this event cycle completes. The purpose of the `reportName`
795 parameter is so that clients can distinguish which of the `ECReport` instances that it
796 receives corresponds to which `ECReportSpec` instance contained in the original
797 `ECSpec`. This is especially useful in cases where fewer reports are delivered than there
798 were `ECReportSpec` instances in the `ECSpec`, because `reportIfEmpty=false`
799 or `reportOnlyOnChange=true` settings suppressed the generation of some reports.

800 **8.2.6 ECRReportSetSpec**

801 ECRReportSetSpec is an enumerated type denoting what set of EPCs is to be
802 considered for filtering and output: all EPCs read in the current event cycle, additions
803 from the previous event cycle, or deletions from the previous event cycle.

804 <<Enumerated Type>>

805 CURRENT

806 ADDITIONS

807 DELETIONS

808 **8.2.7 ECFilterSpec**

809 An ECFilterSpec specifies what EPCs are to be included in the final report.

810 includePatterns : List // List of EPC patterns

811 excludePatterns : List // List of EPC patterns

812 <<extension point>>

813 ---

814 The ECFilterSpec implements a flexible filtering scheme based on two pattern lists.
815 Each list contains zero or more EPC patterns. Each EPC pattern denotes a single EPC, a
816 range of EPCs, or some other set of EPCs. (Patterns are described in detail below in
817 Section 8.2.8.) An EPC is included in the final report if (a) the EPC does *not* match any
818 pattern in the excludePatterns list, *and* (b) the EPC *does* match at least one pattern
819 in the includePatterns list. The (b) test is omitted if the includePatterns list
820 is empty.

821 This can be expressed using the notation of Section 4 as follows, where R is the set of
822 EPCs to be reported from a given event cycle, prior to filtering:

823 $F(R) = \{ epc \mid epc \in R$
824 $\quad \& (epc \in I_1 \mid \dots \mid epc \in I_n)$
825 $\quad \& epc \notin E_1 \& \dots \& epc \notin E_n \}$

826 where I_i denotes the set of EPCs matched by the i th pattern in the includePatterns
827 list, and E_i denotes the set of EPCs matched by the i th pattern in the
828 excludePatterns list.

829 **8.2.8 EPC Patterns (non-normative)**

830 EPC Patterns are used to specify filters within an ECFilterSpec. The normative
831 specification of EPC Patterns may be found in the EPCglobal Tag Data Specification
832 Version 1.1 [TDS1.1]. The remainder of this section provides a non-normative summary
833 of some of the features of that specification, to aid the reader who has not read the
834 EPCglobal Tag Data Specification in understanding the filtering aspects of the ALE API.

835 An EPC pattern is a URI-formatted string that denotes a single EPC or set of EPCs. The
836 general format is:

837 `urn:epc:pat:TagFormat:Filter.Company.Item.Serial`

838 where *TagFormat* denotes one of the tag formats defined by the Tag Data
839 Specification, and the four fields *Filter*, *Company*, *Item*, and *SerialNumber*
840 correspond to data fields of the EPC. The meaning and number of these fields, as well as
841 their formal names, varies according to what *TagFormat* is named. In an EPC pattern,
842 each of the data fields may be (a) a decimal integer, meaning that a matching EPC must
843 have that specific value in the corresponding field; (b) an asterisk (*), meaning that a
844 matching EPC may have any value in that field; or (c) a range denoted like `[lo-hi]`,
845 meaning that a matching EPC must have a value between the decimal integers *lo* and
846 *hi*, inclusive. Depending on the tag format, there may be other restrictions; see the
847 EPCglobal Tag Data Specification for full details.

848 Here are some examples. In these examples, assume that all tags are of the GID-96
849 format (which lacks the *Filter* data field), and that 20 is the Domain Manager
850 (*Company* field) for XYZ Corporation, and 300 is the Object Class (*Item* field) for its
851 UltraWidget product.

<code>urn:epc:pat:gid-96:20.300.4000</code>	Matches the EPC for UltraWidget serial number 4000.
<code>urn:epc:pat:gid-96:20.300.*</code>	Matches any UltraWidget's EPC, regardless of serial number.
<code>urn:epc:pat:gid-96:20.*.[5000-9999]</code>	Matches any XYZ Corporation product whose serial number is between 5000 and 9999, inclusive.
<code>urn:epc:pat:gid-96:*.*.*</code>	Matches any GID-96 tag

852

853 **8.2.9 ECGroupSpec**

854 ECGroupSpec defines how filtered EPCs are grouped together for reporting.

855 `patternList : List // of pattern URIs`

856 `---`

857 Each element of the pattern list is an EPC Pattern URI as defined by the EPCglobal Tag
858 Data Specification Version 1.1 [TDS1.1] (see Section 8.2.8 for an informal description of
859 this syntax), extended by allowing the character X in each position where a * character is
860 allowed. All restrictions on the use of the * character as defined in the Tag Data
861 Specification apply equally to the use of the X character. For example, the following are
862 legal URIs for use in the pattern list:

863 `urn:epc:pat:sgtin-64:3.*.*.*`

864 `urn:epc:pat:sgtin-64:3.*.X.*`

865 urn:epc:pat:sgtin-64:3.X.*.*
 866 urn:epc:pat:sgtin-64:3.X.X.*

867 But the following are not:

868 urn:epc:pat:sgtin-64:3.*.12345.*
 869 urn:epc:pat:sgtin-64:3.X.12345.*

870 Pattern URIs used in an ECGroupSpec are interpreted as follows:

Pattern URI Field	Meaning
X	Create a different group for each distinct value of this field.
*	All values of this field belong to the same group.
<i>Number</i>	Only EPCs having <i>Number</i> in this field will belong to this group.
[<i>Lo-Hi</i>]	Only EPCs whose value for this field falls within the specified range will belong to this group.

871

872 Here are examples of pattern URIs used as group operators:

Pattern URI	Meaning
urn:epc:pat:sgtin-64:X.*.*.*	groups by filter value (<i>e.g.</i> , case/pallet)
urn:epc:pat:sgtin-64:*.*.*	groups by company prefix
urn:epc:pat:sgtin-64:*.*.*	groups by company prefix and item reference (<i>i.e.</i> , groups by specific product)
urn:epc:pat:sgtin-64:X.*.*.*	groups by company prefix, item reference, and filter
urn:epc:pat:sgtin-64:3.X.*.[0-100]	create a different group for each company prefix, including in each such group only EPCs having a filter value of 3 and serial numbers in the range 0 through 100, inclusive

873

874 In the corresponding ECGReport, each group is named by another EPC Pattern URI that
 875 is identical to the group operator URI, except that the group name URI has an actual
 876 value in every position where the group operator URI had an X character.

877 For example, if these are the filtered EPCs read for the current event cycle:

878 urn:epc:tag:sgtin-64:3.0036000.123456.400
 879 urn:epc:tag:sgtin-64:3.0036000.123456.500

880 urn:epc:tag:sgtin-64:3.0029000.111111.100
 881 urn:epc:tag:sscc-64:3.0012345.31415926

882 Then a pattern list consisting of just one element, like this:

883 urn:epc:pat:sgtin-64:*.X.*.*

884 would generate the following groups in the report:

Group Name	EPCs in Group
urn:epc:pat:sgtin-64:*.0036000.*.*	urn:epc:tag:sgtin-64:3.0036000.123456.400 urn:epc:tag:sgtin-64:3.0036000.123456.500
urn:epc:pat:sgtin-64:*.0029000.*.*	urn:epc:tag:sgtin-64:3.0029000.111111.100
[default group]	urn:epc:tag:sscc-64:3.0012345.31415926

885

886 Every filtered EPC that is part of the event cycle is part of exactly one group. If an EPC
 887 does not match any of the EPC Pattern URIs in the pattern list, it is included in a special
 888 “default group.” The name of the default group is null. In the above example, the SSCC
 889 EPC did not match any pattern in the pattern list, and so was included in the default
 890 group.

891 As a special case of the above rule, if the pattern list is empty (or if the `group` parameter
 892 of the `ECReportSpec` is null or omitted), then all EPCs are part of the default group.

893 In order to insure that each EPC is part of only one group, there is an additional
 894 restriction that all patterns in the pattern list must be pairwise disjoint. Disjointedness of
 895 two patterns is defined as follows. Let `Pati` and `Patj` be two pattern URIs, written as a
 896 series of fields as follows:

897 `Pati = urn:epc:pat:typei:fieldi_1.fieldi_2.fieldi_3...`

898 `Patj = urn:epc:pat:typej:fieldj_1.fieldj_2.fieldj_3...`

899 Then `Pati` and `Patj` are disjoint if:

- 900 • `typei` is not equal to `typej`
- 901 • `typei = typej` but there is at least one field `k` for which `fieldi_k` and
 902 `fieldj_k` are disjoint, as defined by the table below:

	X	*	Number	[Lo-Hi]
X	Not disjoint	Not disjoint	Not disjoint	Not disjoint
*	Not disjoint	Not disjoint	Not disjoint	Not disjoint
Number	Not disjoint	Not disjoint	Disjoint if the numbers are different	Disjoint if the number is not included in the range
[Lo-Hi]	Not disjoint	Not disjoint	Disjoint if the number is not	Disjoint if the ranges do not

			included in the range	overlap
--	--	--	-----------------------	---------

903

904 The relationship of the ECGroupSpec to the group operator introduced in Section 5 is
 905 defined as follows. Formally, a group operator G is specified by a list of pattern URIs:

906 $G = (\text{Pat}_1, \text{Pat}_2, \dots, \text{Pat}_N)$

907 Let each pattern be written as a series of fields:

908 $\text{Pat}_i = \text{urn:epc:pat:type}_i:\text{field}_{i_1}.\text{field}_{i_2}.\text{field}_{i_3}\dots$

909 where each field_{i_j} is either X, *, *Number*, or [*Lo-Hi*].

910 Then the definition of G(epc) is as follows. Let epc be written like this:

911 $\text{urn:epc:tag:type}_{epc}:\text{field}_{epc_1}.\text{field}_{epc_2}.\text{field}_{epc_3}\dots$

912 The epc is said to *match* Pat_i if

- 913 • $\text{type}_{epc} = \text{type}_i$; and
- 914 • For each field k , one of the following is true:
 - 915 • $\text{field}_{i_k} = X$
 - 916 • $\text{field}_{i_k} = *$
 - 917 • field_{i_k} is a number, equal to field_{epc_k}
 - 918 • field_{i_k} is a range [*Lo-Hi*], and $Lo \leq \text{field}_{epc_k} \leq Hi$

919 Because of the disjointedness constraint specified above, the epc is guaranteed to match
 920 at most one of the patterns in G.

921 G(epc) is then defined as follows:

- 922 • If epc matches Pat_i for some i , then
 - 923 $G(\text{epc}) = \text{urn:epc:pat:type}_{epc}:\text{field}_{g_1}.\text{field}_{g_2}.\text{field}_{g_3}\dots$
 - 924 where for each k , $\text{field}_{g_k} = *$, if $\text{field}_{i_k} = *$; or $\text{field}_{g_k} =$
 925 field_{epc_j} , otherwise
- 926 • If epc does not match Pat_i for any i , then $G(\text{epc}) =$ the default group.

927 **8.2.10 ECGReportOutputSpec**

928 ECGReportOutputSpec specifies how the final set of EPCs is to be reported.

```
929 includeEPC : boolean
930 includeTag : boolean
931 includeRawHex : boolean
932 includeRawDecimal : boolean
933 includeCount : boolean
934 <<extension point>>
935 ---
```

936 If any of the four booleans `includeEPC`, `includeTag`, `includeRawHex`, or
937 `includeRawDecimal` are true, the report SHALL include a list of the EPCs in the
938 final set for each group. Each element of this list, when included, SHALL include the
939 formats specified by these four Booleans. If `includeCount` is true, the report SHALL
940 include a count of the EPCs in the final set for each group. Both may be true, in which
941 case each group includes both a list and a count. If all five booleans `includeEPC`,
942 `includeTag`, `includeRawHex`, `includeRawDecimal`, and `includeCount` are
943 false, in the absence of any vendor extension to `ECReportOutputSpec`, then the
944 define and immediate methods SHALL raise an
945 `ECSpecValidationException`.

946 **8.2.11 Validation of ECSpecs**

947 The define and immediate methods of the ALE API (Section 8.1) SHALL raise an
948 `ECSpecValidationException` if any of the following are true:

- 949 • Any logical reader name in the `readers` field of `ECSpec` is not known to the
950 implementation.
- 951 • The `startTrigger` or `stopTrigger` field of `ECBoundarySpec`, when
952 specified, does not conform to URI syntax as defined by [RFC2396], or is not
953 supported by the ALE implementation.
- 954 • The `duration`, `stableSetInterval`, or `repeatPeriod` field of
955 `ECBoundarySpec` is negative.
- 956 • The `startTrigger` field of `ECBoundarySpec` is non-empty *and* the
957 `repeatPeriod` field of `ECBoundarySpec` is non-zero.
- 958 • No stopping condition is specified in `ECBoundarySpec`; *i.e.*, neither
959 `stopTrigger` nor `duration` nor `stableSetInterval` nor any vendor
960 extension stopping condition is specified.
- 961 • The list of `ECReportSpec` instances is empty.
- 962 • Two `ECReportSpec` instances have identical values for their name field.
- 963 • The `boundaries` parameter of `ECSpec` is null or omitted.

- 964 • Any filter within `ECFilterSpec` does not conform to the EPC URI pattern syntax
965 specified in [TDS1.1].
- 966 • Any grouping pattern within `ECGroupSpec` does not conform to the syntax for
967 grouping patterns specified in Section 8.2.9.
- 968 • Any two grouping patterns within `ECGroupSpec` are determined to be non-disjoint
969 as that term is defined in Section 8.2.9.
- 970 • Within any `ECReportSpec` of an `ECSpec`, the `ECReportOutputSpec` has no
971 output type specified; *i.e.*, none of `includeEPC`, `includeTag`,
972 `includeRawHex`, `includeRawDecimal`, `includeCount`, nor any vendor
973 extension output type is specified as true.

974 8.3 ECReports

975 `ECReports` is the output from an event cycle.

```

976 specName : string
977 date : dateTime
978 ALEID : string
979 totalMilliseconds : long
980 terminationCondition : ECTerminationCondition
981 spec : ECSpec
982 reports : List // List of ECReport
983 <<extension point>>
984 ---

```

985 The “meat” of an `ECReports` instance is the list of `ECReport` instances, each
986 corresponding to an `ECReportSpec` instance in the event cycle’s `ECSpec`. In addition
987 to the reports themselves, `ECReports` contains a number of “header” fields that provide
988 useful information about the event cycle:

Field	Description
specName	The name of the <code>ECSpec</code> that controlled this event cycle. In the case of an <code>ECSpec</code> that was requested using the <code>immediate</code> method (Section 8.1), this name is one chosen by the ALE implementation.
date	A representation of the date and time when the event cycle ended. For bindings in which this field is represented textually, an ISO-8601 compliant representation SHOULD be used.
ALEID	An identifier for the deployed instance of the ALE implementation. The meaning of this identifier is

Field	Description
	outside the scope of this specification.
<code>totalMilliseconds</code>	The total time, in milliseconds, from the start of the event cycle to the end of the event cycle.
<code>terminationCondition</code>	Indicates what kind of event caused the event cycle to terminate: the receipt of an explicit stop trigger, the expiration of the event cycle duration, or the read field being stable for the prescribed amount of time. These correspond to the possible ways of specifying the end of an event cycle as defined in Section 8.2.1.
<code>spec</code>	A copy of the <code>ECSpec</code> that generated this <code>ECReports</code> instance. Only included if the <code>ECSpec</code> has <code>includeSpecInReports</code> set to true.

