Relatively speaking – temporal alignment for archaeological data

Ceri Binding
Hypermedia Research Unit, University of Glamorgan, Wales

http://hypermedia.research.glam.ac.uk/

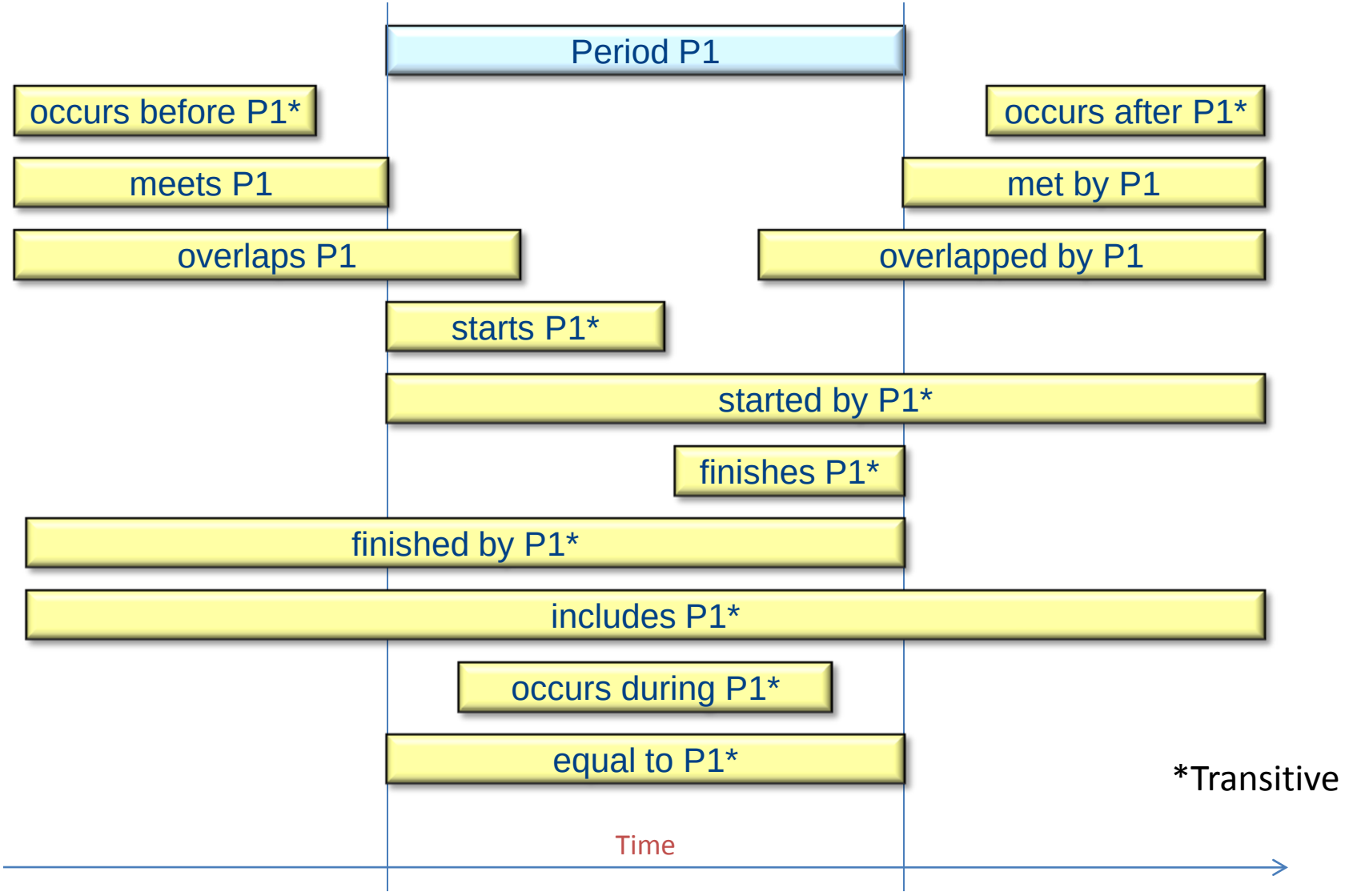
Textual formats representing time periods

