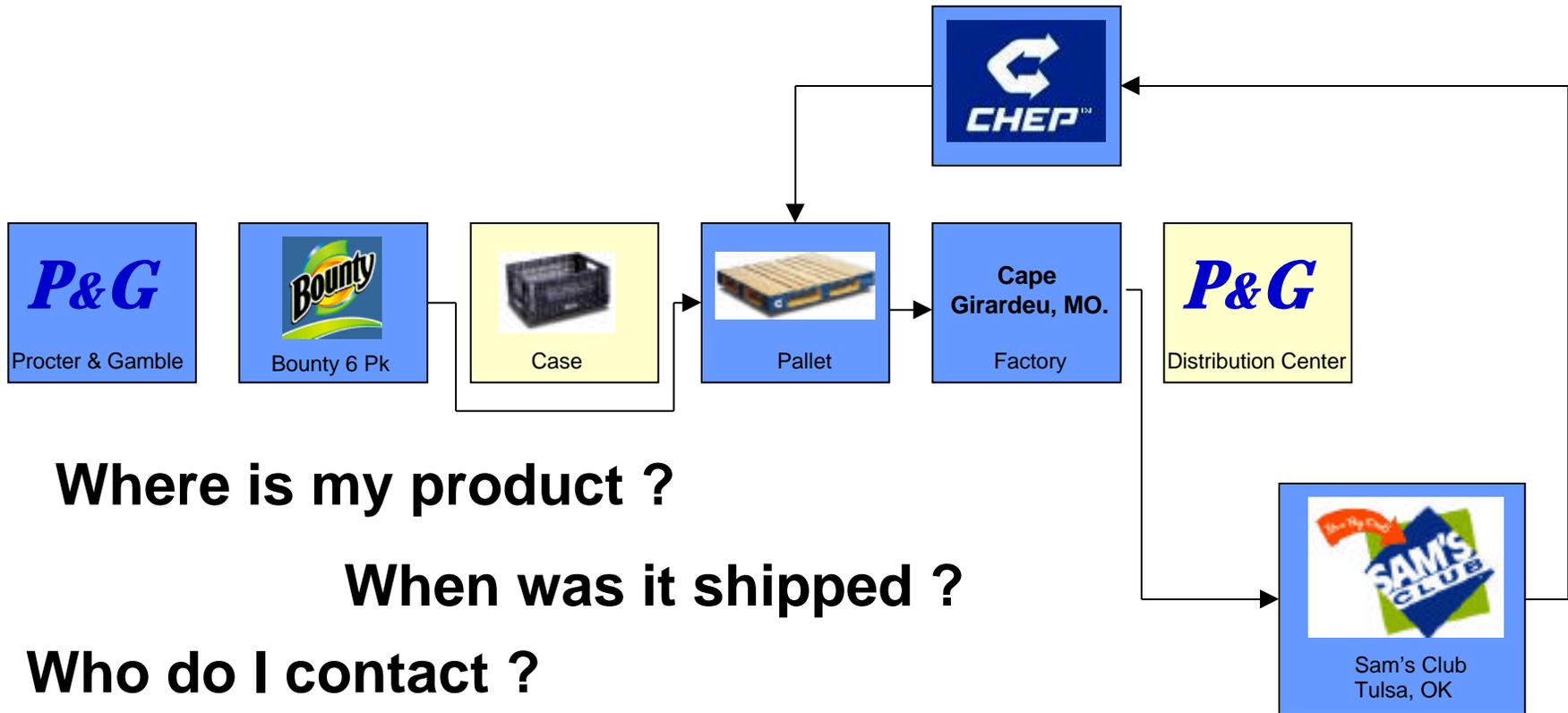


PML Development

June 14, 2001

David Brock
Auto-ID Center



Where is my product ?

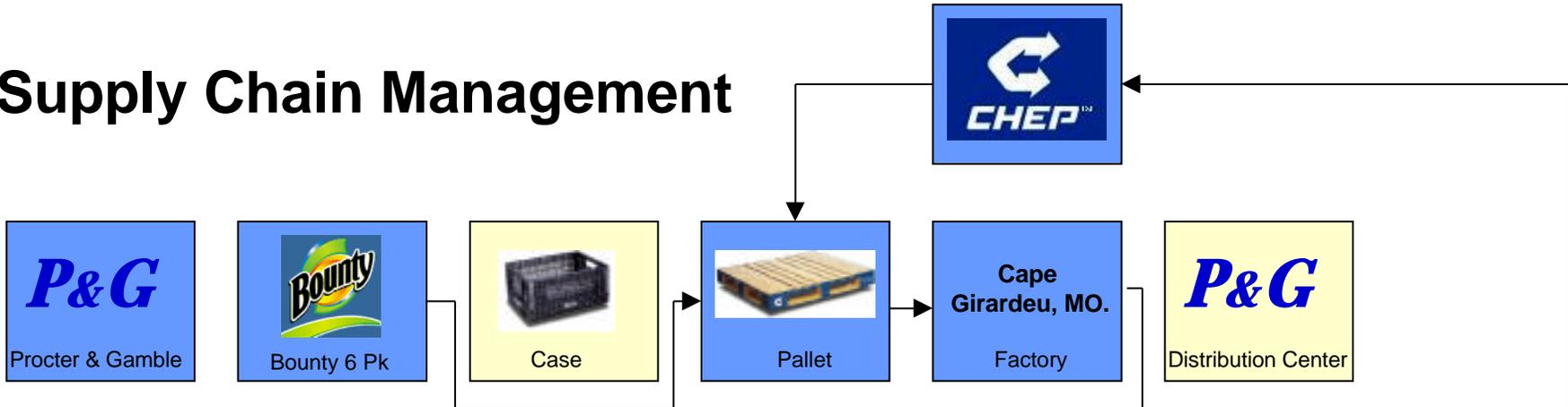
When was it shipped ?

Who do I contact ?

How much was sold ?

Is it still cold ?