989

990 **8.3.1 ECTerminationCondition**

991 `ECTerminationCondition` is an enumerated type that describes how an event cycle
992 was ended.

993 <<Enumerated Type>>

994 TRIGGER

995 DURATION

996 STABLE_SET

997 UNREQUEST

998 The first three values, TRIGGER, DURATION, and STABLE_SET, correspond to the
999 receipt of an explicit stop trigger, the expiration of the event cycle duration, or the set
1000 of EPCs being stable for the event cycle `stableSetInterval`, respectively. These
1001 are the possible stop conditions described in Section 8.2.1. The last value, UNREQUEST,
1002 corresponds to an event cycle being terminated because there were no longer any clients
1003 requesting it. By definition, this value cannot actually appear in an `ECReports`
1004 instance sent to any client.

1005 **8.3.2 ECReport**

1006 `ECReport` represents a single report within an event cycle.

```
1007 reportName : string
1008 groups : List // List of ECReportGroup instances
1009 <<extension point>>
1010 ---
```

1011 The reportName field is a copy of the reportName field from the corresponding
1012 ECReportSpec within the ECSpec that controlled this event cycle. The groups
1013 field is a list containing one element for each group in the report as controlled by the
1014 group field of the corresponding ECReportSpec. When no grouping is specified, the
1015 groups list just consists of the single default group.

1016 **8.3.3 ECReportGroup**

1017 ECReportGroup represents one group within an ECReport.

```
1018 groupName : string
1019 groupList : ECReportGroupList
1020 groupCount : ECReportGroupCount
1021 <<extension point>>
1022 ---
```

1023 The groupName SHALL be null for the default group. The groupList field SHALL
1024 be null if the includeEPC, includeTag, includeRawHex, and
1025 includeRawDecimal fields of the corresponding ECReportOutputSpec are all
1026 false (unless ECReportOutputSpec has vendor extensions that cause groupList
1027 to be included). The groupCount field SHALL be null if the includeCount field
1028 of the corresponding ECReportOutputSpec is false (unless
1029 ECReportOutputSpec has vendor extensions that cause groupCount to be
1030 included).

1031 **8.3.4 ECReportGroupList**

1032 An ECReportGroupList SHALL be included in an ECReportGroup when any of
1033 the four boolean fields includeEPC, includeTag, includeRawHex, and
1034 includeRawDecimal of the corresponding ECReportOutputSpec are true.

```
1035 members : List //List of ECReportGroupListMember instances
1036 <<extension point>>
1037 ---
```

1038 The order in which EPCs are enumerated within the list is unspecified.

1039 **8.3.5 ECRptGroupListMember**

1040 Each member of the `ECRptGroupList` is an `ECRptGroupListMember` as
1041 defined below. The reason for having `ECRptGroupListMember` is to allow
1042 multiple EPC formats to be included, and to provide an extension point for adding per-
1043 EPC information to the list report.

1044	<code>epc</code> : URI
1045	<code>tag</code> : URI
1046	<code>rawHex</code> : URI
1047	<code>rawDecimal</code> : URI
1048	<<extension point>
1049	---

1050 Each of these fields SHALL contain a URI as described below or be null, depending on
1051 the value of a boolean in the corresponding `ECRptOutputSpec`. Specifically, the
1052 `epc` field SHALL be non-null if and only if the `includeEPC` field of
1053 `ECRptOutputSpec` is true, the `tag` field SHALL be non-null according to
1054 `includeTag`, the `rawHex` field SHALL be non-null according to `includeRawHex`,
1055 and the `rawDecimal` field SHALL be non-null according to `includeDecimal`.

1056 When non-null, the `epc` field SHALL contain an EPC represented as a pure identity URI
1057 according to the EPCglobal Tag Data Specification (`urn:epc:id:...`). This URI
1058 SHALL be determined using the first procedure given in Section 5 of [TDS1.1]. If that
1059 procedure fails in any step, the `epc` field SHALL instead contain a raw decimal URI
1060 determined using Step 20 of the second procedure given in Section 5 of [TDS1.1].

1061 When non-null, the `tag` field SHALL contain an EPC represented as a tag URI
1062 according to the EPCglobal Tag Data Specification (`urn:epc:tag:...`). This URI
1063 SHALL be determined using the second procedure given in Section 5 of [TDS1.1].

1064 When non-null, the `rawDecimal` field SHALL contain a raw tag value represented as a
1065 raw decimal URI according to the EPCglobal Tag Data Specification
1066 (`urn:epc:raw:...`). This URI SHALL be determined using Step 20 of the second
1067 procedure given in Section 5 of [TDS1.1].

1068 When non-null, the `rawHex` field SHALL contain a raw tag value represented as a raw
1069 hexadecimal URI according to the following extension to the EPCglobal Tag Data
1070 Specification. The URI SHALL be determined by concatenating the following: the
1071 string `urn:epc:raw:`, the length of the tag value in bits, a dot (`.`) character, a
1072 lowercase `x` character, and the tag value considered as a single hexadecimal integer. The
1073 length value preceding the dot character SHALL have no leading zeros. The
1074 hexadecimal tag value following the dot SHALL have a number of characters equal to the
1075 length of the tag value in bits divided by four and rounded up to the nearest whole
1076 number, and SHALL only use uppercase letters for the hexadecimal digits A, B, C, D, E,
1077 and F.

1078 Each distinct tag value included in the report SHALL have a distinct
1079 ECR`ReportGroupListMember` element in the ECR`ReportGroupList`, even if those
1080 ECR`ReportGroupListMember` elements would be identical due to the formats
1081 selected. In particular, it is possible for two different tags to have the same pure identity
1082 EPC representation; e.g., two SGTIN-64 tags that differ only in the filter bits. If both
1083 tags are read in the same event cycle, and ECR`ReportOutputSpec` specified
1084 `includeEPC` true and all other formats false, then the resulting
1085 ECR`ReportGroupList` SHALL have two ECR`ReportGroupListMember` elements,
1086 each having the same pure identity URI in the `epc` field. In other words, the result
1087 should be equivalent to performing all duplicate removal, additions/deletions processing,
1088 grouping, and filtering *before* converting the raw tag values into the selected
1089 representation(s).

1090 *Explanation (non-normative): The situation in which this rule applies is expected to be*
1091 *extremely rare. In theory, no two tags should be programmed with the same pure*
1092 *identity, even if they differ in filter bits or other fields not part of the pure identity. But*
1093 *because the situation is possible, it is necessary to specify a definite behavior in this*
1094 *specification. The behavior specified above is intended to be the most easily*
1095 *implemented.*

1096 **8.3.6 ECR`ReportGroupCount`**

1097 An ECR`ReportGroupCount` is included in an ECR`ReportGroup` when the
1098 `includeCount` field of the corresponding ECR`ReportOutputSpec` is true.

```
1099 count : int  
1100 <<extension point>>  
1101 ---
```

1102 The `count` field is the total number of distinct EPCs that are part of this group.

1103 **9 Standard Notification URIs**

1104 This section specifies the syntax and semantics of standard URIs that may be used in
1105 conjunction with the `subscribe` and `unsubscribe` methods of the main ALE
1106 interface (Section 8.1). Each subsection below specifies the conformance requirement
1107 (MAY, SHOULD, SHALL) for each standard URI.

1108 All notification URIs, whether standardized as a part of this specification or not, must
1109 conform to the general syntax for URIs as defined in [RFC2396]. Each notification URI
1110 scheme may impose additional constraints upon syntax.

1111 **9.1 HTTP Notification URI**

1112 The HTTP notification URI provides for delivery of ECR`Reports` in XML via the HTTP
1113 protocol using the POST operation. Implementations SHOULD provide support for this
1114 notification URI.

1115 The syntax for HTTP notification URIs as used by ALE is defined in [RFC2616],
1116 Section 3.2.2. Informally, an HTTP URI has one of the two following forms:

1117 <http://host:port/remainder-of-URL>
1118 `http://host/remainder-of-URL`

1119 where

- 1120 • *host* is the DNS name or IP address of the host where the receiver is listening for
1121 incoming HTTP connections.
- 1122 • *port* is the TCP port on which the receiver is listening for incoming HTTP
1123 connections. The port and the preceding colon character may be omitted, in which
1124 case the port defaults to 80.
- 1125 • *remainder-of-URL* is the URL to which an HTTP POST operation will be
1126 directed.

1127 The ALE implementation delivers event cycle reports by sending an HTTP POST request
1128 to receiver designated in the URI, where *remainder-of-URL* is included in the HTTP
1129 request-line (as defined in [RFC2616]), and where the payload is the `ECReports`
1130 instance encoded in XML according to the schema specified in Section 10.2.

1131 The interpretation by the ALE implementation of the response code returned by the
1132 receiver is outside the scope of this specification; however, all implementations SHALL
1133 interpret a response code 2xx (that is, any response code between 200 and 299, inclusive)
1134 as a normal response, not indicative of any error.

1135 **9.2 TCP Notification URI**

1136 The TCP notification URI provides for delivery of `ECReports` in XML via a raw TCP
1137 connection. Implementations SHOULD provide support for this notification URI.

1138 The syntax for TCP notification URIs as used by ALE is as follows:

1139 `tcp_URL = "tcp:" "/" host ":" port`

1140 where the syntax definition for `host` and `port` is specified in [RFC2396].

1141 Informally, a TCP URI has the following form:

1142 `tcp://host:port`

1143 The ALE implementation delivers an event cycle report by opening a new TCP
1144 connection to the specified host and port, writing to the connection the `ECReports`
1145 instance encoded in XML according to the schema specified in Section 10.2, and then
1146 closing the connection. No reply or acknowledgement is expected by the ALE
1147 implementation.

1148 **9.3 FILE Notification URI**

1149 The FILE notification URI provides for writing of `ECReports` in XML to a file.
1150 Implementations MAY provide support for this notification URI.

1151 The syntax for FILE notification URIs as used by ALE is defined in [RFC1738],
1152 Section 3.10. Informally, an FILE URI has one of the two following forms:

1153 `file://host/path`

1154 `file:///path`

1155 where

- 1156 • *host* is the DNS name or IP address of a remote host whose filesystem is accessible
1157 to the ALE implementation.
- 1158 • *path* is the pathname of a file within the remote filesystem, or the local filesystem if
1159 *host* is omitted.

1160 The ALE implementation delivers an event cycle report by appending to the specified file
1161 the ECREports instance encoded in XML according to the schema specified in
1162 Section 10.2. Note that if more than one event cycle completes, the file will contain a
1163 concatenation of XML documents, rather than a single XML document.

1164 Implementations of ALE may impose additional constraints on the use of the FILE URI.
1165 For example, some implementations of ALE may support only a local filesystem while
1166 others may support only a remote filesystem, some implementations of ALE may impose
1167 further restrictions on the syntax of the *path* component, and so forth. This
1168 specification also does not define the behavior when *path* names a directory; the
1169 behavior in that case is implementation dependent.

1170 *Rationale (non-normative): The intended use for the FILE notification URI is for*
1171 *debugging, and hence the specification is intentionally lax in order to give freedom to*
1172 *implementations to provide the most appropriate and useful facility given the unique*
1173 *circumstances of that implementation.*

1174 **10 XML Schema for Event Cycle Specs and Reports**

1175 This section defines the standard XML representation for ECSpec instances
1176 (Section 8.2) and ECREports instances (Section 8.3), using the W3C XML Schema
1177 language [XSD1, XSD2]. Samples are also shown.

1178 The schema below conforms to EPCglobal standard schema design rules. The schema
1179 below imports the EPCglobal standard base schema, as mandated by the design rules.

1180 **10.1 Extensibility Mechanism**

1181 The XML schema in this section implements the <<extension point>> given in
1182 the UML of Section 8 using a methodology described in [XMLVersioning]. This
1183 methodology provides for both vendor extension, and for extension by EPCglobal in
1184 future versions of this specification or in supplemental specifications. Extensions
1185 introduced through this mechanism will be *backward compatible*, in that documents
1186 conforming to older versions of the schema will also conform to newer versions of the
1187 standard schema and to schema containing vendor-specific extensions. Extensions will
1188 also be *forward compatible*, in that documents that contain vendor extensions or that

1189 conform to newer versions of the standard schema will also conform to older versions of
1190 the schema.

1191 When a document contains extensions (vendor-specific or standardized in newer versions
1192 of schema), it may conform to more than one schema. For example, a document
1193 containing vendor extensions to the EPCglobal Version 1.0 schema will conform both to
1194 the EPCglobal Version 1.0 schema and to a vendor-specific schema that includes the
1195 vendor extensions. In this example, when the document is parsed using the standard
1196 schema there will be no type-checking of the extension elements and attributes, but when
1197 the document is parsed using the vendor-specific schema the extensions will be type-
1198 checked. Similarly, a document containing new features introduced in a hypothetical
1199 EPCglobal Version 1.1 schema will conform both to the EPCglobal Version 1.0 schema
1200 and to the EPCglobal Version 1.1 schema, but type checking of the new features will
1201 only be available using the Version 1.1 schema.

1202 The design rules for this extensibility pattern are given in [XMLVersioning]. In
1203 summary, it amounts to the following rules:

- 1204 • For each type in which <<extension point>> occurs, include an
1205 `xsd:anyAttribute` declaration. This declaration provides for the addition of
1206 new attributes, either in subsequent versions of the standard schema or in vendor-
1207 specific schema.
- 1208 • For each type in which <<extension point>> occurs, include an optional
1209 (`minOccurs = 0`) element named `extension`. The type declared for the
1210 `extension` element will always be as follows:

```
1211 <xsd:sequence>  
1212   <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"  
1213     namespace="##local"/>  
1214 </xsd:sequence>  
1215 <xsd:anyAttribute processContents="lax"/>
```

1216 This declaration provides for forward-compatibility with new elements introduced
1217 into subsequent versions of the standard schema.