Period type	Examples
Centuries	MLC2-C3 LC2/EC3 1st century?
BC / AD years	AD 341-6 c. AD 270
3 age system	Iron Age Bronze Age BA Neolithic?
Monarchs / Emperors	Georgian Antonine Vespasian
Cultural styles	Beaker
Prefixes (pre, post, early, mid, late etc.) and combinations	Early C3 LBA 2nd/early 1st BC

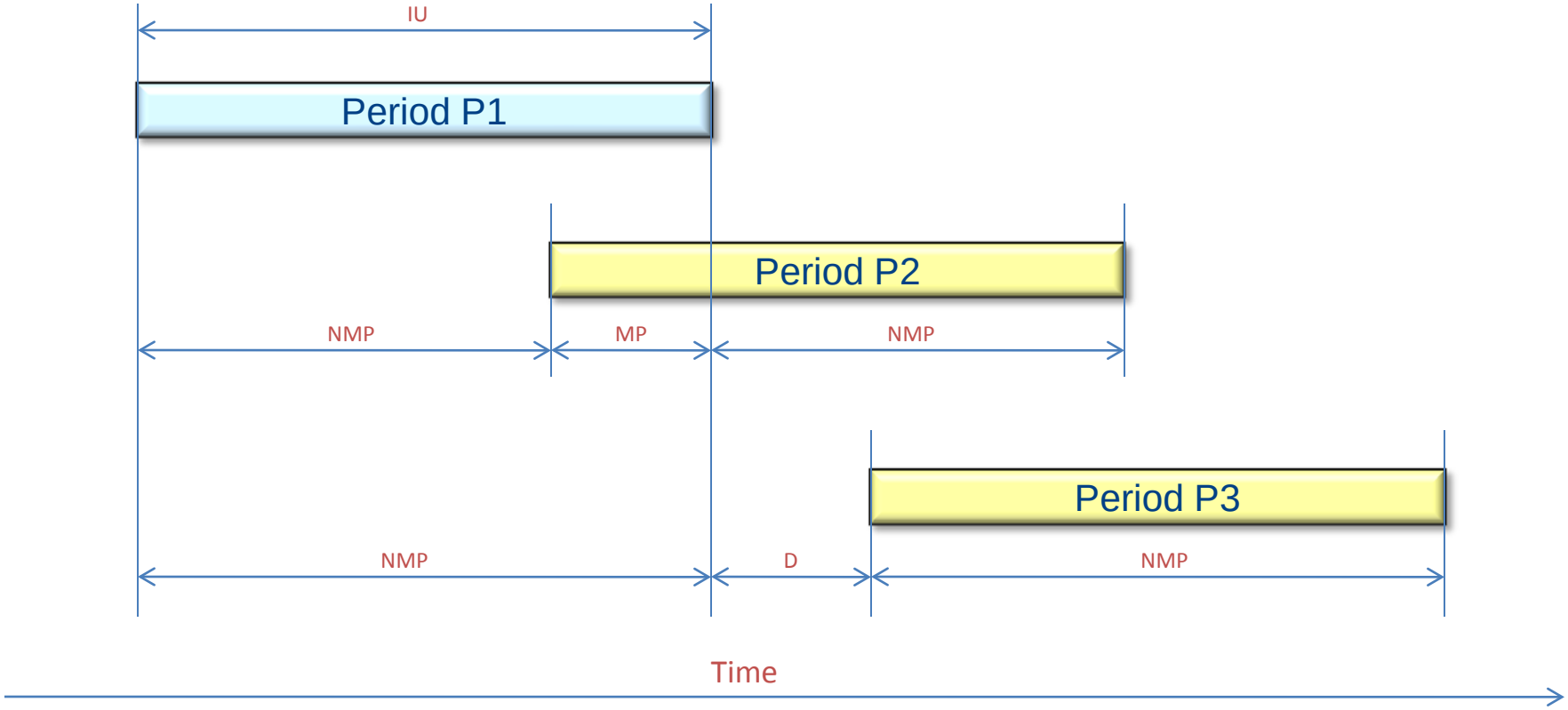
Data cleansing – assigning date ranges

Object ID	Dating	MIN_START_YEAR	MAX_END_YEAR
1519	AD 354-64	354	364
1520	1st century AD	1	100
1538	2nd century	101	200
1548	1st century	1	100
1562	AD 367-75	367	375
1563	AD 348-50	348	350
1567	Mid 1st century AD	33	66