Supply Chain Management



```

<node label="CHEP Pallet" epc=01.0002F6C.0015BE.0002938D8>
  </node label="Bounty" epc=01.0009088.007A58.00000298A 5>
  </node label="Bounty" epc=01.0009088.007A58.00000298A 6>
    <date type="Acq" resolution=3>55188015000</date>
    <date type="Rel" resolution=3>55188334000</date>
  </node label="Bounty" epc=01.0009088.007A58.00000298A 9>
  </node label="Bounty" epc=01.0009088.007A58.00000298A A>
</node><trace>
<trace>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55360928000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  45.5</measure>
    <measure label="longitude" m=1 accuracy=3>
  98.5</measure> </location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  47.2</measure>
    <measure label="longitude" m=1 accuracy=3>
  78.5</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  47.2</measure>
    <measure label="longitude" m=1 accuracy=3>
  78.5</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  47.2</measure>
    <measure label="longitude" m=1 accuracy=3>
  78.5</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  47.2</measure>
    <measure label="longitude" m=1 accuracy=3>
  78.5</measure> </location> </step></location> </step>
  
```

```

<location epc=01.00105AC.001029.000009239A>
  <measure label="x" m=1 accuracy=3>
  53.2</measure>
  <measure label="longitude" m=1 accuracy=3>
  25.4</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
    <measure label="x" m=1 accuracy=3>
  76.2</measure>
    <measure label="longitude" m=1 accuracy=3>
  15.9</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Shipper" </role>
  <entity> Kraft Distribution Center<entity> </owner>
  <date accuracy=5>339355212568</date>
  <measure label="Temperature" K=1 accuracy=5>
  277.59
  </measure> </location> </step>
<step>
  <owner> <role> "Shipper" </role>
  <entity> Sam's Club Distribution Center<entity> </owner>
  <date accuracy=5>339376845715</date>
  <measure label="Temperature" K=1 accuracy=5>
  281.59
  </measure> </location> </step>
<step>
  <owner> <role> "Shipper" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  
```

- Information
- Packaging
- Shipping
- Tracking
- In-store movement
- Shipment history
- Temperature monitoring
- Real-time Inventory
- Shrinkage

- PML Overview
- PML Components
- PML Examples
- PML Future

What is PML?

PML is the “*Physical Markup Language*” - a common “*language*” for describing ***physical objects, physical processes*** and ***environments***.

Is PML just XML?

No, XML is a language ***syntax***; that is the ***structure*** and ***grammatical arrangement*** of the language. PML is a ***semantic***; that is the components which provide ***meaning*** to the language.

Won't a common language be impossible?

No, PML will not be an exhaustive specification, but only describe the most ***basic characteristics*** shared by physical systems.

How will PML translate between various companies, industries and countries?

PML will ***not translate***. PML provides a ***single description***. This single description provides a reference for translators, developers and applications.

Will databases have to be written in PML?

No, PML is primarily a **communication** method **between** databases, companies, industries and countries. Although many may choose PML as a data storage method, there is no reason to change existing database formats.

Is PML extensible?

Yes and no. Yes, PML will provide simple mechanisms to extend the basic descriptions. No, the common language elements cannot be modified. The idea is that a shared understanding of basic elements provides a common reference point for translators, developers and applications.

What about EDI, ebXML and UDDI? Are these the same as PML?

No, EDI (Electronic Data Interchange) is an established, open standard containing information necessary for ***business transactions***, including business entity information, ordering, dispatching and invoicing.

ebXML describes ***business processes and transactions***, as well as the ***choreography*** of documents between ***trading partners***.

UDDI (Universal Description, Discovery and Integration) allows businesses to ***share*** business, service and contact ***information*** through global registries.

PML focuses on ***physical objects, physical processes and environments***.

When will be PML be ready?

A first, **beta** release of the PML specification will be available in Q4 2001.

What applications will be available?

A *non-commercial, prototype editor* and *viewer* will be available with the release of the PML specification.

<Data>

As items flow through the supply chain, it is often necessary to take a temporary inventory. The **data** element contains a 'snapshot' of the physical state of the environment.

```
<data>
```

```
  <date type="ACQ" resolution=3>
```

```
    55188015000
```

```
  </date>
```

```
  <epc>01.0009088.007A58.00000298A3 </epc>
```

```
  <epc>01.0009088.007A58.000002997B </epc>
```

```
  <epc>01.0002F6C.0015BE.0002938D8 </epc>
```

```
  <epc>01.0002F6C.0015BE.000293A9C </epc>
```

```
</data>
```

<Node>

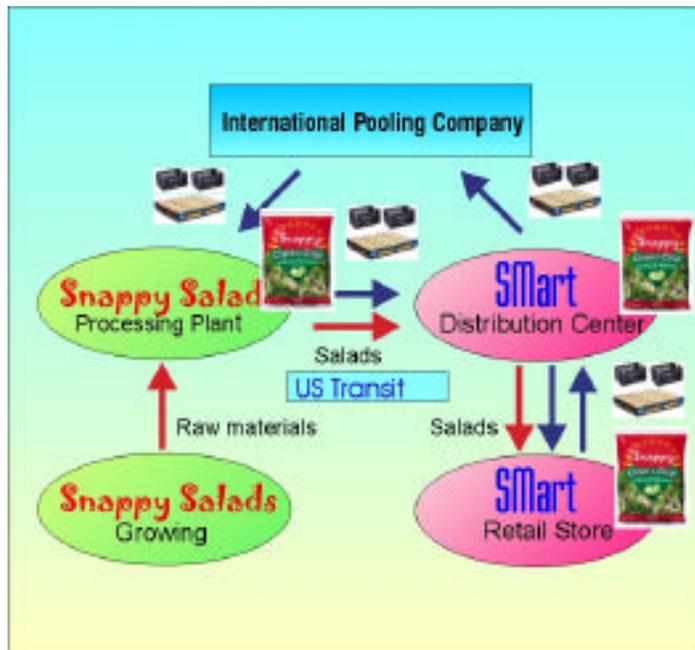
Many physical systems have hierarchical structures composed of assemblies, subassemblies and components. The recursively defined **node** element captures this basic structure.



```
<node label="Truck" ePC="01.0016CA2.000104.0000005910">  
  <node label="Pallet" ePC="01.000142F.001C0E8.0010298730">  
    <node label="RPC" ePC="01.000142F.001C0F3.0000319280">  
      <node label="Salad" ePC="01.000A571.003459.000E9FC61B">  
      </node>  
    </node>  
  </node>  
</node>
```