- 1218 • For each type in which <<extension point>> occurs, include at the end of the
1219 element list a declaration

```
1220 <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"  
1221   namespace="##other"/>
```

1222 This declaration provides for forward-compatibility with new elements introduced in
1223 vendor-specific schema.

1224 The rules for adding vendor-specific extensions to the schema are as follows:

- 1225 • Vendor-specific attributes may be added to any type in which <<extension
1226 `point`>> occurs. Vendor-specific attributes SHALL NOT be in the EPCglobal ALE
1227 namespace (`urn:epcglobal:ale:xsd:1`). Vendor-specific attributes SHALL
1228 be in a namespace whose namespace URI has the vendor as the owning authority. (In
1229 schema parlance, this means that all vendor-specific attributes must have
1230 `qualified` as their form.) For example, the namespace URI may be an HTTP
1231 URL whose authority portion is a domain name owned by the vendor, a URN having

1232 a URN namespace identifier issued to the vendor by IANA, an OID URN whose
1233 initial path is a Private Enterprise Number assigned to the vendor, etc. Declarations
1234 of vendor-specific attributes SHALL specify use="optional".

1235 • Vendor-specific elements may be added to any type in which <<extension
1236 point>> occurs. Vendor-specific elements SHALL NOT be in the EPCglobal ALE
1237 namespace (urn:epcglobal:ale:xsd:1). Vendor-specific attributes SHALL
1238 be in a namespace whose namespace URI has the vendor as the owning authority (as
1239 described above). (In schema parlance, this means that all vendor-specific elements
1240 must have qualified as their form.)

1241 To create a schema that contains vendor extensions, replace the <xsd:any ...
1242 namespace="##other"/> declaration with a content group reference to a group
1243 defined in the vendor namespace; e.g., <xsd:group
1244 ref="vendor:VendorExtension">. In the schema file defining elements for
1245 the vendor namespace, define a content group using a declaration of the following
1246 form:

```
1247 <xsd:group name="VendorExtension">  
1248   <xsd:sequence>  
1249     <!--  
1250       Definitions or references to vendor elements  
1251       go here. Each SHALL specify minOccurs="0".  
1252     -->  
1253     <xsd:any processContents="lax"  
1254       minOccurs="0" maxOccurs="unbounded"  
1255       namespace="##other"/>  
1256   </xsd:sequence>  
1257 </xsd:group>
```

1258 (In the foregoing illustrations, vendor and VendorExtension may be any
1259 strings the vendor chooses.)

1260 *Explanation (non-normative): Because vendor-specific elements must be optional,*
1261 *including references to their definitions directly into the ALE schema would violate the*
1262 *XML Schema Unique Particle Attribution constraint, because the <xsd:any ...>*
1263 *element in the ALE schema can also match vendor-specific elements. Moving the*
1264 *<xsd:any ...> into the vendor's schema avoids this problem, because ##other in*
1265 *that schema means "match an element that has a namespace other than the vendor's*
1266 *namespace." This does not conflict with standard elements, because the element form*
1267 *default for the standard ALE schema is unqualified, and hence the ##other in the*
1268 *vendor's schema does not match standard ALE elements, either.*

1269 The rules for adding attributes or elements to future versions of the EPCglobal standard
1270 schema are as follows:

1271 • Standard attributes may be added to any type in which <<extension point>>
1272 occurs. Standard attributes SHALL NOT be in any namespace, and SHALL NOT
1273 conflict with any existing standard attribute name.

- 1274 • Standard elements may be added to any type in which <<extension point>>
1275 occurs. New elements are added using the following rules:
- 1276 • Find the innermost extension element type.
- 1277 • Replace the <xsd:any ... namespace="##local"/> declaration with (a)
1278 new elements (which SHALL NOT be in any namespace); followed by (b) a new
1279 extension element whose type is constructed as described before. In
1280 subsequent revisions of the standard schema, new standard elements will be added
1281 within this new extension element rather than within this one.

1282 *Explanation (non-normative): the reason that new standard attributes and elements are*
1283 *specified above not to be in any namespace is to be consistent with the ALE schema's*
1284 *attribute and element form default of unqualified.*

1285 10.2 Schema

1286 The following is an XML Schema (XSD) defining both ECSpec and ECREports.

```

1287 <?xml version="1.0" encoding="UTF-8"?>
1288 <xsd:schema targetNamespace="urn:epcglobal:ale:xsd:1"
1289   xmlns:ale="urn:epcglobal:ale:xsd:1"
1290   xmlns:epcglobal="urn:epcglobal:xsd:1"
1291   xmlns:xsd="http://www.w3.org/2001/XMLSchema"
1292   elementFormDefault="unqualified"
1293   attributeFormDefault="unqualified"
1294   version="1.0">
1295
1296   <xsd:annotation>
1297     <xsd:documentation xml:lang="en">
1298       <epcglobal:copyright>
1299         Copyright (C) 2005, 2004 Epcglobal Inc., All Rights Reserved.
1300       </epcglobal:copyright>
1301       <epcglobal:disclaimer>
1302         EPCglobal Inc., its members, officers, directors, employees, or
1303         agents shall not be liable for any injury, loss, damages, financial
1304         or otherwise, arising from, related to, or caused by the use of
1305         this document. The use of said document shall constitute your
1306         express consent to the foregoing exculpation.
1307       </epcglobal:disclaimer>
1308       <epcglobal:specification>
1309         Application Level Events (ALE) version 1.0
1310       </epcglobal:specification>
1311     </xsd:documentation>
1312   </xsd:annotation>
1313
1314   <xsd:import namespace="urn:epcglobal:xsd:1" schemaLocation="./EpcGlobal.xsd"/>
1315
1316   <!-- ALE ELEMENTS -->
1317
1318   <xsd:element name="ECSpec" type="ale:ECSpec"/>
1319   <xsd:element name="ECReports" type="ale:ECReports"/>
1320
1321   <!-- ALE TYPES -->
1322
1323   <!-- items listed alphabetically by name -->
1324
1325   <!-- Some element types accommodate extensibility in the manner of
1326   "Versioning XML Vocabularies" by David Orchard (see
1327   http://www.xml.com/pub/a/2003/12/03/versioning.html) .
1328
1329   In this approach, an optional <extension> element is defined
1330   for each extensible element type, where an <extension> element

```

1331 may contain future elements defined in the target namespace.
1332
1333 In addition to the optional <extension> element, extensible element
1334 types are declared with a final xsd:any wildcard to accommodate
1335 future elements defined by third parties (as denoted by the ##other
1336 namespace).
1337
1338 Finally, the xsd:anyAttribute facility is used to allow arbitrary
1339 attributes to be added to extensible element types. -->
1340
1341
1342 <xsd:complexType name="ECBoundarySpec">
1343 <xsd:annotation>
1344 <xsd:documentation xml:lang="en">
1345 A ECBoundarySpec specifies how the beginning and end of event cycles
1346 are to be determined. The startTrigger and repeatPeriod elements
1347 are mutually exclusive. One may, however, specify a ECBoundarySpec
1348 with neither event cycle start condition (i.e., startTrigger nor
1349 repeatPeriod) present. At least one event cycle stopping condition
1350 (stopTrigger, duration, and/or stableSetInterval) must be present.
1351 </xsd:documentation>
1352 </xsd:annotation>
1353 <xsd:sequence>
1354 <xsd:element name="startTrigger" type="ale:ECTrigger" minOccurs="0"/>
1355 <xsd:element name="repeatPeriod" type="ale:ECTime" minOccurs="0"/>
1356 <xsd:element name="stopTrigger" type="ale:ECTrigger" minOccurs="0"/>
1357 <xsd:element name="duration" type="ale:ECTime" minOccurs="0"/>
1358 <xsd:element name="stableSetInterval" type="ale:ECTime" minOccurs="0"/>
1359 <xsd:element name="extension" type="ale:ECBoundarySpecExtension"
1360 minOccurs="0"/>
1361 <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1362 namespace="##other"/>
1363 </xsd:sequence>
1364 <xsd:anyAttribute processContents="lax"/>
1365 </xsd:complexType>
1366
1367 <xsd:complexType name="ECBoundarySpecExtension">
1368 <xsd:sequence>
1369 <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1370 namespace="##local"/>
1371 </xsd:sequence>
1372 <xsd:anyAttribute processContents="lax"/>
1373 </xsd:complexType>
1374
1375
1376 <xsd:complexType name="ECExcludePatterns">
1377 <xsd:sequence>
1378 <xsd:element name="excludePattern" type="xsd:string" minOccurs="0"
1379 maxOccurs="unbounded"/>
1380 </xsd:sequence>
1381 </xsd:complexType>
1382
1383 <xsd:complexType name="ECFilterSpec">
1384 <xsd:annotation>
1385 <xsd:documentation xml:lang="en">
1386 A ECFilterSpec specifies what EPCs are to be included in the final
1387 report. The ECFilterSpec implements a flexible filtering scheme based on
1388 pattern lists for inclusion and exclusion.
1389 </xsd:documentation>
1390 </xsd:annotation>
1391 <xsd:sequence>
1392 <xsd:element name="includePatterns" type="ale:ECIncludePatterns"
1393 minOccurs="0"/>
1394 <xsd:element name="excludePatterns" type="ale:ECExcludePatterns"
1395 minOccurs="0"/>
1396 <xsd:element name="extension" type="ale:ECFilterSpecExtension"
1397 minOccurs="0"/>
1398 <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1399 namespace="##other"/>
1400 </xsd:sequence>

```

1401     <xsd:anyAttribute processContents="lax"/>
1402 </xsd:complexType>
1403
1404 <xsd:complexType name="ECFilterSpecExtension">
1405   <xsd:sequence>
1406     <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1407       namespace="##local"/>
1408   </xsd:sequence>
1409   <xsd:anyAttribute processContents="lax"/>
1410 </xsd:complexType>
1411
1412 <xsd:complexType name="ECGroupSpec">
1413   <xsd:sequence>
1414     <xsd:element name="pattern" type="xsd:string"
1415       minOccurs="0" maxOccurs="unbounded"/>
1416   </xsd:sequence>
1417 </xsd:complexType>
1418
1419 <xsd:complexType name="ECIncludePatterns">
1420   <xsd:sequence>
1421     <xsd:element name="includePattern" type="xsd:string" minOccurs="0"
1422       maxOccurs="unbounded"/>
1423   </xsd:sequence>
1424 </xsd:complexType>
1425
1426 <xsd:complexType name="ECLogicalReaders">
1427   <xsd:sequence>
1428     <xsd:element name="logicalReader" type="xsd:string" maxOccurs="unbounded"/>
1429   </xsd:sequence>
1430 </xsd:complexType>
1431
1432 <xsd:complexType name="ECReport">
1433   <xsd:sequence>
1434     <xsd:element name="group" type="ale:ECReportGroup" minOccurs="0"
1435       maxOccurs="unbounded"/>
1436     <xsd:element name="extension" type="ale:ECReportExtension"
1437       minOccurs="0"/>
1438     <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1439       namespace="##other"/>
1440   </xsd:sequence>
1441   <xsd:attribute name="reportName" type="xsd:string" use="required"/>
1442   <xsd:anyAttribute processContents="lax"/>
1443 </xsd:complexType>
1444
1445 <xsd:complexType name="ECReportExtension">
1446   <xsd:sequence>
1447     <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1448       namespace="##local"/>
1449   </xsd:sequence>
1450   <xsd:anyAttribute processContents="lax"/>
1451 </xsd:complexType>
1452
1453 <xsd:complexType name="ECReportList">
1454   <xsd:sequence>
1455     <xsd:element name="report" type="ale:ECReport" minOccurs="0"
1456       maxOccurs="unbounded"/>
1457   </xsd:sequence>
1458 </xsd:complexType>
1459
1460 <xsd:complexType name="ECReportGroup">
1461   <xsd:sequence>
1462     <xsd:element name="groupList" type="ale:ECReportGroupList" minOccurs="0"/>
1463     <xsd:element name="groupCount" type="ale:ECReportGroupCount" minOccurs="0"/>
1464     <xsd:element name="extension" type="ale:ECReportGroupExtension"
1465       minOccurs="0"/>
1466     <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1467       namespace="##other"/>
1468   </xsd:sequence>
1469   <!-- The groupName attribute SHALL be omitted to indicate the default group. -->
1470   <xsd:attribute name="groupName" type="xsd:string" use="optional"/>

```

```

1471     <xsd:anyAttribute processContents="lax"/>
1472 </xsd:complexType>
1473
1474 <xsd:complexType name="ECReportGroupExtension">
1475     <xsd:sequence>
1476         <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1477             namespace="##local"/>
1478     </xsd:sequence>
1479     <xsd:anyAttribute processContents="lax"/>
1480 </xsd:complexType>
1481
1482 <xsd:complexType name="ECReportGroupList">
1483     <xsd:sequence>
1484         <xsd:element name="member" type="ale:ECReportGroupListMember"
1485             minOccurs="0" maxOccurs="unbounded"/>
1486         <xsd:element name="extension" type="ale:ECReportGroupListExtension"
1487             minOccurs="0"/>
1488         <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1489             namespace="##other"/>
1490     </xsd:sequence>
1491 </xsd:complexType>
1492
1493 <xsd:complexType name="ECReportGroupListExtension">
1494     <xsd:sequence>
1495         <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1496             namespace="##local"/>
1497     </xsd:sequence>
1498     <xsd:anyAttribute processContents="lax"/>
1499 </xsd:complexType>
1500
1501 <xsd:complexType name="ECReportGroupListMember">
1502     <xsd:sequence>
1503         <!-- Each of the following four elements SHALL be omitted if null. -->
1504         <xsd:element name="epc" type="epcglobal:EPC" minOccurs="0"/>
1505         <xsd:element name="tag" type="epcglobal:EPC" minOccurs="0"/>
1506         <xsd:element name="rawHex" type="epcglobal:EPC" minOccurs="0"/>
1507         <xsd:element name="rawDecimal" type="epcglobal:EPC" minOccurs="0"/>
1508         <xsd:element name="extension" type="ale:ECReportGroupListMemberExtension"
1509             minOccurs="0"/>
1510         <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1511             namespace="##other"/>
1512     </xsd:sequence>
1513     <xsd:anyAttribute processContents="lax"/>
1514 </xsd:complexType>
1515
1516 <xsd:complexType name="ECReportGroupListMemberExtension">
1517     <xsd:sequence>
1518         <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1519             namespace="##local"/>
1520     </xsd:sequence>
1521     <xsd:anyAttribute processContents="lax"/>
1522 </xsd:complexType>
1523
1524 <xsd:complexType name="ECReportGroupCount">
1525     <xsd:sequence>
1526         <xsd:element name="count" type="xsd:int"/>
1527         <xsd:element name="extension" type="ale:ECReportGroupCountExtension"
1528             minOccurs="0"/>
1529         <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1530             namespace="##other"/>
1531     </xsd:sequence>
1532     <xsd:anyAttribute processContents="lax"/>
1533 </xsd:complexType>
1534
1535 <xsd:complexType name="ECReportGroupCountExtension">
1536     <xsd:sequence>
1537         <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1538             namespace="##local"/>
1539     </xsd:sequence>
1540     <xsd:anyAttribute processContents="lax"/>