1571	First half 1st centu	1	50
1572	Mid first century AD	33	66
1580	c. AD 270	270	270
1583	First half first cen	1	50
1584	First half first cen	1	50
1591	AD 341-6	341	346
1593	AD 287-93	287	293
1594	AD 43-44	43	44
1595	Medieval	1066	1540
1627	2nd century AD	101	200
1631	?1st century	1	100
1635	AD 354-64	354	364
1664	AD 330-5	330	335
1681	Medieval	1066	1540
1701	Romano-British	43	410
1704	Modern?	1901	2100
2136	2nd/early 1st C BC	1	200
98157	post-mediaeval	1540	1901

Period alignment - relationships



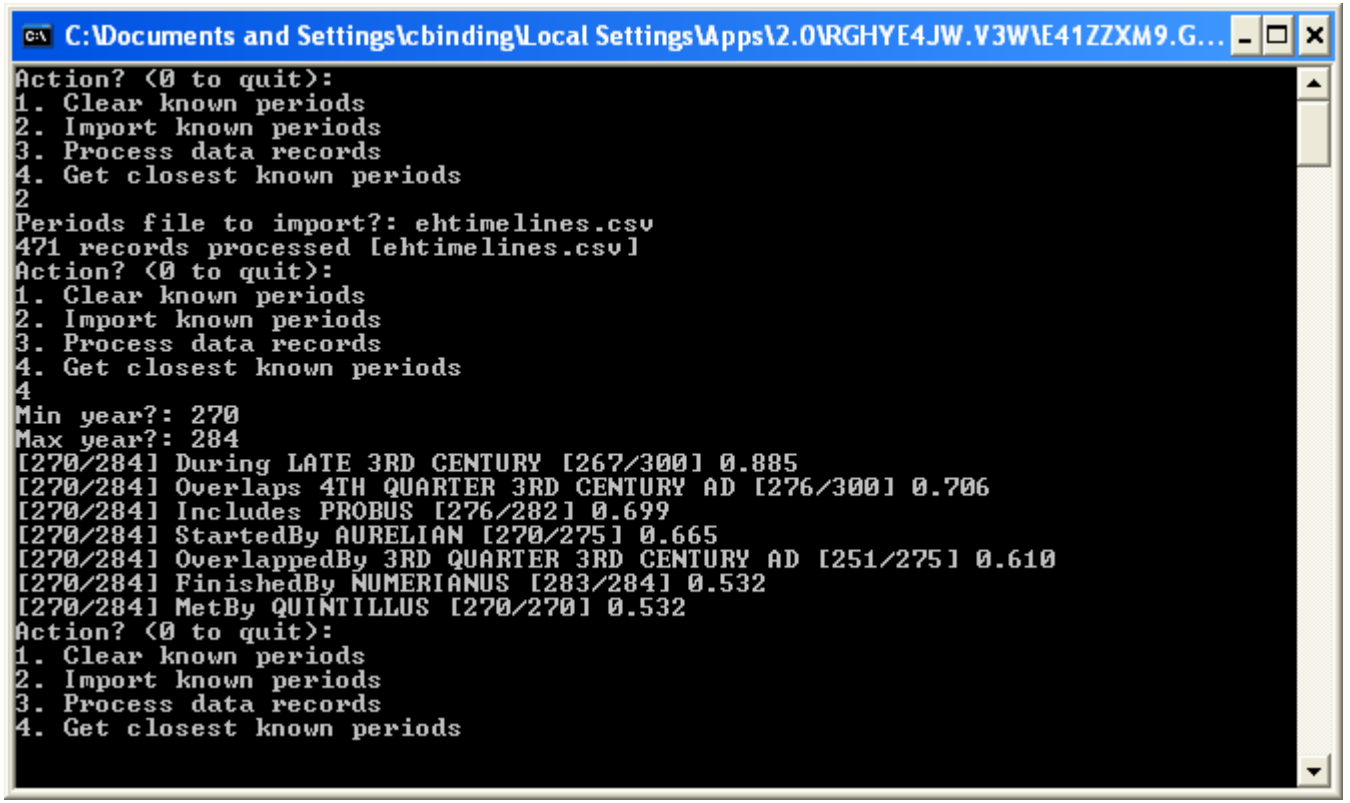
Period comparison – closeness calculation