<Trace>

It is important to know not only where an object *is*, but also where an object *was*. The **trace** element records the movement of a particular object as it moves through the supply chain.



```
<trace>
  <step>
    <owner>
      <role>"Owner"</role>
      <entity>..."Snappy Salads, Inc."...</entity>
    </owner>
    <location>..."Processing Plant"...</location>
    <date type="Rel">39384060145</date>
  </step>
  ....
  <step>
    <owner>
      <role>"Shipper"</role>
      <entity>"U.S. Transit"</entity>
    </owner>
    <location> ..."DC"...</location>
    <date type="Release">39561977489</date>
  </step>
  ....
</trace>
```

<Entity>

Almost every physical object is owned or managed by someone. The **Entity** element describe entities – whether people, companies or organizations – that own or manage physical objects.



```
<entity>
  <type>Person</type>
  <name>
    <title>Mr.</type>
    <first> Robert </first>
    <middle>Douglas </middle>
    <last>Mooreland</last>
  </name>
  <association>
    <type>Personal</type>
    <channel type="Mobile">513-632-8229</channel>
  </association>
  <association>
    <name> Receiving Dock</name>
    <type>Work</type>
    <role>Shipping Manager</role>
    <channel type="Voice">513-633-2938</channel>
    <address>
      <building>F19</building>
      <number>143</number>
      <street>Commerce Park Road</street>
      <city>Cincinnati</city>
      <state>Ohio</state>
      <country>USA</country>
      <code>45202-1579</code>
    </address>
    <entity> ..."link S.Mart Stores"... </entity>
  </association>
</entity>
```

<Location>

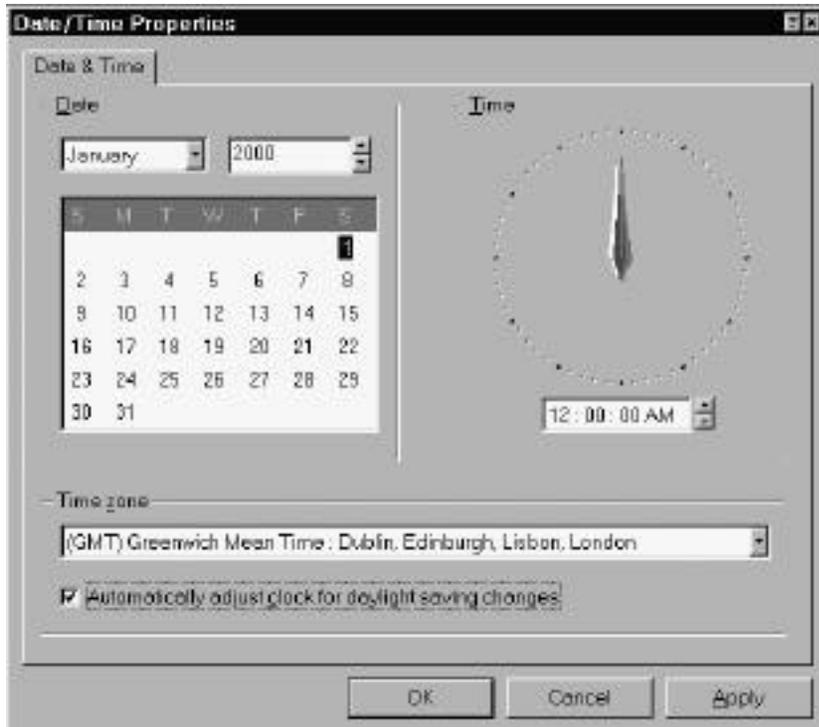
One of the most important questions to answer in the supply chain is “Where is my shipment?”
The **location** element defines the position of an object relative to a known reference.



```
<location ePC="01.0016CA2.000104.0000005910">  
  <measure label="x" m=1 accuracy=2>3.42</measure>  
  <measure label="y" m=1 accuracy=2>1.56</measure>  
  <location>  
    <measure label="latitude" m=1 accuracy=5>  
      4058808.538  
    </measure>  
    <measure label="longitude" m=1 accuracy=5>  
      625111.743  
    </measure>  
    <measure label="altitude" m=1 accuracy=5>  
      16.154  
    </measure>  
  </location>  
</location>
```

<Date>

Date and time are critical to the supply chain. Shipping, delivery, receiving, transport and expiration dates must be recorded and transmitted to manufactures, distributors, retailers and consumers. The **date** element contains of milliseconds that have passed since January 1, 2000 00:00:00.000 GMT.



```
<date type="Acq" resolution=3>  
55188347000  
</date>
```

<Measure>

Physical states of matter are compared to known references. The **measure** element state value relative the seven fundamental units based on the *Le Système International d'Unités – SI* system.

<measure

label="String"