```

```

1541 </xsd:complexType>
1542
1543 <xsd:complexType name="ECReportOutputSpec">
1544   <xsd:annotation>
1545     <xsd:documentation xml:lang="en">
1546       ECReportOutputSpec specifies how the final set of EPCs is to be reported
1547       with respect to type.
1548     </xsd:documentation>
1549   </xsd:annotation>
1550   <xsd:sequence>
1551     <xsd:element name="extension" type="ale:ECReportOutputSpecExtension"
1552       minOccurs="0"/>
1553     <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1554       namespace="##other"/>
1555   </xsd:sequence>
1556   <xsd:attribute name="includeEPC" type="xsd:boolean" default="false"/>
1557   <xsd:attribute name="includeTag" type="xsd:boolean" default="false"/>
1558   <xsd:attribute name="includeRawHex" type="xsd:boolean" default="false"/>
1559   <xsd:attribute name="includeRawDecimal" type="xsd:boolean" default="false"/>
1560   <xsd:attribute name="includeCount" type="xsd:boolean" default="false"/>
1561 </xsd:complexType>
1562
1563 <xsd:complexType name="ECReportOutputSpecExtension">
1564   <xsd:sequence>
1565     <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1566       namespace="##local"/>
1567   </xsd:sequence>
1568   <xsd:anyAttribute processContents="lax"/>
1569 </xsd:complexType>
1570
1571
1572 <xsd:complexType name="ECReports">
1573   <xsd:annotation>
1574     <xsd:documentation xml:lang="en">
1575       ECReports is the output from an event cycle. The "meat" of an ECReports
1576       instance is the lists of count report instances and list report
1577       instances, each corresponding to an ECReportSpec instance in the event
1578       cycle's ECSpec. In addition to the reports themselves, ECReports contains
1579       a number of "header" fields that provide useful information about the
1580       event cycle.
1581     </xsd:documentation>
1582   </xsd:annotation>
1583   <xsd:complexContent>
1584     <xsd:extension base="epcglobal:Document">
1585       <xsd:sequence>
1586         <xsd:element name="reports" type="ale:ECReportList"/>
1587         <xsd:element name="extension" type="ale:ECReportsExtension"
1588           minOccurs="0"/>
1589         <xsd:element name="ECSpec" type="ale:ECSpec" minOccurs="0"/>
1590         <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1591           namespace="##other"/>
1592       </xsd:sequence>
1593       <xsd:attribute name="specName" type="xsd:string" use="required"/>
1594       <xsd:attribute name="date" type="xsd:dateTime" use="required"/>
1595       <xsd:attribute name="ALEID" type="xsd:string" use="required"/>
1596       <xsd:attribute name="totalMilliseconds" type="xsd:long" use="required"/>
1597       <xsd:attribute name="terminationCondition"
1598         type="ale:ECTerminationCondition" use="required"/>
1599       <xsd:attribute name="schemaURL" type="xsd:string" use="optional"/>
1600       <xsd:anyAttribute processContents="lax"/>
1601     </xsd:extension>
1602   </xsd:complexContent>
1603 </xsd:complexType>
1604
1605 <xsd:complexType name="ECReportsExtension">
1606   <xsd:sequence>
1607     <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1608       namespace="##local"/>
1609   </xsd:sequence>
1610   <xsd:anyAttribute processContents="lax"/>

```

```

1611 </xsd:complexType>
1612
1613
1614 <xsd:complexType name="ECReportSetSpec">
1615   <xsd:annotation>
1616     <xsd:documentation xml:lang="en">
1617       ECReportSetSpec specifies which set of EPCs is to be considered for
1618       filtering and output.
1619     </xsd:documentation>
1620   </xsd:annotation>
1621   <xsd:attribute name="set" type="ale:ECReportSetEnum"/>
1622 </xsd:complexType>
1623
1624 <xsd:simpleType name="ECReportSetEnum">
1625   <xsd:annotation>
1626     <xsd:documentation xml:lang="en">
1627       ECReportSetEnum is an enumerated type denoting what set of EPCs is to be
1628       considered for filtering and output: all EPCs read in the current event
1629       cycle, additions from the previous event cycle, or deletions from the
1630       previous event cycle.
1631     </xsd:documentation>
1632   </xsd:annotation>
1633   <xsd:restriction base="xsd:NCName">
1634     <xsd:enumeration value="CURRENT"/>
1635     <xsd:enumeration value="ADDITIONS"/>
1636     <xsd:enumeration value="DELETIONS"/>
1637   </xsd:restriction>
1638 </xsd:simpleType>
1639
1640 <xsd:complexType name="ECReportSpec">
1641   <xsd:annotation>
1642     <xsd:documentation xml:lang="en">
1643       A ReportSpec specifies one report to be returned from executing an event
1644       cycle. An ECSpec may contain one or more ECReportSpec instances.
1645     </xsd:documentation>
1646   </xsd:annotation>
1647   <xsd:sequence>
1648     <xsd:element name="reportSet" type="ale:ECReportSetSpec"/>
1649     <xsd:element name="filterSpec" type="ale:ECFilterSpec" minOccurs="0"/>
1650     <xsd:element name="groupSpec" type="ale:ECGroupSpec" minOccurs="0"/>
1651     <xsd:element name="output" type="ale:ECReportOutputSpec"/>
1652     <xsd:element name="extension" type="ale:ECReportSpecExtension"
1653       minOccurs="0"/>
1654     <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1655       namespace="##other"/>
1656   </xsd:sequence>
1657   <xsd:attribute name="reportName" type="xsd:string" use="required"/>
1658   <xsd:attribute name="reportIfEmpty" type="xsd:boolean" default="false"/>
1659   <xsd:attribute name="reportOnlyOnChange" type="xsd:boolean" default="false"/>
1660   <xsd:anyAttribute processContents="lax"/>
1661 </xsd:complexType>
1662
1663 <xsd:complexType name="ECReportSpecExtension">
1664   <xsd:sequence>
1665     <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1666       namespace="##local"/>
1667   </xsd:sequence>
1668   <xsd:anyAttribute processContents="lax"/>
1669 </xsd:complexType>
1670
1671
1672 <xsd:complexType name="ECReportSpecs">
1673   <xsd:sequence>
1674     <xsd:element name="reportSpec" type="ale:ECReportSpec"
1675       maxOccurs="unbounded"/>
1676   </xsd:sequence>
1677 </xsd:complexType>
1678
1679 <xsd:complexType name="ECSpec">
1680   <xsd:annotation>

```

```

1681     <xsd:documentation xml:lang="en">
1682         An ECSpec describes an event cycle and one or more reports that are to
1683         be generated from it. It contains a list of logical readers whose reader
1684         cycles are to be included in the event cycle, a specification of read
1685         cycle timing, a specification of how the boundaries of event cycles are
1686         to be determined, and list of specifications each of which describes a
1687         report to be generated from this event cycle.
1688     </xsd:documentation>
1689 </xsd:annotation>
1690 <xsd:complexContent>
1691     <xsd:extension base="epcglobal:Document">
1692         <xsd:sequence>
1693             <xsd:element name="logicalReaders" type="ale:ECLogicalReaders"/>
1694             <xsd:element name="boundarySpec" type="ale:ECBoundarySpec"/>
1695             <xsd:element name="reportSpecs" type="ale:ECReportSpecs"/>
1696             <xsd:element name="extension" type="ale:ECSpecExtension"
1697                 minOccurs="0"/>
1698             <xsd:any processContents="lax" minOccurs="0" maxOccurs="unbounded"
1699                 namespace="##other"/>
1700         </xsd:sequence>
1701         <xsd:attribute name="includeSpecInReports" type="xsd:boolean"
1702             default="false"/>
1703         <xsd:anyAttribute processContents="lax"/>
1704     </xsd:extension>
1705 </xsd:complexContent>
1706 </xsd:complexType>
1707
1708 <xsd:complexType name="ECSpecExtension">
1709     <xsd:sequence>
1710         <xsd:any processContents="lax" minOccurs="1" maxOccurs="unbounded"
1711             namespace="##local"/>
1712     </xsd:sequence>
1713     <xsd:anyAttribute processContents="lax"/>
1714 </xsd:complexType>
1715
1716 <xsd:simpleType name="ECTerminationCondition">
1717     <xsd:restriction base="xsd:NCName">
1718         <xsd:enumeration value="TRIGGER"/>
1719         <xsd:enumeration value="DURATION"/>
1720         <xsd:enumeration value="STABLE_SET"/>
1721         <xsd:enumeration value="UNREQUEST"/>
1722     </xsd:restriction>
1723 </xsd:simpleType>
1724
1725 <xsd:complexType name="ECTime">
1726     <xsd:annotation>
1727         <xsd:documentation xml:lang="en">
1728             An ECTime specifies a time duration in physical units.
1729         </xsd:documentation>
1730     </xsd:annotation>
1731     <xsd:simpleContent>
1732         <xsd:extension base="xsd:long">
1733             <xsd:attribute name="unit" type="ale:ECTimeUnit"/>
1734         </xsd:extension>
1735     </xsd:simpleContent>
1736 </xsd:complexType>
1737
1738 <xsd:simpleType name="ECTimeUnit">
1739     <xsd:annotation>
1740         <xsd:documentation xml:lang="en">
1741             ECTimeUnit represents the supported physical time unit: millisecond
1742         </xsd:documentation>
1743     </xsd:annotation>
1744     <xsd:restriction base="xsd:NCName">
1745         <xsd:enumeration value="MS"/>
1746     </xsd:restriction>
1747 </xsd:simpleType>
1748
1749 <xsd:complexType name="ECTrigger">

```

```

1751     <xsd:annotation>
1752       <xsd:documentation xml:lang="en">
1753         A trigger is a URI that is used to specify a start or stop trigger for
1754         an event cycle.
1755       </xsd:documentation>
1756     </xsd:annotation>
1757     <xsd:simpleContent>
1758       <xsd:extension base="xsd:string"/>
1759     </xsd:simpleContent>
1760   </xsd:complexType>
1761 </xsd:schema>

```

1762 10.3 ECSpec – Example (non-normative)

1763 Here is an example ECSpec rendered into XML [XML1.0]:

```

1764 <?xml version="1.0" encoding="UTF-8"?>
1765 <ale:ECSpec xmlns:ale="urn:epcglobal:ale:xsd:1"
1766   xmlns:epcglobal="urn:epcglobal:xsd:1"
1767   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
1768   xsi:schemaLocation="urn:epcglobal:ale:xsd:1 Ale.xsd"
1769   schemaVersion="1.0"
1770   creationDate="2003-08-06T10:54:06.444-05:00">
1771   <logicalReaders>
1772     <logicalReader>dock_la</logicalReader>
1773     <logicalReader>dock_lb</logicalReader>
1774   </logicalReaders>
1775   <boundarySpec>
1776     <startTrigger>http://sample.com/trigger1</startTrigger>
1777     <repeatPeriod unit="MS">20000</repeatPeriod>
1778     <stopTrigger>http://sample.com/trigger2</stopTrigger>
1779     <duration unit="MS">3000</duration>
1780   </boundarySpec>
1781   <reportSpecs>
1782     <reportSpec reportName="report1">
1783       <reportSet set="CURRENT"/>
1784       <output includeTag="true"/>
1785     </reportSpec>
1786     <reportSpec reportName="report2">
1787       <reportSet set="ADDITIONS"/>
1788       <output includeCount="true"/>
1789     </reportSpec>
1790     <reportSpec reportName="report3">
1791       <reportSet set="DELETIONS"/>
1792       <groupSpec>
1793         <pattern>urn:epc:pat:sgtin-64:X.X.X.*</pattern>
1794       </groupSpec>
1795       <output includeCount="true"/>
1796     </reportSpec>
1797   </reportSpecs>
1798 </ale:ECSpec>

```

1799 10.4 ECREports – Example (non-normative)

1800 Here is an example ECREports rendered into XML [XML1.0]:

```

1801 <?xml version="1.0" encoding="UTF-8"?>
1802 <ale:ECReports xmlns:ale="urn:epcglobal:ale:xsd:1"
1803   xmlns:epcglobal="urn:epcglobal:xsd:1"
1804   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
1805   xsi:schemaLocation="urn:epcglobal:ale:xsd:1 Ale.xsd"
1806   schemaVersion="1.0"
1807   creationDate="2003-08-06T10:54:06.444-05:00"
1808   specName="EventCycle1"
1809   date="2003-08-06T10:54:06.444-05:00"
1810   ALEID="Edge34"
1811   totalMilliseconds="3034"
1812   terminationCondition="DURATION">

```

```

1813     <reports>
1814       <report reportName="report1">
1815         <group>
1816           <groupList>
1817             <member><tag>urn:epc:tag:gid-96:10.50.1000</tag></member>
1818             <member><tag>urn:epc:tag:gid-96:10.50.1001</tag></member>
1819           </groupList>
1820         </group>
1821       </report>
1822       <report reportName="report2">
1823         <group><groupCount><count>6847</count></groupCount></group>
1824       </report>
1825       <report reportName="report3">
1826         <group name="urn:epc:pat:sgtin-64:3.0037000.12345.*">
1827           <groupCount><count>2</count></groupCount>
1828         </group>
1829         <group name="urn:epc:pat:sgtin-64:3.0037000.55555.*">
1830           <groupCount><count>3</count></groupCount>
1831         </group>
1832         <group>
1833           <groupCount><count>6842</count></groupCount>
1834         </group>
1835       </report>
1836     </reports>
1837 </ale:ECReports>

```

1838 11 SOAP Binding for ALE API

1839 11.1 SOAP Binding

1840 The following is a Web Service Definition Language (WSDL) 1.1 [WSDL1.1]
 1841 specification defining the standard SOAP binding of the ALE API. This SOAP binding is
 1842 compliant with the WS-i Basic Profile Version 1.0 [WSI].

```

1843 <?xml version="1.0" encoding="UTF-8"?>
1844 <!-- ALESERVICE DEFINITIONS -->
1845 <wsdl:definitions
1846   targetNamespace="urn:epcglobal:ale:wsdl:1"
1847   xmlns="http://schemas.xmlsoap.org/wsdl/"
1848   xmlns:impl="urn:epcglobal:ale:wsdl:1"
1849   xmlns:ale="urn:epcglobal:ale:xsd:1"
1850   xmlns:epcglobal="urn:epcglobal:xsd:1"
1851   xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
1852   xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
1853   xmlns:wsdlsoap="http://schemas.xmlsoap.org/wsdl/soap/"
1854   xmlns:xsd="http://www.w3.org/2001/XMLSchema">
1855   <wsdl:documentation>
1856     <epcglobal:copyright>Copyright (C) 2005, 2004 EPCglobal Inc., All Rights
1857     Reserved.</epcglobal:copyright>
1858     <epcglobal:disclaimer>EPCglobal Inc., its members, officers, directors, employees,
1859     or agents shall not be liable for any injury, loss, damages, financial or otherwise,
1860     arising from, related to, or caused by the use of this document. The use of said
1861     document shall constitute your express consent to the foregoing
1862     exculpation.</epcglobal:disclaimer>
1863     <epcglobal:specification></epcglobal:specification>
1864     This WSDL document describes the types, messages, operations, and
1865     bindings for the ALESERVICE.
1866   </wsdl:documentation>
1867   <!-- ALESERVICE TYPES -->
1868   <wsdl:types>
1869     <xsd:schema targetNamespace="urn:epcglobal:ale:wsdl:1"
1870       xmlns:impl="urn:epcglobal:ale:wsdl:1"