Match(P1, P2) = W1 (MP / IU) + W2 (IU / (NMP + IU)) + W3 (IU / (D + IU))

Period alignment – data processing

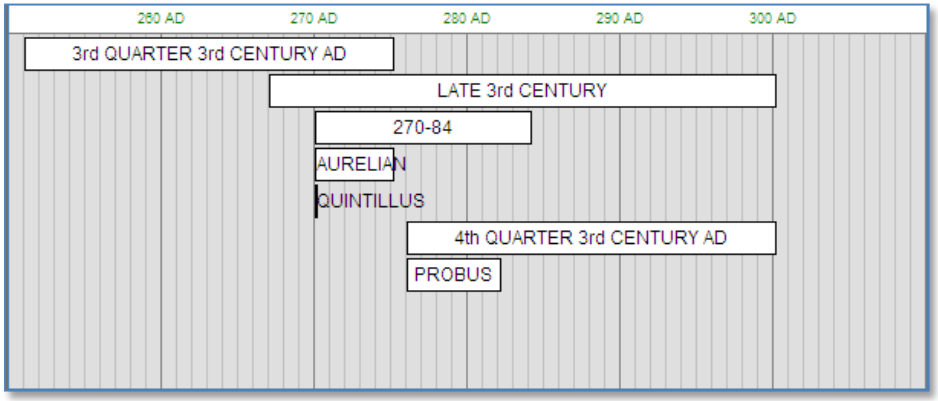
- Align data *relative to* closest period concepts from English Heritage 'Timelines' thesaurus



Period alignment - results

Records aligned relative to closest "known" periods

Data record (dates deduced from labels)				Calculated closest matching known periods			
Data Label	From	To	Relationship	Concept Label	From	To	Closeness
1555-1623?	1555	1623	overlaps	JAMES I AND VI	1567	1625	0.895
			occurs during	POST MEDIEVAL	1540	1901	0.838
			includes	ELIZABETHAN	1558	1603	0.814
			overlapped by	2nd HALF 16th CENTURY AD	1551	1600	0.808
AD270-284	270	284	occurs during	LATE 3rd CENTURY	267	300	0.885
			overlaps	4th QUARTER 3rd CENTURY AD	276	300	0.706
			includes	PROBUS	276	282	0.699
			started by	AURELIAN	270	275	0.665
			overlapped by	3rd QUARTER 3rd CENTURY AD	251	275	0.610
			met by	QUINTILLUS	270	270	0.532



Rediscovering links to known periods

Data record – dates deduced from labels					Closest 'known' period match - based on dates			
ID	Label	From	To	Relationship	ID	Label	From	To
1315	AD 228-31	228	231	occurs during	136122	ALEXANDER SEVERUS	222	235
1316	AD 364-78	364	378	overlapped by	900014	3RD QUARTER 4TH CENTURY AD	351	375
1317	**AD 69-79**	**69**	**79**	**equal to**	**136087**	**VESPASIAN**	**69**	**79**
1318	**AD 270-4**	**270**	**274**	**equal to**	**136164**	**TETRICUS I**	**270**	**274**
1319	AD 275-402	275	402	includes	134825	4TH CENTURY AD	300	399
1320	AD 341-6	341	346	occurs during	900013	2ND QUARTER 4TH CENTURY AD	326	350
1321	**AD 268-70**	**268**	**270**	**equal to**	**136154**	**CLAUDIUS II GOTHICUS**	**268**	**270**
1322	AD 367-75	367	375	finishes	900014	3RD QUARTER 4TH CENTURY AD	351	375
1324	AD 270-84	270	284	occurs during	135952	LATE 3RD CENTURY	266	299
1327	AD 383-8	383	388	occurs during	900015	4TH QUARTER 4TH CENTURY AD	376	399
1328	AD 330-40	330	340	occurs during	900013	2ND QUARTER 4TH CENTURY AD	326	350
1337	Post-medieval	1540	1901	equal to	134746	POST MEDIEVAL	1540	1901
1370	Medieval	1066	1540	equal to	134745	MEDIEVAL	1066	1540
1371	AD 1943	1943	1943	occurs during	134848	SECOND WORLD WAR	1939	1945

Periods have an implicit spatial context…

In Red Dwarf Series 6 '*Out of Time*', the crew obtain a time drive, and travel to the medieval period…

Lister: "We're still where we were!"