m=Integer

kg=Integer

s=Integer

q=Integer

K=Integer

mol=Integer

cd=Integer

accuracy= Integer>

float

</measure>

Example: atmospheric pressure

101.325kPa

76 cm of Hg

101,325 m⁻¹ kg s⁻²

760 millimeters of mercury

14.7 lb/in²

1013.25mb

29.92 inches of mercury

34 ft of water

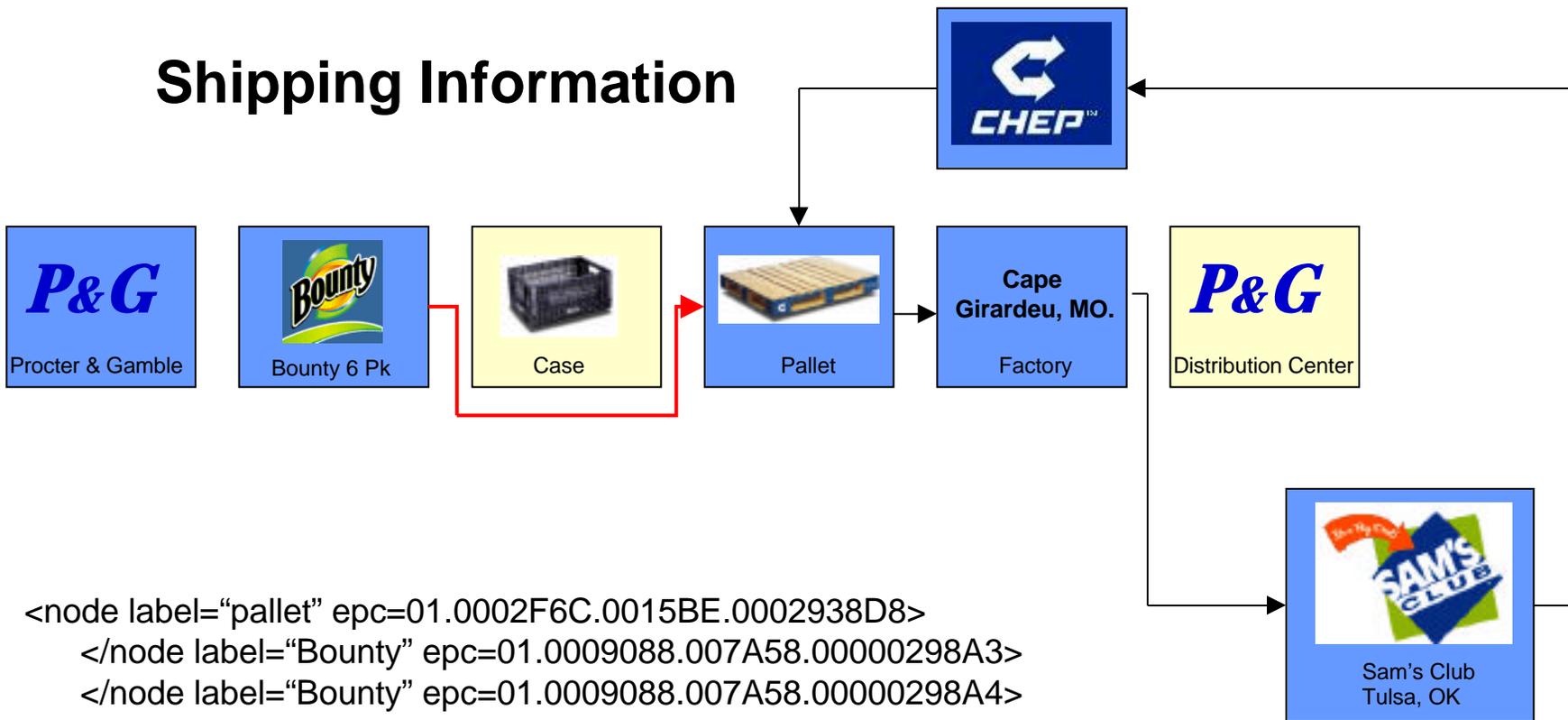
101,325 Pascal

```
<measure label="Pressure" m=-1 kg=1 s=-2>
```

```
101325.0
```

```
</measure>
```

Shipping Information

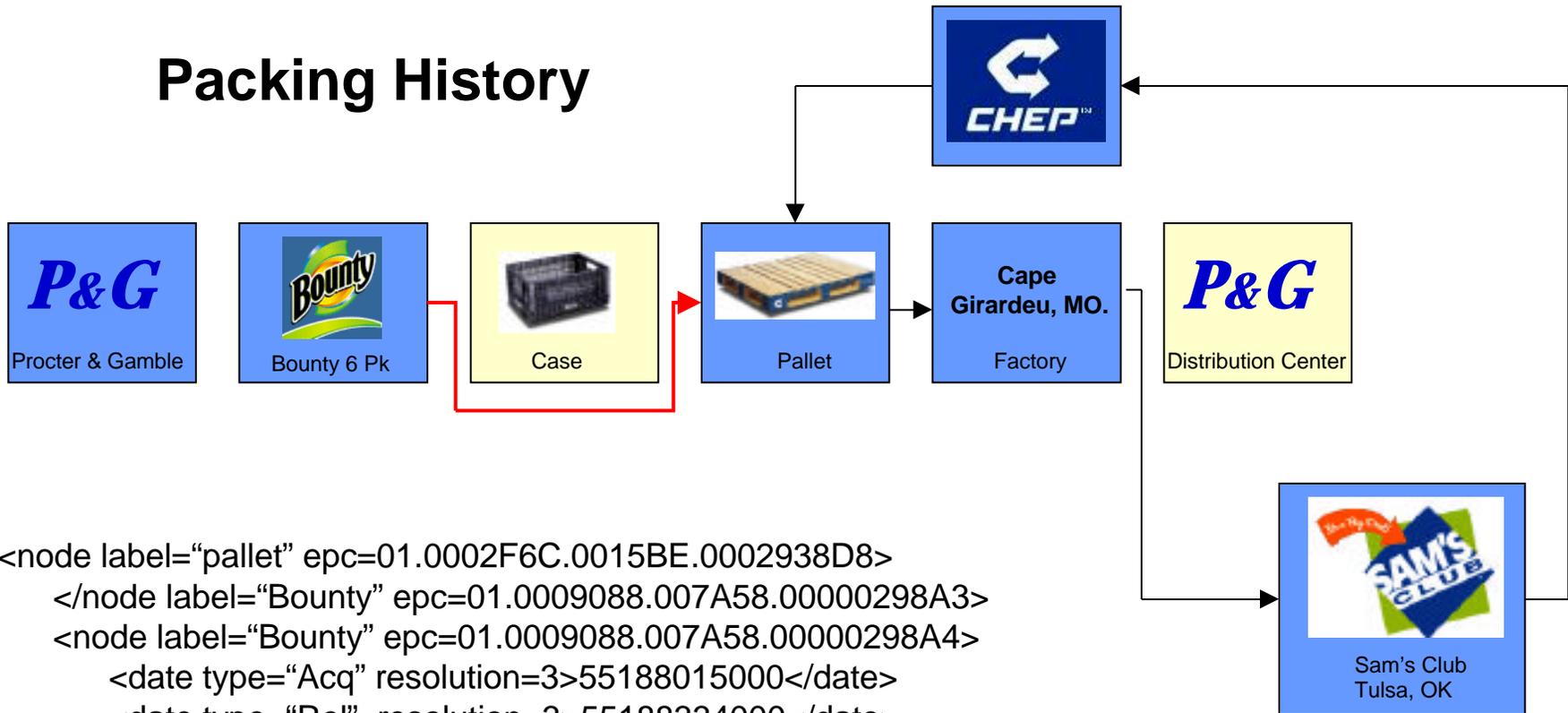


```

<node label="pallet" epc=01.0002F6C.0015BE.0002938D8>
  </node label="Bounty" epc=01.0009088.007A58.00000298A3>
  </node label="Bounty" epc=01.0009088.007A58.00000298A4>
  .....
  </node label="Bounty" epc=01.0009088.007A58.00000298D3>
</node>
  