```

```

1875         xmlns:xsd="http://www.w3.org/2001/XMLSchema">
1876 <xsd:import namespace="urn:epcglobal:ale:xsd:1"
1877           schemaLocation="./ALE.xsd"/>
1878
1879 <!-- ALESERVICE MESSAGE WRAPPERS -->
1880 <xsd:element name="Define" type="impl:Define"/>
1881 <xsd:complexType name="Define">
1882   <xsd:sequence>
1883     <xsd:element name="specName" type="xsd:string"/>
1884     <xsd:element name="spec" type="ale:ECSpec"/>
1885   </xsd:sequence>
1886 </xsd:complexType>
1887
1888 <xsd:element name="Undefine" type="impl:Undefine"/>
1889 <xsd:complexType name="Undefine">
1890   <xsd:sequence>
1891     <xsd:element name="specName" type="xsd:string"/>
1892   </xsd:sequence>
1893 </xsd:complexType>
1894
1895 <xsd:element name="GetECSpec" type="impl:GetECSpec"/>
1896 <xsd:complexType name="GetECSpec">
1897   <xsd:sequence>
1898     <xsd:element name="specName" type="xsd:string"/>
1899   </xsd:sequence>
1900 </xsd:complexType>
1901 <xsd:element name="GetECSpecResult" type="ale:ECSpec"/>
1902
1903 <xsd:element name="GetECSpecNames" type="impl:EmptyParms"/>
1904 <xsd:element name="GetECSpecNamesResult" type="impl:ArrayOfString"/>
1905
1906 <xsd:element name="Subscribe" type="impl:Subscribe"/>
1907 <xsd:complexType name="Subscribe">
1908   <xsd:sequence>
1909     <xsd:element name="specName" type="xsd:string"/>
1910     <xsd:element name="notificationURI" type="xsd:string"/>
1911   </xsd:sequence>
1912 </xsd:complexType>
1913
1914 <xsd:element name="Unsubscribe" type="impl:Unsubscribe"/>
1915 <xsd:complexType name="Unsubscribe">
1916   <xsd:sequence>
1917     <xsd:element name="specName" type="xsd:string"/>
1918     <xsd:element name="notificationURI" type="xsd:string"/>
1919   </xsd:sequence>
1920 </xsd:complexType>
1921
1922 <xsd:element name="Poll" type="impl:Poll"/>
1923 <xsd:complexType name="Poll">
1924   <xsd:sequence>
1925     <xsd:element name="specName" type="xsd:string"/>
1926   </xsd:sequence>
1927 </xsd:complexType>
1928 <xsd:element name="PollResult" type="ale:ECReports"/>
1929
1930 <xsd:element name="Immediate" type="impl:Immediate"/>
1931 <xsd:complexType name="Immediate">
1932   <xsd:sequence>
1933     <xsd:element name="spec" type="ale:ECSpec"/>
1934   </xsd:sequence>
1935 </xsd:complexType>
1936 <xsd:element name="ImmediateResult" type="ale:ECReports"/>
1937
1938 <xsd:element name="GetSubscribers" type="impl:GetSubscribers"/>
1939 <xsd:complexType name="GetSubscribers">
1940   <xsd:sequence>
1941     <xsd:element name="specName" type="xsd:string"/>
1942   </xsd:sequence>
1943 </xsd:complexType>
1944 <xsd:element name="GetSubscribersResult" type="impl:ArrayOfString"/>

```

```

1945
1946 <xsd:element name="GetStandardVersion" type="impl:EmptyParms"/>
1947 <xsd:element name="GetStandardVersionResult" type="xsd:string"/>
1948
1949 <xsd:element name="GetVendorVersion" type="impl:EmptyParms"/>
1950 <xsd:element name="GetVendorVersionResult" type="xsd:string"/>
1951
1952 <xsd:element name="VoidHolder" type="impl:VoidHolder"/>
1953 <xsd:complexType name="VoidHolder">
1954 <xsd:sequence>
1955 </xsd:sequence>
1956 </xsd:complexType>
1957
1958 <xsd:complexType name="EmptyParms"/>
1959
1960 <xsd:complexType name="ArrayOfString">
1961 <xsd:sequence>
1962 <xsd:element name="string" type="xsd:string" minOccurs="0"
1963 maxOccurs="unbounded"/>
1964 </xsd:sequence>
1965 </xsd:complexType>
1966
1967 <!-- ALE EXCEPTIONS -->
1968 <xsd:element name="ALEException" type="impl:ALEException"/>
1969 <xsd:complexType name="ALEException">
1970 <xsd:sequence>
1971 <xsd:element name="reason" type="xsd:string"/>
1972 </xsd:sequence>
1973 </xsd:complexType>
1974
1975 <xsd:element name="SecurityException"
1976 type="impl:SecurityException"/>
1977 <xsd:complexType name="SecurityException">
1978 <xsd:complexContent>
1979 <xsd:extension base="impl:ALEException">
1980 <xsd:sequence/>
1981 </xsd:extension>
1982 </xsd:complexContent>
1983 </xsd:complexType>
1984
1985 <xsd:element name="DuplicateNameException"
1986 type="impl:DuplicateNameException"/>
1987 <xsd:complexType name="DuplicateNameException">
1988 <xsd:complexContent>
1989 <xsd:extension base="impl:ALEException">
1990 <xsd:sequence/>
1991 </xsd:extension>
1992 </xsd:complexContent>
1993 </xsd:complexType>
1994
1995 <xsd:element name="ECSpecValidationException"
1996 type="impl:ECSpecValidationException"/>
1997 <xsd:complexType name="ECSpecValidationException">
1998 <xsd:complexContent>
1999 <xsd:extension base="impl:ALEException">
2000 <xsd:sequence/>
2001 </xsd:extension>
2002 </xsd:complexContent>
2003 </xsd:complexType>
2004
2005 <xsd:element name="InvalidURIException" type="impl:InvalidURIException"/>
2006 <xsd:complexType name="InvalidURIException">
2007 <xsd:complexContent>
2008 <xsd:extension base="impl:ALEException">
2009 <xsd:sequence/>
2010 </xsd:extension>
2011 </xsd:complexContent>
2012 </xsd:complexType>
2013
2014 <xsd:element name="NoSuchNameException" type="impl:NoSuchNameException"/>

```

```

2015     <xsd:complexType name="NoSuchNameException">
2016         <xsd:complexContent>
2017             <xsd:extension base="impl:ALEException">
2018                 <xsd:sequence/>
2019             </xsd:extension>
2020         </xsd:complexContent>
2021     </xsd:complexType>
2022
2023     <xsd:element name="NoSuchSubscriberException"
2024                 type="impl:NoSuchSubscriberException"/>
2025     <xsd:complexType name="NoSuchSubscriberException">
2026         <xsd:complexContent>
2027             <xsd:extension base="impl:ALEException">
2028                 <xsd:sequence/>
2029             </xsd:extension>
2030         </xsd:complexContent>
2031     </xsd:complexType>
2032
2033     <xsd:element name="DuplicateSubscriptionException"
2034                 type="impl:DuplicateSubscriptionException"/>
2035     <xsd:complexType name="DuplicateSubscriptionException">
2036         <xsd:complexContent>
2037             <xsd:extension base="impl:ALEException">
2038                 <xsd:sequence/>
2039             </xsd:extension>
2040         </xsd:complexContent>
2041     </xsd:complexType>
2042
2043     <xsd:element name="ImplementationException"
2044                 type="impl:ImplementationException"/>
2045     <xsd:complexType name="ImplementationException">
2046         <xsd:complexContent>
2047             <xsd:extension base="impl:ALEException">
2048                 <xsd:sequence>
2049                     <xsd:element name="severity"
2050                                 type="impl:ImplementationExceptionSeverity"/>
2051                 </xsd:sequence>
2052             </xsd:extension>
2053         </xsd:complexContent>
2054     </xsd:complexType>
2055
2056     <xsd:simpleType name="ImplementationExceptionSeverity">
2057         <xsd:restriction base="xsd:NCName">
2058             <xsd:enumeration value="ERROR"/>
2059             <xsd:enumeration value="SEVERE"/>
2060         </xsd:restriction>
2061     </xsd:simpleType>
2062
2063 </xsd:schema>
2064 </wsdl:types>
2065
2066 <!-- ALESERVICE MESSAGES -->
2067 <wsdl:message name="defineRequest">
2068     <wsdl:part name="parms" element="impl:Define"/>
2069 </wsdl:message>
2070 <wsdl:message name="defineResponse">
2071     <wsdl:part name="defineReturn" element="impl:VoidHolder"/>
2072 </wsdl:message>
2073
2074 <wsdl:message name="undefineRequest">
2075     <wsdl:part name="parms" element="impl:Undefine"/>
2076 </wsdl:message>
2077 <wsdl:message name="undefineResponse">
2078     <wsdl:part name="undefineReturn" element="impl:VoidHolder"/>
2079 </wsdl:message>
2080
2081 <wsdl:message name="getECSpecRequest">
2082     <wsdl:part name="parms" element="impl:GetECSpec"/>
2083 </wsdl:message>
2084 <wsdl:message name="getECSpecResponse">

```

```

2085     <wsdl:part name="getECSpecReturn" element="impl:GetECSpecResult"/>
2086 </wsdl:message>
2087
2088 <wsdl:message name="getECSpecNamesRequest">
2089     <wsdl:part name="parms" element="impl:GetECSpecNames"/>
2090 </wsdl:message>
2091 <wsdl:message name="getECSpecNamesResponse">
2092     <wsdl:part name="getECSpecNamesReturn" element="impl:GetECSpecNamesResult"/>
2093 </wsdl:message>
2094
2095 <wsdl:message name="subscribeRequest">
2096     <wsdl:part name="parms" element="impl:Subscribe"/>
2097 </wsdl:message>
2098 <wsdl:message name="subscribeResponse">
2099     <wsdl:part name="subscribeReturn" element="impl:VoidHolder"/>
2100 </wsdl:message>
2101
2102 <wsdl:message name="unsubscribeRequest">
2103     <wsdl:part name="parms" element="impl:Unsubscribe"/>
2104 </wsdl:message>
2105 <wsdl:message name="unsubscribeResponse">
2106     <wsdl:part name="unsubscribeReturn" element="impl:VoidHolder"/>
2107 </wsdl:message>
2108
2109 <wsdl:message name="pollRequest">
2110     <wsdl:part name="parms" element="impl:Poll"/>
2111 </wsdl:message>
2112 <wsdl:message name="pollResponse">
2113     <wsdl:part name="pollReturn" element="impl:PollResult"/>
2114 </wsdl:message>
2115
2116 <wsdl:message name="immediateRequest">
2117     <wsdl:part name="parms" element="impl:Immediate"/>
2118 </wsdl:message>
2119 <wsdl:message name="immediateResponse">
2120     <wsdl:part name="immediateReturn" element="impl:ImmediateResult"/>
2121 </wsdl:message>
2122
2123 <wsdl:message name="getSubscribersRequest">
2124     <wsdl:part name="parms" element="impl:GetSubscribers"/>
2125 </wsdl:message>
2126 <wsdl:message name="getSubscribersResponse">
2127     <wsdl:part name="getSubscribersReturn" element="impl:GetSubscribersResult"/>
2128 </wsdl:message>
2129
2130 <wsdl:message name="getStandardVersionRequest">
2131     <wsdl:part name="parms" element="impl:GetStandardVersion"/>
2132 </wsdl:message>
2133 <wsdl:message name="getStandardVersionResponse">
2134     <wsdl:part name="getStandardVersionReturn"
2135 element="impl:GetStandardVersionResult"/>
2136 </wsdl:message>
2137
2138
2139 <wsdl:message name="getVendorVersionRequest">
2140     <wsdl:part name="parms" element="impl:GetVendorVersion"/>
2141 </wsdl:message>
2142 <wsdl:message name="getVendorVersionResponse">
2143     <wsdl:part name="getVendorVersionReturn" element="impl:GetVendorVersionResult"/>
2144 </wsdl:message>
2145
2146 <!-- ALESERVICE FAULT EXCEPTIONS -->
2147 <wsdl:message name="DuplicateNameExceptionResponse">
2148     <wsdl:part name="fault" element="impl:DuplicateNameException"/>
2149 </wsdl:message>
2150 <wsdl:message name="ECSpecValidationExceptionResponse">
2151     <wsdl:part name="fault" element="impl:ECSpecValidationException"/>
2152 </wsdl:message>
2153 <wsdl:message name="InvalidURIExceptionResponse">
2154     <wsdl:part name="fault" element="impl:InvalidURIException"/>

```

```

2155 </wsdl:message>
2156 <wsdl:message name="NoSuchNameExceptionResponse">
2157   <wsdl:part name="fault" element="impl:NoSuchNameException"/>
2158 </wsdl:message>
2159 <wsdl:message name="NoSuchSubscriberExceptionResponse">
2160   <wsdl:part name="fault" element="impl:NoSuchSubscriberException"/>
2161 </wsdl:message>
2162 <wsdl:message name="DuplicateSubscriptionExceptionResponse">
2163   <wsdl:part name="fault" element="impl:DuplicateSubscriptionException"/>
2164 </wsdl:message>
2165 <wsdl:message name="ImplementationExceptionResponse">
2166   <wsdl:part name="fault" element="impl:ImplementationException"/>
2167 </wsdl:message>
2168 <wsdl:message name="SecurityExceptionResponse">
2169   <wsdl:part name="fault" element="impl:SecurityException"/>
2170 </wsdl:message>
2171
2172 <!-- ALESERVICE PORTTYPE -->
2173 <wsdl:portType name="ALEServicePortType">
2174   <wsdl:operation name="define">
2175     <wsdl:input message="impl:defineRequest" name="defineRequest"/>
2176     <wsdl:output message="impl:defineResponse" name="defineResponse"/>
2177     <wsdl:fault message="impl:DuplicateNameExceptionResponse"
2178       name="DuplicateNameExceptionFault"/>
2179     <wsdl:fault message="impl:ECSpecValidationExceptionResponse"
2180       name="ECSpecValidationExceptionFault"/>
2181     <wsdl:fault message="impl:SecurityExceptionResponse"
2182       name="SecurityExceptionFault"/>
2183     <wsdl:fault message="impl:ImplementationExceptionResponse"
2184       name="ImplementationExceptionFault"/>
2185   </wsdl:operation>
2186
2187   <wsdl:operation name="undefine">
2188     <wsdl:input message="impl:undefineRequest" name="undefineRequest"/>
2189     <wsdl:output message="impl:undefineResponse" name="undefineResponse"/>
2190     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2191       name="NoSuchNameExceptionFault"/>
2192     <wsdl:fault message="impl:SecurityExceptionResponse"
2193       name="SecurityExceptionFault"/>
2194     <wsdl:fault message="impl:ImplementationExceptionResponse"
2195       name="ImplementationExceptionFault"/>
2196   </wsdl:operation>
2197
2198   <wsdl:operation name="getECSpec">
2199     <wsdl:input message="impl:getECSpecRequest" name="getECSpecRequest"/>
2200     <wsdl:output message="impl:getECSpecResponse" name="getECSpecResponse"/>
2201     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2202       name="NoSuchNameExceptionFault"/>
2203     <wsdl:fault message="impl:SecurityExceptionResponse"
2204       name="SecurityExceptionFault"/>
2205     <wsdl:fault message="impl:ImplementationExceptionResponse"
2206       name="ImplementationExceptionFault"/>
2207   </wsdl:operation>
2208
2209   <wsdl:operation name="getECSpecNames">
2210     <wsdl:input message="impl:getECSpecNamesRequest"
2211       name="getECSpecNamesRequest"/>
2212     <wsdl:output message="impl:getECSpecNamesResponse"
2213       name="getECSpecNamesResponse"/>
2214     <wsdl:fault message="impl:SecurityExceptionResponse"
2215       name="SecurityExceptionFault"/>
2216     <wsdl:fault message="impl:ImplementationExceptionResponse"
2217       name="ImplementationExceptionFault"/>
2218   </wsdl:operation>
2219
2220   <wsdl:operation name="subscribe">
2221     <wsdl:input message="impl:subscribeRequest" name="subscribeRequest"/>
2222     <wsdl:output message="impl:subscribeResponse" name="subscribeResponse"/>
2223     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2224       name="NoSuchNameExceptionFault"/>