```

0 37000 31320 7

Packing History

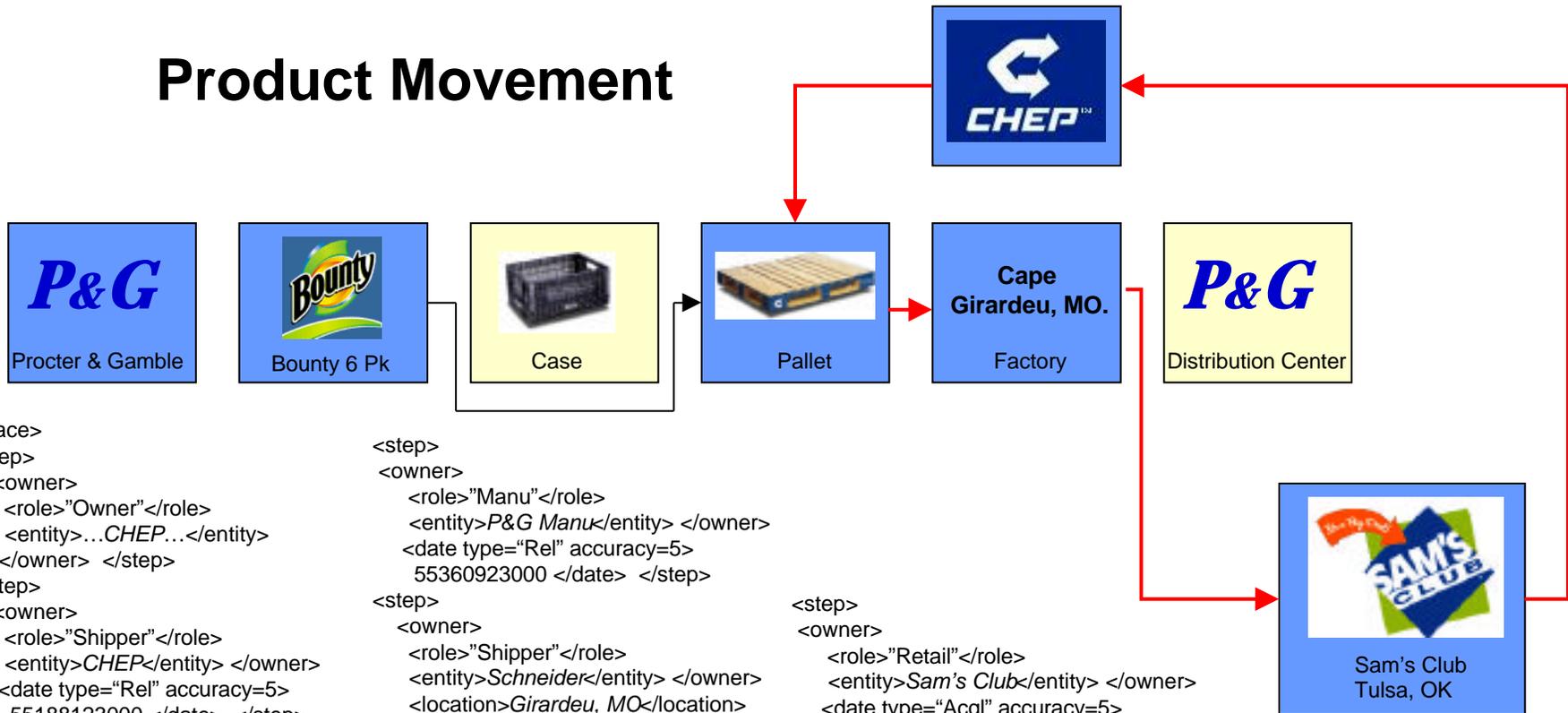


```

<node label="pallet" epc=01.0002F6C.0015BE.0002938D8>
  </node label="Bounty" epc=01.0009088.007A58.00000298A3>
  <node label="Bounty" epc=01.0009088.007A58.00000298A4>
    <date type="Acq" resolution=3>55188015000</date>
    <date type="Rel" resolution=3>55188334000</date>
    <node label="Bounty" epc=01.0009088.007A58.00000298D4>
      <date type="Acq" resolution=3>55188347000</date>
      .....
    </node label="Bounty" epc=01.0009088.007A58.00000298D3>
  </node>
  
```

Oct 1, 2001 Central
6:05AM 47sec.

Product Movement



```

<trace>
<step>
  <owner>
    <role>"Owner"</role>
    <entity>...CHEP...</entity>
  </owner> </step>

```

```

<step>
  <owner>
    <role>"Shipper"</role>
    <entity>CHEP</entity> </owner>
    <date type="Rel" accuracy=5>
      55188123000 </date> </step>

```

```

<step>
  <owner>
    <role>"Manu"</role>
    <entity>P&G Manu</entity> </owner>
    <date type="Acq" accuracy=5>
      55188123000 </date> </step>

```

```

<step>
  <owner>
    <role>"Manu"</role>
    <entity>P&G Manu</entity> </owner>
    <date type="Rel" accuracy=5>
      55360923000 </date> </step>

```

```

<step>
  <owner>
    <role>"Shipper"</role>
    <entity>Schneider</entity> </owner>
    <location>Girardeu, MO</location>
    <date type="Acq" accuracy=5>
      55360928000 </date> </step>

```

```

<step>
  <owner>
    <role>"Shipper"</role>
    <entity>Schneider</entity> </owner>
    <location>Tulsa, OK</location>
    <date type="Rel" accuracy=5>
      55677728000 </date> </step>

```

```

<step>
  <owner>
    <role>"Retail"</role>
    <entity>Sam's Club</entity> </owner>
    <date type="Acq" accuracy=5>
      55677732000 </date> </step>

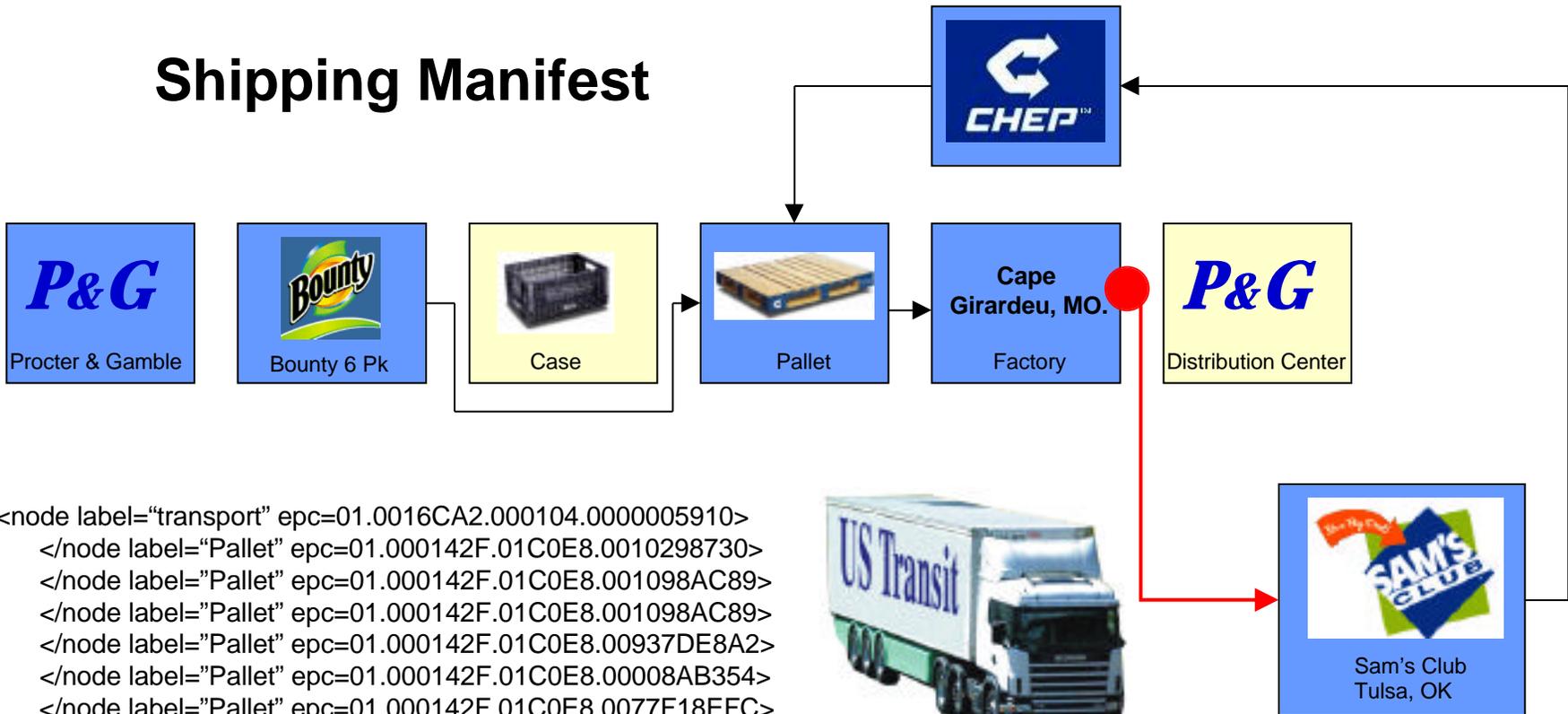
```

```

</trace>

```

Shipping Manifest



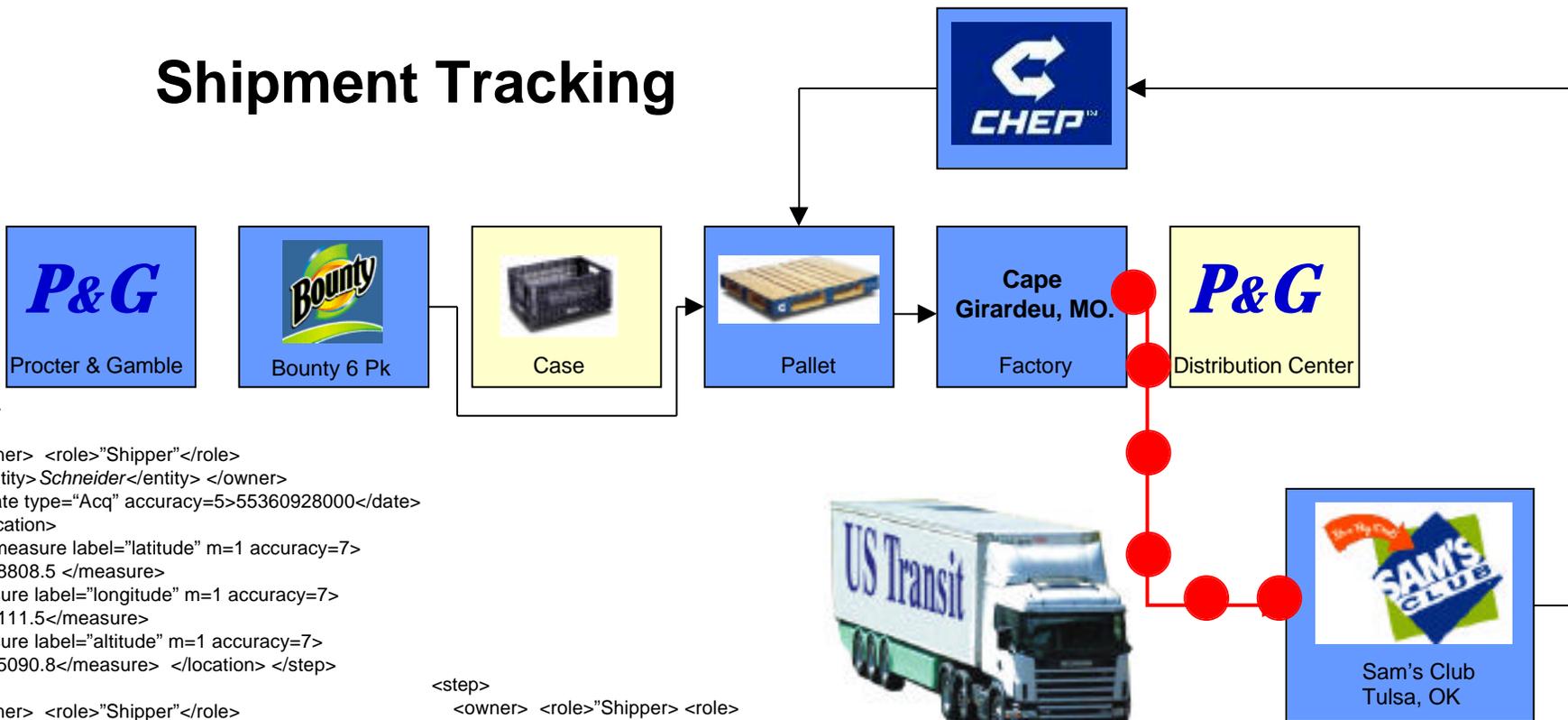
```

<node label="transport" epc=01.0016CA2.000104.0000005910>
  </node label="Pallet" epc=01.000142F.01C0E8.0010298730>
  </node label="Pallet" epc=01.000142F.01C0E8.001098AC89>
  </node label="Pallet" epc=01.000142F.01C0E8.001098AC89>
  </node label="Pallet" epc=01.000142F.01C0E8.00937DE8A2>
  </node label="Pallet" epc=01.000142F.01C0E8.00008AB354>
  </node label="Pallet" epc=01.000142F.01C0E8.0077F18EFC>
  </node label="Pallet" epc=01.000142F.01C0E8.0000083CB5>
  </node label="Pallet" epc=01.000142F.01C0E8.0010590580>
  </node label="Pallet" epc=01.000142F.01C0E8.0023049800>
  </node label="Pallet" epc=01.0009088.089120A.001098AC89>