```

```

2225     <wsdl:fault message="impl:InvalidURIExceptionResponse"
2226             name="InvalidURIExceptionFault"/>
2227     <wsdl:fault message="impl:DuplicateSubscriptionExceptionResponse"
2228             name="DuplicateSubscriptionExceptionFault"/>
2229     <wsdl:fault message="impl:SecurityExceptionResponse"
2230             name="SecurityExceptionFault"/>
2231     <wsdl:fault message="impl:ImplementationExceptionResponse"
2232             name="ImplementationExceptionFault"/>
2233 </wsdl:operation>
2234
2235 <wsdl:operation name="unsubscribe">
2236     <wsdl:input message="impl:unsubscribeRequest" name="unsubscribeRequest"/>
2237     <wsdl:output message="impl:unsubscribeResponse" name="unsubscribeResponse"/>
2238     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2239             name="NoSuchNameExceptionFault"/>
2240     <wsdl:fault message="impl:NoSuchSubscriberExceptionResponse"
2241             name="NoSuchSubscriberExceptionFault"/>
2242     <wsdl:fault message="impl:InvalidURIExceptionResponse"
2243             name="InvalidURIExceptionFault"/>
2244     <wsdl:fault message="impl:SecurityExceptionResponse"
2245             name="SecurityExceptionFault"/>
2246     <wsdl:fault message="impl:ImplementationExceptionResponse"
2247             name="ImplementationExceptionFault"/>
2248 </wsdl:operation>
2249
2250 <wsdl:operation name="poll">
2251     <wsdl:input message="impl:pollRequest" name="pollRequest"/>
2252     <wsdl:output message="impl:pollResponse" name="pollResponse"/>
2253     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2254             name="NoSuchNameExceptionFault"/>
2255     <wsdl:fault message="impl:SecurityExceptionResponse"
2256             name="SecurityExceptionFault"/>
2257     <wsdl:fault message="impl:ImplementationExceptionResponse"
2258             name="ImplementationExceptionFault"/>
2259 </wsdl:operation>
2260
2261 <wsdl:operation name="immediate">
2262     <wsdl:input message="impl:immediateRequest" name="immediateRequest"/>
2263     <wsdl:output message="impl:immediateResponse" name="immediateResponse"/>
2264     <wsdl:fault message="impl:ECSpecValidationExceptionResponse"
2265             name="ECSpecValidationExceptionFault"/>
2266     <wsdl:fault message="impl:SecurityExceptionResponse"
2267             name="SecurityExceptionFault"/>
2268     <wsdl:fault message="impl:ImplementationExceptionResponse"
2269             name="ImplementationExceptionFault"/>
2270 </wsdl:operation>
2271
2272 <wsdl:operation name="getSubscribers">
2273     <wsdl:input message="impl:getSubscribersRequest"
2274             name="getSubscribersRequest"/>
2275     <wsdl:output message="impl:getSubscribersResponse"
2276             name="getSubscribersResponse"/>
2277     <wsdl:fault message="impl:NoSuchNameExceptionResponse"
2278             name="NoSuchNameExceptionFault"/>
2279     <wsdl:fault message="impl:SecurityExceptionResponse"
2280             name="SecurityExceptionFault"/>
2281     <wsdl:fault message="impl:ImplementationExceptionResponse"
2282             name="ImplementationExceptionFault"/>
2283 </wsdl:operation>
2284
2285 <wsdl:operation name="getStandardVersion">
2286     <wsdl:input message="impl:getStandardVersionRequest"
2287     name="getStandardVersionRequest"/>
2288     <wsdl:output message="impl:getStandardVersionResponse"
2289     name="getStandardVersionResponse"/>
2290     <wsdl:fault message="impl:ImplementationExceptionResponse"
2291     name="ImplementationExceptionFault"/>
2292 </wsdl:operation>
2293
2294 <wsdl:operation name="getVendorVersion">

```

```

2295         <wsdl:input message="impl:getVendorVersionRequest"
2296 name="getVendorVersionRequest"/>
2297         <wsdl:output message="impl:getVendorVersionResponse"
2298 name="getVendorVersionResponse"/>
2299         <wsdl:fault message="impl:ImplementationExceptionResponse"
2300 name="ImplementationExceptionFault"/>
2301     </wsdl:operation>         </wsdl:portType>
2302
2303     <!-- ALESERVICE BINDING -->
2304     <wsdl:binding name="ALEServiceBinding" type="impl:ALEServicePortType">
2305         <wsdlsoap:binding style="document"
2306             transport="http://schemas.xmlsoap.org/soap/http"/>
2307         <wsdl:operation name="define">
2308             <wsdlsoap:operation soapAction=""/>
2309             <wsdl:input name="defineRequest">
2310                 <wsdlsoap:body
2311                     use="literal"/>
2312             </wsdl:input>
2313             <wsdl:output name="defineResponse">
2314                 <wsdlsoap:body
2315                     use="literal"/>
2316             </wsdl:output>
2317             <wsdl:fault name="DuplicateNameExceptionFault">
2318                 <wsdlsoap:fault
2319                     name="DuplicateNameExceptionFault"
2320                     use="literal"/>
2321             </wsdl:fault>
2322             <wsdl:fault name="ECSpecValidationExceptionFault">
2323                 <wsdlsoap:fault
2324                     name="ECSpecValidationExceptionFault"
2325                     use="literal"/>
2326             </wsdl:fault>
2327             <wsdl:fault name="SecurityExceptionFault">
2328                 <wsdlsoap:fault
2329                     name="SecurityExceptionFault"
2330                     use="literal"/>
2331             </wsdl:fault>
2332             <wsdl:fault name="ImplementationExceptionFault">
2333                 <wsdlsoap:fault
2334                     name="ImplementationExceptionFault"
2335                     use="literal"/>
2336             </wsdl:fault>
2337         </wsdl:operation>
2338
2339         <wsdl:operation name="undefine">
2340             <wsdlsoap:operation soapAction=""/>
2341             <wsdl:input name="undefineRequest">
2342                 <wsdlsoap:body
2343                     use="literal"/>
2344             </wsdl:input>
2345             <wsdl:output name="undefineResponse">
2346                 <wsdlsoap:body
2347                     use="literal"/>
2348             </wsdl:output>
2349             <wsdl:fault name="NoSuchNameExceptionFault">
2350                 <wsdlsoap:fault
2351                     name="NoSuchNameExceptionFault"
2352                     use="literal"/>
2353             </wsdl:fault>
2354             <wsdl:fault name="SecurityExceptionFault">
2355                 <wsdlsoap:fault
2356                     name="SecurityExceptionFault"
2357                     use="literal"/>
2358             </wsdl:fault>
2359             <wsdl:fault name="ImplementationExceptionFault">
2360                 <wsdlsoap:fault
2361                     name="ImplementationExceptionFault"
2362                     use="literal"/>
2363             </wsdl:fault>
2364         </wsdl:operation>

```

```

2365
2366 <wsdl:operation name="getECSpec">
2367   <wsdlsoap:operation soapAction=""/>
2368   <wsdl:input name="getECSpecRequest">
2369     <wsdlsoap:body
2370       use="literal"/>
2371   </wsdl:input>
2372   <wsdl:output name="getECSpecResponse">
2373     <wsdlsoap:body
2374       use="literal"/>
2375   </wsdl:output>
2376   <wsdl:fault name="NoSuchNameExceptionFault">
2377     <wsdlsoap:fault
2378       name="NoSuchNameExceptionFault"
2379       use="literal"/>
2380   </wsdl:fault>
2381   <wsdl:fault name="SecurityExceptionFault">
2382     <wsdlsoap:fault
2383       name="SecurityExceptionFault"
2384       use="literal"/>
2385   </wsdl:fault>
2386   <wsdl:fault name="ImplementationExceptionFault">
2387     <wsdlsoap:fault
2388       name="ImplementationExceptionFault"
2389       use="literal"/>
2390   </wsdl:fault>
2391 </wsdl:operation>
2392
2393 <wsdl:operation name="getECSpecNames">
2394   <wsdlsoap:operation soapAction=""/>
2395   <wsdl:input name="getECSpecNamesRequest">
2396     <wsdlsoap:body
2397       use="literal"/>
2398   </wsdl:input>
2399   <wsdl:output name="getECSpecNamesResponse">
2400     <wsdlsoap:body
2401       use="literal"/>
2402   </wsdl:output>
2403   <wsdl:fault name="SecurityExceptionFault">
2404     <wsdlsoap:fault
2405       name="SecurityExceptionFault"
2406       use="literal"/>
2407   </wsdl:fault>
2408   <wsdl:fault name="ImplementationExceptionFault">
2409     <wsdlsoap:fault
2410       name="ImplementationExceptionFault"
2411       use="literal"/>
2412   </wsdl:fault>
2413 </wsdl:operation>
2414
2415 <wsdl:operation name="subscribe">
2416   <wsdlsoap:operation soapAction=""/>
2417   <wsdl:input name="subscribeRequest">
2418     <wsdlsoap:body
2419       use="literal"/>
2420   </wsdl:input>
2421   <wsdl:output name="subscribeResponse">
2422     <wsdlsoap:body
2423       use="literal"/>
2424   </wsdl:output>
2425   <wsdl:fault name="NoSuchNameExceptionFault">
2426     <wsdlsoap:fault
2427       name="NoSuchNameExceptionFault"
2428       use="literal"/>
2429   </wsdl:fault>
2430   <wsdl:fault name="InvalidURIExceptionFault">
2431     <wsdlsoap:fault
2432       name="InvalidURIExceptionFault"
2433       use="literal"/>
2434   </wsdl:fault>

```

```

2435     <wsdl:fault name="DuplicateSubscriptionExceptionFault">
2436         <wsdlsoap:fault
2437             name="DuplicateSubscriptionExceptionFault"
2438             use="literal"/>
2439     </wsdl:fault>
2440     <wsdl:fault name="SecurityExceptionFault">
2441         <wsdlsoap:fault
2442             name="SecurityExceptionFault"
2443             use="literal"/>
2444     </wsdl:fault>
2445     <wsdl:fault name="ImplementationExceptionFault">
2446         <wsdlsoap:fault
2447             name="ImplementationExceptionFault"
2448             use="literal"/>
2449     </wsdl:fault>
2450 </wsdl:operation>
2451
2452 <wsdl:operation name="unsubscribe">
2453     <wsdlsoap:operation soapAction=""/>
2454     <wsdl:input name="unsubscribeRequest">
2455         <wsdlsoap:body
2456             use="literal"/>
2457     </wsdl:input>
2458     <wsdl:output name="unsubscribeResponse">
2459         <wsdlsoap:body
2460             use="literal"/>
2461     </wsdl:output>
2462     <wsdl:fault name="NoSuchNameExceptionFault">
2463         <wsdlsoap:fault
2464             name="NoSuchNameExceptionFault"
2465             use="literal"/>
2466     </wsdl:fault>
2467     <wsdl:fault name="NoSuchSubscriberExceptionFault">
2468         <wsdlsoap:fault
2469             name="NoSuchSubscriberExceptionFault"
2470             use="literal"/>
2471     </wsdl:fault>
2472     <wsdl:fault name="InvalidURIExceptionFault">
2473         <wsdlsoap:fault
2474             name="InvalidURIExceptionFault"
2475             use="literal"/>
2476     </wsdl:fault>
2477     <wsdl:fault name="SecurityExceptionFault">
2478         <wsdlsoap:fault
2479             name="SecurityExceptionFault"
2480             use="literal"/>
2481     </wsdl:fault>
2482     <wsdl:fault name="ImplementationExceptionFault">
2483         <wsdlsoap:fault
2484             name="ImplementationExceptionFault"
2485             use="literal"/>
2486     </wsdl:fault>
2487 </wsdl:operation>
2488
2489 <wsdl:operation name="poll">
2490     <wsdlsoap:operation soapAction=""/>
2491     <wsdl:input name="pollRequest">
2492         <wsdlsoap:body
2493             use="literal"/>
2494     </wsdl:input>
2495     <wsdl:output name="pollResponse">
2496         <wsdlsoap:body
2497             use="literal"/>
2498     </wsdl:output>
2499     <wsdl:fault name="NoSuchNameExceptionFault">
2500         <wsdlsoap:fault
2501             name="NoSuchNameExceptionFault"
2502             use="literal"/>
2503     </wsdl:fault>
2504     <wsdl:fault name="SecurityExceptionFault">