```

...
</node>

Shipment Tracking



```

<trace>
<step>
  <owner> <role>"Shipper"</role>
  <entity> Schneider</entity> </owner>
  <date type="Acq" accuracy=5>55360928000</date>
  <location>
    <measure label="latitude" m=1 accuracy=7>
    4058808.5 </measure>
  <measure label="longitude" m=1 accuracy=7>
    625111.5</measure>
  <measure label="altitude" m=1 accuracy=7>
    9075090.8</measure> </location> </step>
<step>
  <owner> <role>"Shipper"</role>
  <entity> Schneider</entity> </owner>
  <date type="Acq" accuracy=5>55389728000</date>
  <location>
    <measure label="latitude" m=1 accuracy=5>
    43571855.2</measure>
  <measure label="longitude" m=1 accuracy=5>
    834895.5</measure>
  <measure label="altitude" m=1 accuracy=5>
    9075545.7</measure> </location> </step>
  
```

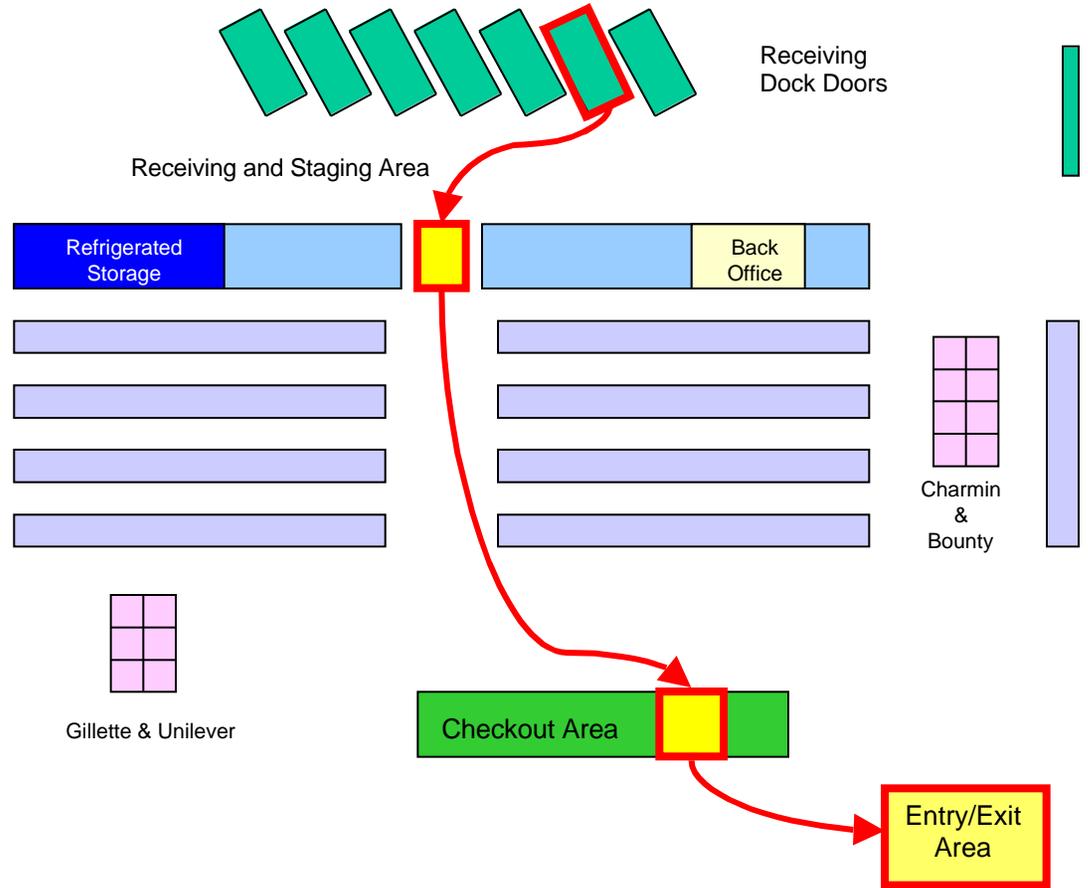
```

<step>
  <owner> <role>"Shipper" <role>
  <entity> Schneider entity</owner>
  <date type="Acq" accuracy=5> 55404139000</date>
  <location>
    <measure label="latitude" m=1 accuracy=5>
    43812879.2</measure>
  <measure label="longitude" m=1 accuracy=5>
    94273129.5</measure>
  <measure label="altitude" m=1 accuracy=5>
    9075895.3</measure> </location> </step>
  