```

```

2505         <wsdlsoap:fault
2506             name="SecurityExceptionFault"
2507             use="literal"/>
2508     </wsdl:fault>
2509     <wsdl:fault name="ImplementationExceptionFault">
2510         <wsdlsoap:fault
2511             name="ImplementationExceptionFault"
2512             use="literal"/>
2513     </wsdl:fault>
2514 </wsdl:operation>
2515
2516 <wsdl:operation name="immediate">
2517     <wsdlsoap:operation soapAction=""/>
2518     <wsdl:input name="immediateRequest">
2519         <wsdlsoap:body
2520             use="literal"/>
2521     </wsdl:input>
2522     <wsdl:output name="immediateResponse">
2523         <wsdlsoap:body
2524             use="literal"/>
2525     </wsdl:output>
2526     <wsdl:fault name="ECSpecValidationExceptionFault">
2527         <wsdlsoap:fault
2528             name="ECSpecValidationExceptionFault"
2529             use="literal"/>
2530     </wsdl:fault>
2531     <wsdl:fault name="SecurityExceptionFault">
2532         <wsdlsoap:fault
2533             name="SecurityExceptionFault"
2534             use="literal"/>
2535     </wsdl:fault>
2536     <wsdl:fault name="ImplementationExceptionFault">
2537         <wsdlsoap:fault
2538             name="ImplementationExceptionFault"
2539             use="literal"/>
2540     </wsdl:fault>
2541 </wsdl:operation>
2542
2543 <wsdl:operation name="getSubscribers">
2544     <wsdlsoap:operation soapAction=""/>
2545     <wsdl:input name="getSubscribersRequest">
2546         <wsdlsoap:body
2547             use="literal"/>
2548     </wsdl:input>
2549     <wsdl:output name="getSubscribersResponse">
2550         <wsdlsoap:body
2551             use="literal"/>
2552     </wsdl:output>
2553     <wsdl:fault name="NoSuchNameExceptionFault">
2554         <wsdlsoap:fault
2555             name="NoSuchNameExceptionFault"
2556             use="literal"/>
2557     </wsdl:fault>
2558     <wsdl:fault name="SecurityExceptionFault">
2559         <wsdlsoap:fault
2560             name="SecurityExceptionFault"
2561             use="literal"/>
2562     </wsdl:fault>
2563     <wsdl:fault name="ImplementationExceptionFault">
2564         <wsdlsoap:fault
2565             name="ImplementationExceptionFault"
2566             use="literal"/>
2567     </wsdl:fault>
2568 </wsdl:operation>
2569
2570 <wsdl:operation name="getStandardVersion">
2571     <wsdlsoap:operation soapAction=""/>
2572     <wsdl:input name="getStandardVersionRequest">
2573         <wsdlsoap:body
2574             use="literal"/>

```

```

2575         </wsdl:input>
2576         <wsdl:output name="getStandardVersionResponse">
2577             <wsdlsoap:body
2578                 use="literal"/>
2579         </wsdl:output>
2580         <wsdl:fault name="ImplementationExceptionFault">
2581             <wsdlsoap:fault
2582                 name="ImplementationExceptionFault"
2583                 use="literal"/>
2584         </wsdl:fault>
2585     </wsdl:operation>
2586
2587     <wsdl:operation name="getVendorVersion">
2588         <wsdlsoap:operation soapAction=""/>
2589         <wsdl:input name="getVendorVersionRequest">
2590             <wsdlsoap:body
2591                 use="literal"/>
2592         </wsdl:input>
2593         <wsdl:output name="getVendorVersionResponse">
2594             <wsdlsoap:body
2595                 use="literal"/>
2596         </wsdl:output>
2597         <wsdl:fault name="ImplementationExceptionFault">
2598             <wsdlsoap:fault
2599                 name="ImplementationExceptionFault"
2600                 use="literal"/>
2601         </wsdl:fault>
2602     </wsdl:operation>
2603 </wsdl:binding>
2604
2605 <!-- ALESERVICE -->
2606 <wsdl:service name="ALEService">
2607     <wsdl:port binding="impl:ALEServiceBinding" name="ALEServicePort">
2608         <!-- The value of the location attribute below is an example only;
2609             Implementations are free to choose any appropriate URL. -->
2610         <wsdlsoap:address
2611             location="http://localhost:6060/axis/services/ALEService"/>
2612     </wsdl:port>
2613 </wsdl:service>
2614
2615 </wsdl:definitions>

```

2616 12 Use Cases (non-normative)

2617 This section provides a non-normative illustration of how the ALE interface is used in
2618 various application scenarios.

- 2619 1. For **shipment and receipt verification**, applications will request the number of
2620 Logistic Units such as Pallets and Cases moving through a portal, totaled by Pallet
2621 and Case GTIN across all serial numbers. Object types other than Pallet and Case
2622 should be filtered out of the reading.
- 2623 2. For **retail OOS management**, applications will request one of 2 things:
 - 2624 a. The number of Items that were added to or removed from the shelf since the
2625 last read cycle, totaled by Item GTIN across all serial numbers. Object types
2626 other than Item should be filtered out of the reading; or
 - 2627 b. The total number of Items on the shelf during the current read cycle, totaled
2628 by GTIN across all serial numbers. Object types other than Item should be
2629 filtered out of the reading.
- 2630 3. For **retail checkout**, applications will request the full EPC of Items that move
2631 through the checkout zone. Object types other than Item should be filtered out. In
2632 order to prevent charging for Items that aren't for sale (*e.g.*, Items the consumer or

2633 checkout clerk brought into the store that inadvertently happen to be read), something
 2634 in the architecture needs to make sure such Items are not read or filter them out.
 2635 Prevention might be achievable with proper portal design and the ability for the
 2636 checkout clerk to override errant reads. Alternatively, the ALE implementation could
 2637 filter errant reads via access to a list of Items (down to the serial number) that are
 2638 qualified for sale in that store (this could be hundreds of thousands to millions of
 2639 items), or the POS application itself could do it. With the list options, the requesting
 2640 application would be responsible for maintaining the list.

- 2641 4. For **retail front door theft detection**, applications will request the full EPC of any
 2642 Item that passes through the security point portal and that has not be marked as sold
 2643 by the store and perhaps that meet certain theft detection criteria established by the
 2644 store, such as item value. Like the retail checkout use case, the assumption is that the
 2645 ALE implementation will have access to a list of store Items (to the serial number
 2646 level) that have not been sold and that meet the stores theft alert conditions. The
 2647 requesting application will be responsible for maintaining the list, and will decide
 2648 what action, if any, should be taken based on variables such as the value and quantity
 2649 of Items reported.
- 2650 5. For **retail shelf theft detection**, applications will request the number of Items that
 2651 were removed from the shelf since the last read cycle, totaled by Item GTIN across all
 2652 serial numbers. Object types other than Item should be filtered out.
- 2653 6. For **warehouse management**, a relatively complex range of operations and thus
 2654 requirements will exist. For illustration at this stage, one of the requirements is that
 2655 the application will request the EPC of the slot location into which a forklift operator
 2656 has placed a Pallet of products. Object types other than “slot” should be filtered out
 2657 of the reading.
 2658

2659 The table below summarizes the ALE API settings used in each of these use cases.

Use Case	Event Cycle Boundaries	Report Settings		
		Result Set <i>R</i>	Filter <i>F(R)</i>	Report Type
1 (ship/rcpt)	Triggered by pallet entering and leaving portal	Complete	Pallet & Case	Group cardinality, G = pallet/case GTIN
2a (retail OOS)	Periodic	Additions & Deletions	Item	Group cardinality, G = item GTIN
2b (retail OOS)	Periodic	Complete	Item	Group cardinality, G = item GTIN
3 (retail ckout)	Single	Complete	Item	Membership (EPC)

Use Case	Event Cycle Boundaries	Report Settings		
		Result Set R	Filter $F(R)$	Report Type
4 (door theft)	Triggered by object(s) entering and leaving portal	Complete	None	Membership (EPC)
5 (shelf theft)	Periodic	Deletions	Item	Group cardinality, $G = \text{item GTIN}$
6 (forklift)	Single	Complete	Slot	Membership (EPC)

2660

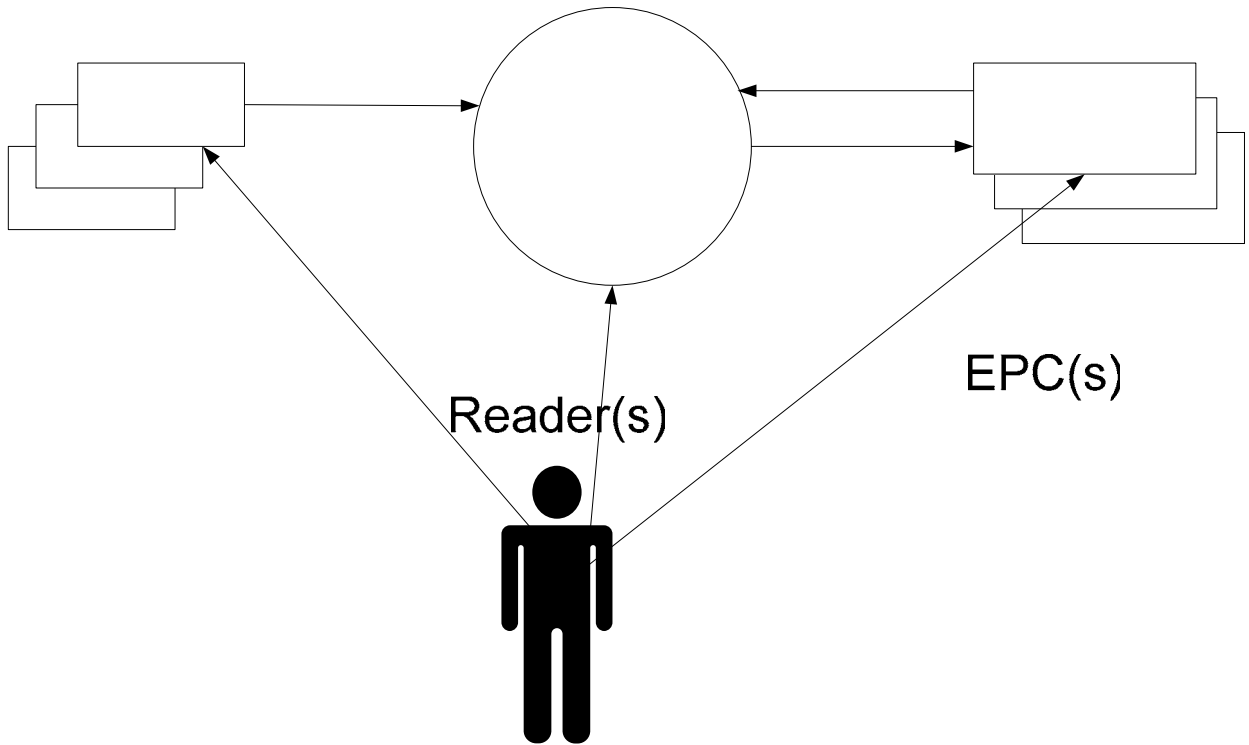
2661 **13 ALE Scenarios (non-normative)**

2662 This section provides a non-normative illustration of the API-level interactions between
 2663 the ALE interface and the ALE client and other actors.

2664 **13.1 ALE Context**

2665 The ALE layer exists in a context including RFID readers, Users (administrative) and
 2666 Client applications as shown below. Initially the administrators are responsible for
 2667 installing and configuring the RFID environment. Once the environment is configured,
 2668 EPC data (tag reads) are sent from the Readers to the ALE layer. In some cases the ALE
 2669 layer may be implemented on the Reader or elsewhere, but in these scenarios we assume
 2670 that the ALE layer is implemented as a distinct software component and is configured to
 2671 support more than one Reader.

2672



2673
2674

2675 The ALE clients are applications or services that process EPC tag information. Several
2676 methods are defined within the ALE interface which allow clients to specify the data they
2677 wish to receive and the conditions for the production of the reports containing the data.
2678 These methods are:

- 2679 • define, undefine
- 2680 • subscribe, unsubscribe
- 2681 • poll
- 2682 • immediate
- 2683 • getECSpecNames, getECSpec

2684 These methods are defined normatively in Section 8.1.

2685 13.2 Scenarios

2686 A few sample scenarios are illustrated below to demonstrate the use of the ALE interface
2687 messages. Below is a representative list of the kinds of scenarios ALE supports.

- 2688 1. Defining Subscribe ECName, ECSpec
 - 2689 a. Direct Subscription. Defined by A, Report to: A
 - 2690 b. Indirect Subscription Defined by A, Report to: B
- 2691 2. Poll(ECName)

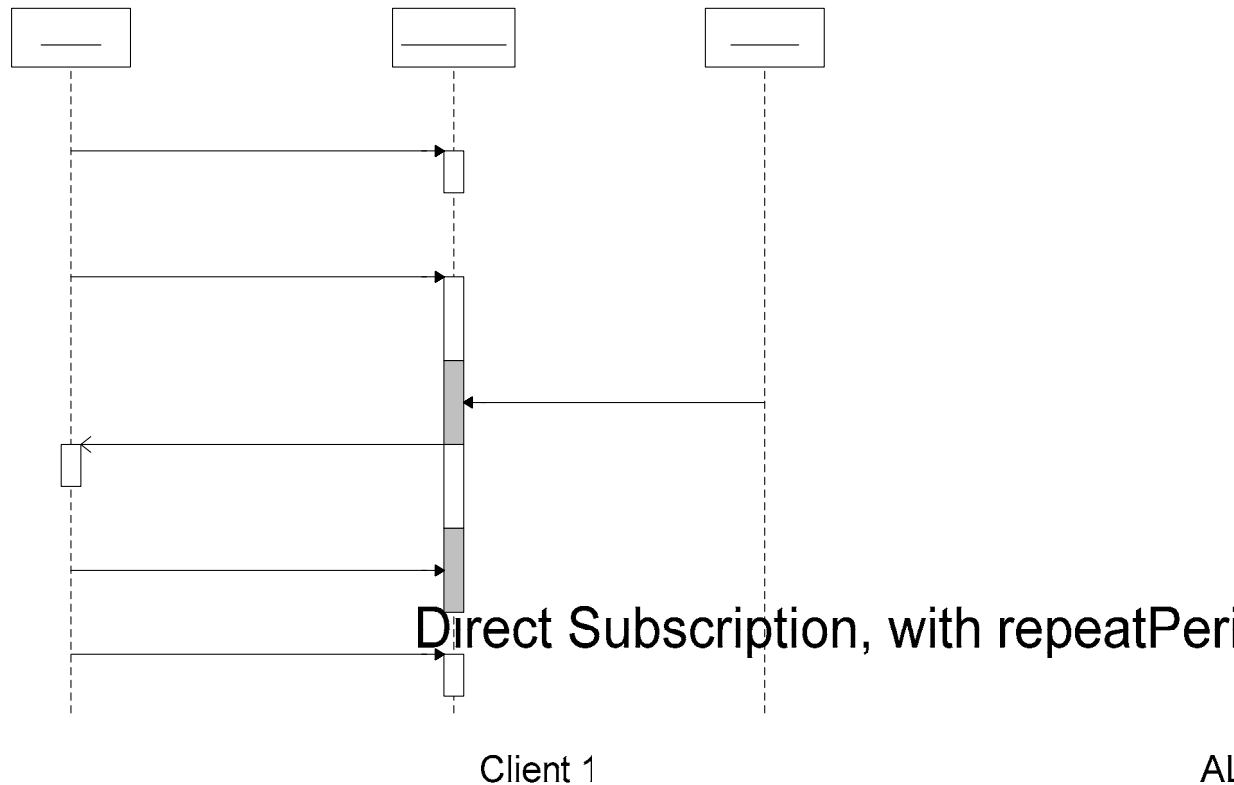
config

config

- 2692 3. Immediate(ECSpec)
- 2693 4. Operation Errors
- 2694 5. System Errors

2695 **13.2.1 Scenario 1a: Direct Subscription**

2696 The scenario shown below involves a client application specifying the EPC data it is
 2697 interested in collecting. After specifying the ECSpec, it then subscribes to receive the
 2698 resulting ECRports. The ECSpec shown in this scenario specifies that event cycles
 2699 should repeat periodically. The ECRportSpec requests reports for additions and
 2700 deletions, and reportIfEmpty is set to false. This is a normal scenario involving no
 2701 errors.



2702

2703 **13.2.1.1 Assumptions**

- 2704 1. All discovery, configuration, and initialization required has already been
 2705 performed.
- 2706 2. The ALE layer is implemented as a distinct software component.
- 2707 3. ECSpec boundary condition specified using: repeatPeriod
- 2708 4. ECFilterSpec includePatterns includes the EPC(s) illustrated in
 2709 this scenario
- 2710 5. Client 1 is the only client of ALE and the only subscriber of the ECSpec

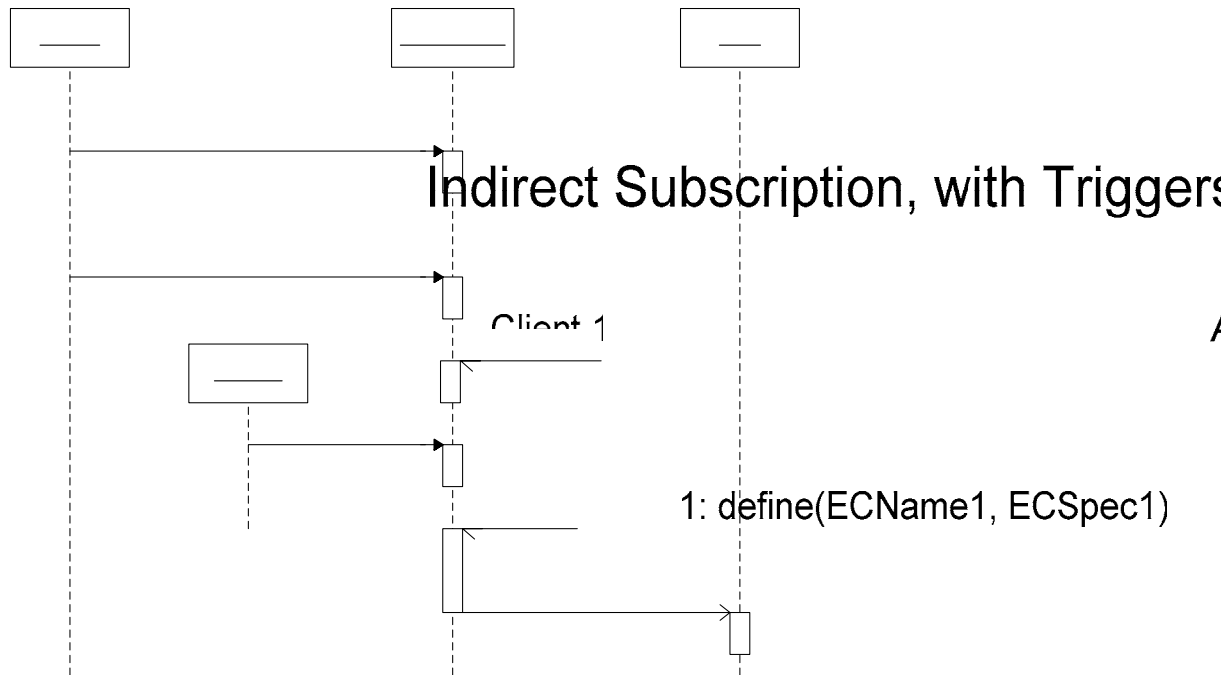
2: subscribe(ECName, NotifyURI)

2711 **13.2.1.2 Description**

- 2712 1. The client calls the `define` method of the ALE interface. The `ECSpec`
2713 specifies that the event cycle is to begin using `repeatPeriod` as the
2714 boundary specification and to end using `duration` as the boundary
2715 specification (but any valid boundary conditions could be specified). The
2716 `ECReportSpec` and `ECFilterSpec` contained within the `ECSpec` are
2717 defined to include the EPC data sent later in step 3.
- 2718 2. The client calls the `subscribe` method of the ALE interface, including a
2719 URI that identifies the client itself as the destination for the `ECReports`. At
2720 this point the `ECSpec` is considered “Requested.” Since the start condition is
2721 given by `repeatPeriod`, the `ECSpec` immediately transitions to the
2722 “Active” state.
- 2723 3. During `period1` no new tags (additions) were reported by the Reader, and no
2724 deletions were noted, thus no `ECReports` is generated.
- 2725 4. In `period2`, an EPC that does meet the filter conditions specified in the
2726 `ECSpec` is reported to the ALE layer by one of the Readers indicated in the
2727 `ECSpec`.
- 2728 5. At the end of `period2`, the requested `ECReports` is generated and sent to the
2729 client.
- 2730 6. In `period3`, no EPCs are reported, and no `ECReports` are generated.
- 2731 7. In `period4` the client calls the `unsubscribe` method of the ALE interface.
2732 As this client is the only subscriber, the `ECSpec` transitions to the
2733 “Unrequested” state, and no further `ECReports` are generated.
- 2734 8. Because the `ECSpec` is Unrequested, the client can undefine the `ECSpec`
2735 without any error.

2736 **13.2.2 Scenario 1b: Indirect Subscription**

2737 The scenario shown below involves a client application specifying the EPC data that is of
2738 interest to another observer. After specifying the `ECSpec`, the client subscribes a third
2739 party observer to receive the resulting `ECReports`. The `ECSpec` shown in this
2740 scenario specifies the event cycle to start and stop using a trigger mechanism. This is a
2741 normal scenario involving no errors.



2742

2: subscribe(ECName, NotifyURI)

2743 **13.2.2.1 Assumptions**

- 2744 1. All discovery, configuration, and initialization required has already been
- 2745 performed.
- 2746 2. The ALE layer is implemented as a distinct software component.
- 2747 3. ECSpec boundary conditions specified using startTrigger, stopTrigger
- 2748 4. ECFilterSpec includePatterns includes the EPC(s) illustrated in
- 2749 this scenario

2750 **13.2.2.2 Description**

4: read(EPC)

- 2751 1. The ALE client calls the define methods of the ALE interface. The
- 2752 ECSpec contains a valid startTrigger and stopTrigger as boundary
- 2753 specifications – though any valid boundary conditions could be specified. The
- 2754 ECReportSpec and ECFilterSpec contained within the ECSpec is
- 2755 defined to include the EPC data sent later in step 4.
- 2756 2. The ALE client calls the subscribe method of the ALE interface which
- 2757 includes the URI of the intended observer. At this point the ECSpec is
- 2758 considered “Requested.”
- 2759 3. After the start trigger is received, the ECSpec is considered “Active.”
- 2760 Subsequent EPCs that meet the filter conditions in the ECSpec will be
- 2761 collected by the ALE layer.
- 2762 4. An EPC that does meet the filter conditions in the ECSpec is reported to the
- 2763 ALE layer.

- 2764 5. The stop trigger is received. The ECSpec transitions to the “Requested”
- 2765 state.
- 2766 6. The ECReports is generated and sent asynchronously to the observer.

2767 **13.2.3 Scenario 2, 3: Poll, Immediate**

2768 The scenario shown illustrates an ALE client using the poll method of the ALE

2769 interface to synchronously obtain the EPC data it is interested in collecting. The

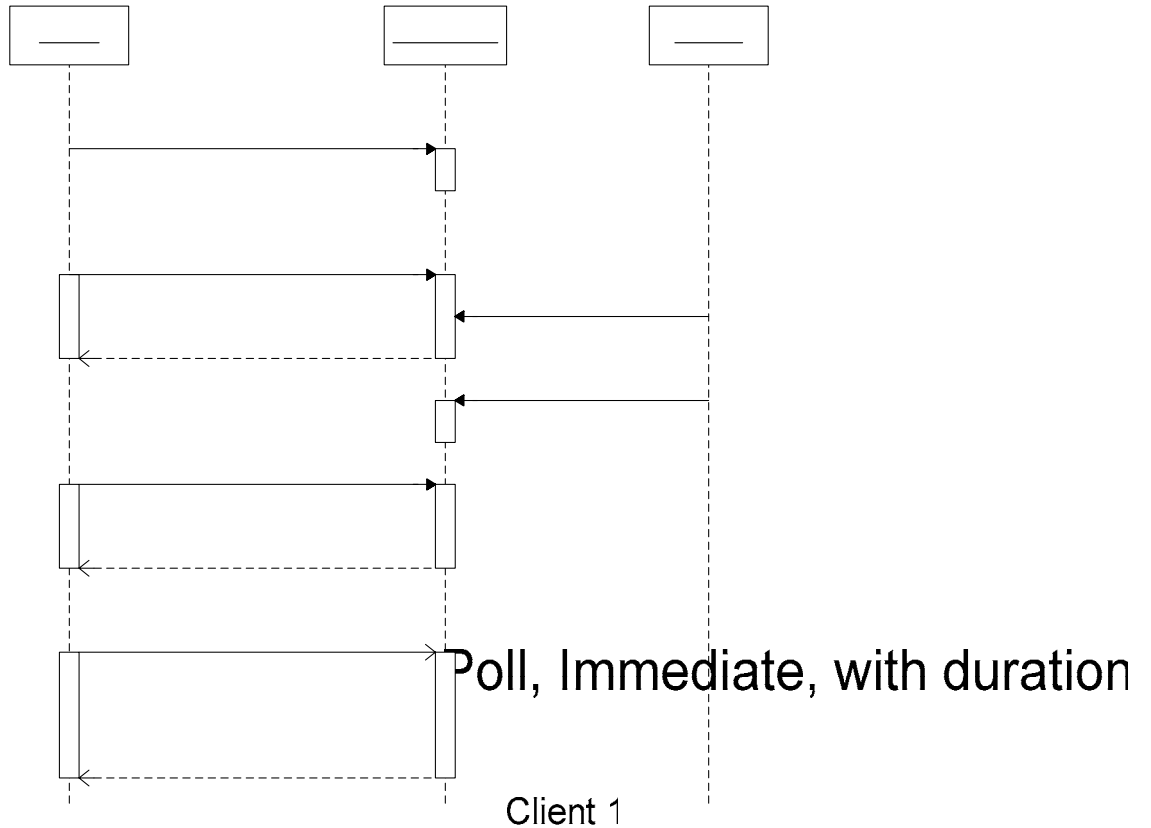
2770 ECSpec shown in this scenario specifies the event cycle boundary to be a duration of

2771 time. Later in the scenario the ALE client uses the immediate method of the ALE

2772 interface, again synchronously obtaining EPC data. The combination of poll and

2773 immediate is not required, and only serves to illustrate a possibility. This is a normal

2774 scenario involving no errors.



2775

2776 **13.2.3.1 Assumptions**

- 2777 1. All discovery, configuration, and initialization required has already been
- 2778 performed. 1: define(ECName1, ECSpec1)
- 2779 2. The ALE layer is implemented as a distinct software component.
- 2780 3. ECSpec boundary condition is specified as duration.

2781 4. `ECFilterSpec includePatterns` includes the EPC(s) illustrated in
 2782 this scenario.

2783 **13.2.3.2 Description**

- 2784 1. The ALE client calls the `define` method of the ALE interface. The
 2785 `ECSpec` contains a valid `duration` as the boundary specification – though
 2786 any valid boundary conditions could be specified. The `ECReportSpec` and
 2787 `ECFilterSpec` contained within the `ECSpec` are defined to include the
 2788 EPC data sent later in steps 3 and 4. At this point the `ECSpec` is considered
 2789 “Unrequested.”
- 2790 2. The ALE client calls the `poll` method of the ALE interface, naming the
 2791 `ECSpec` previously defined in Step 1. At this point the `ECSpec` is
 2792 transitioned to the “Active” state, and the event cycle begins for the duration
 2793 specified in the `ECSpec`. During the duration of the event cycle the ALE
 2794 client is blocked waiting for a response to the `poll` method.
- 2795 3. An EPC which meets the filter conditions of the `ECSpec` is received during
 2796 the event cycle. At the end of the event cycle, the `ECReports` is generated
 2797 and returned to the ALE client as the response to the `poll` method. At this
 2798 point the `ECSpec` transitions to the “Unrequested” state.
- 2799 4. An EPC that meets the filter conditions of the `ECSpec` is reported to the ALE
 2800 layer, but since there is no “Active” `ECSpec`, this EPC will not be reported.
- 2801 5. The ALE client invokes the `poll` method of the ALE interface a second time.
 2802 This is similar to the process described above in Steps 2 and 3, but since no
 2803 EPC is received, no EPC data is returned in the `ECReports`.
- 2804 6. Later, the ALE client calls the `immediate` method of the ALE interface.
 2805 This is very similar to the use of `poll`, except that when the client calls
 2806 `immediate` it provides the `ECSpec` as part of the method call, as opposed
 2807 to referring to a previously defined `ECSpec`. Since a new `ECSpec` is
 2808 provided with the `immediate` method, it can contain any valid combination
 2809 of parameters and report options.

2810 **14 Glossary (non-normative)**

2811 This section provides a non-normative summary of terms used within this specification.
 2812 For normative definitions of these terms, please consult the relevant sections of the
 2813 document.

Term	Section	Meaning
ALE (Application Level Events) Interface	1	Software interface through which ALE Clients may obtain filtered, consolidated EPC data from a variety of sources.

Term	Section	Meaning
ALE (Application Level Events) Layer	2	Functionality that sits between raw EPC detection events (RFID tag reads or otherwise) and application business logic (an ALE Client). The ALE Interface is the interface between this layer and the ALE Client.
ALE Client	2	Software, typically application business logic, which obtains EPC data through the ALE Interface.
Event Cycle	3	One or more Read Cycles, from one or more Readers, that are to be treated as a unit from a client perspective. It is the smallest unit of interaction between the ALE Interface and an ALE Client.
Read Cycle	3	The smallest unit of interaction of the ALE Layer with a Reader.
Reader	3	A source of raw EPC data events. Often an RFID reader, but may also be EPC-compatible bar code reader, or even a person typing on a keyboard.
Report	3	Data about event cycle communicated from the ALE interface to an ALE Client.
Immediate Request	2	A request in which information is reported on a one-time basis at the time of request. Immediate requests are made using the <code>immediate</code> or <code>poll</code> methods of the ALE Interface.
Recurring Request	2	A request in which information is reported repeatedly whenever an event is detected or at a specified time interval. Recurring requests are made using the <code>subscribe</code> method of the ALE Interface.
Grouping Operator	5	A function that maps an EPC code into a group code. Specifies how EPCs read within an Event Cycle are to be partitioned into groups for reporting purposes.
Physical Reader	7	A physical device, such as an RFID reader or bar code scanner, that acts as one or more Readers for the purposes of the ALE Layer.
Logical Reader Name	7	An abstract name that an ALE Client uses to refer to one or more Readers that have a single logical purpose; <i>e.g.</i> , <code>DockDoor42</code> .

2814

2815 **15 References**

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