```

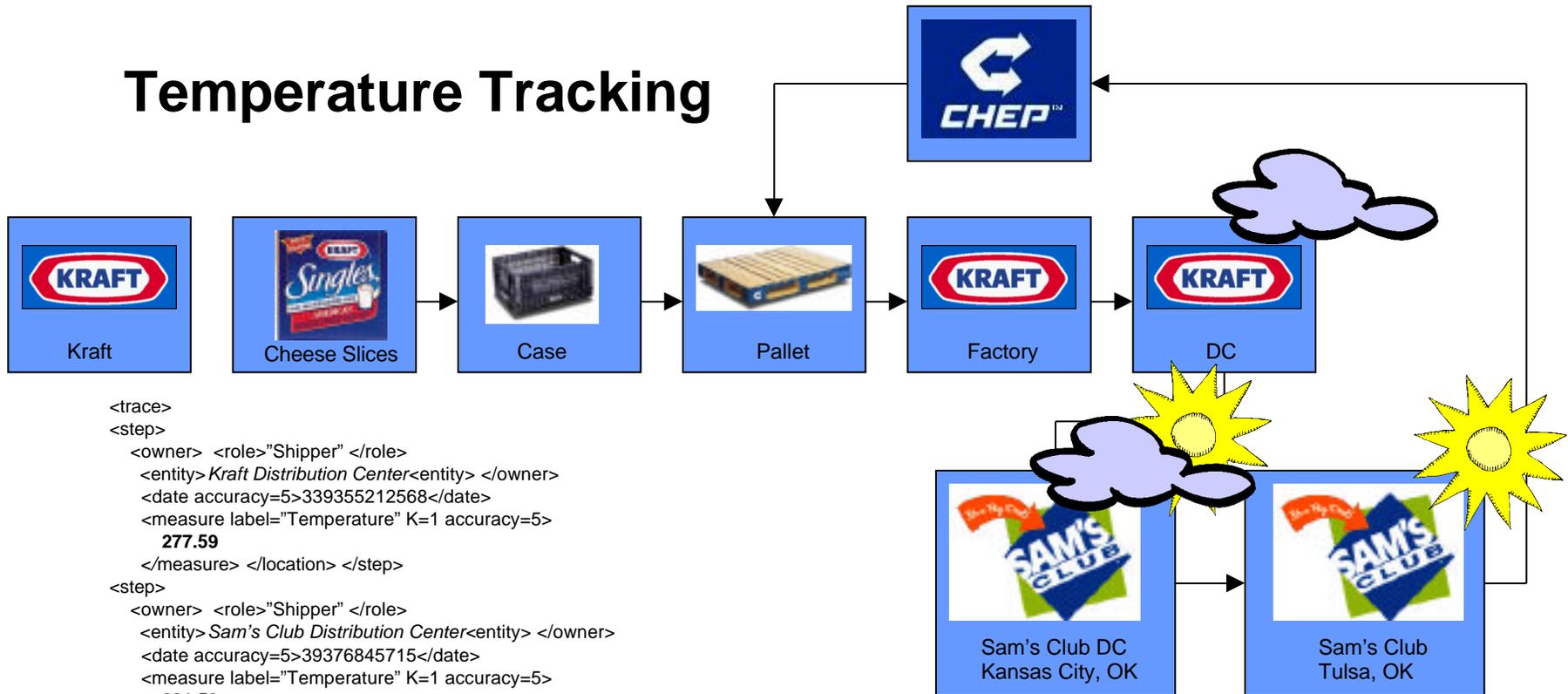
In-Store Movement

```

<trace>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55360928000</date>
  <location epc=01.00105AC.001029.000009239A>
  <measure label="x" m=1 accuracy=3>
    45.5</measure>
  <measure label="longitude" m=1 accuracy=3>
    98.5</measure> </location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
  <measure label="x" m=1 accuracy=3>
    47.2</measure>
  <measure label="longitude" m=1 accuracy=3>
    78.5</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
  <measure label="x" m=1 accuracy=3>
    53.2</measure>
  <measure label="longitude" m=1 accuracy=3>
    25.4</measure> </location> </step></location> </step>
<step>
  <owner> <role> "Retailer" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=8>55362132000</date>
  <location epc=01.00105AC.001029.000009239A>
  <measure label="x" m=1 accuracy=3>
    76.2</measure>
  <measure label="longitude" m=1 accuracy=3>
    15.9</measure> </location> </step></location> </step>
  
```



Temperature Tracking



```

<trace>
<step>
  <owner> <role>"Shipper" </role>
  <entity> Kraft Distribution Center<entity> </owner>
  <date accuracy=5>339355212568</date>
  <measure label="Temperature" K=1 accuracy=5>
    277.59
  </measure> </location> </step>
<step>
  <owner> <role>"Shipper" </role>
  <entity> Sam's Club Distribution Center<entity> </owner>
  <date accuracy=5>39376845715</date>
  <measure label="Temperature" K=1 accuracy=5>
    281.59
  </measure> </location> </step>
<step>
  <owner> <role>"Shipper" </role>
  <entity> Sam's Club<entity> </owner>
  <date accuracy=5>39402120770</date>
  <measure label="Temperature" K=1 accuracy=5>
    283.71
  </measure> </location> </step>
</trace>
  
```

- **Physical properties** – Geometry and material properties
- **Categorization** – Cataloging specification
- **Presentation information** – Text, image and audio representations
- **Attributed values** – Pricing, usage, manuals and safety information
- **Process** – Project plans, timelines and schedules

- **Distributed database coordination** – PML messaging architecture ... *“PMP Physical Markup Protocol”*
- **Business process integration** – Coordination with business process languages