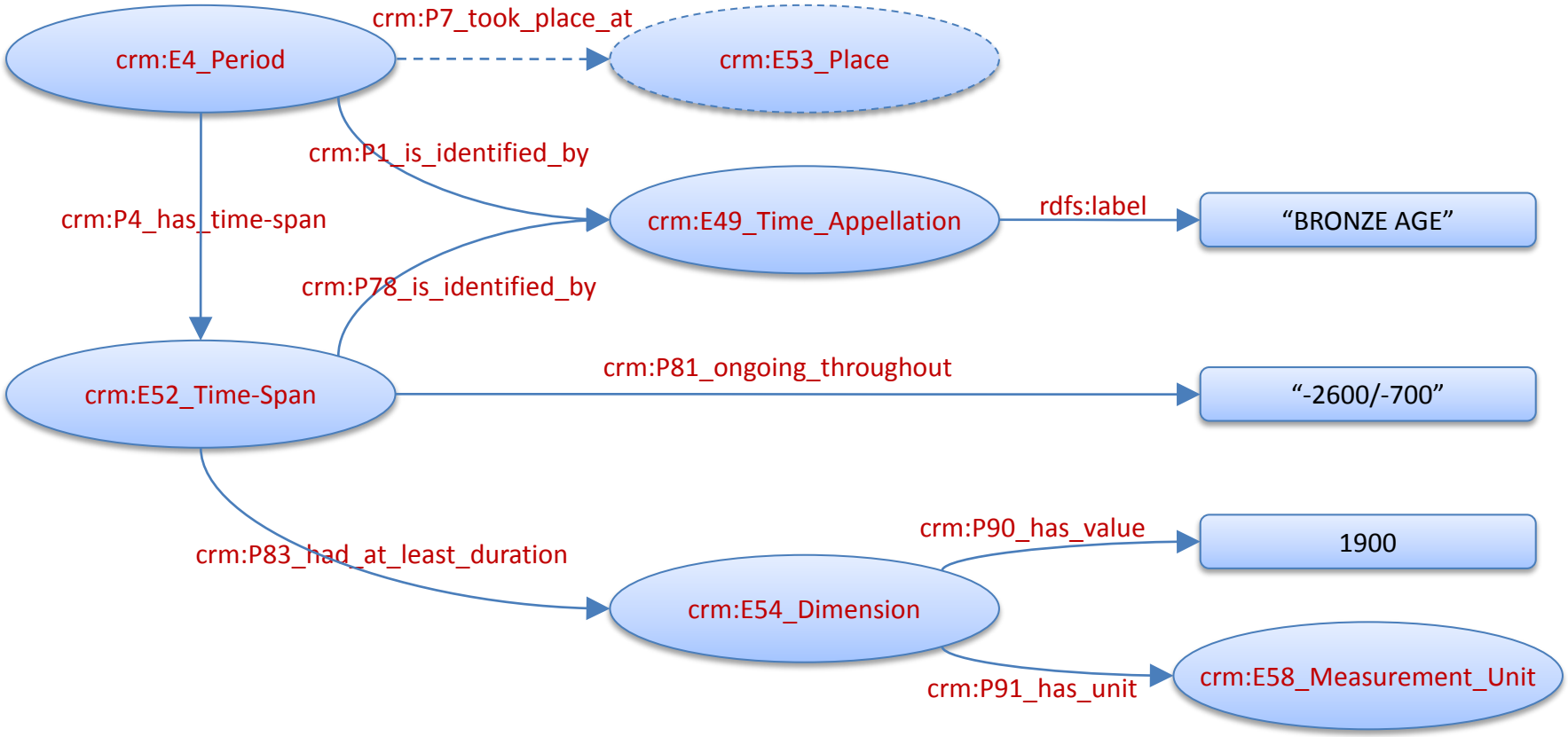
Kryten: "Of course. We're still in deep space sir, only now we're in deep space in the 15th century. Isn't it wonderful?"

Rimmer: "So we're still three million years away from Earth?"

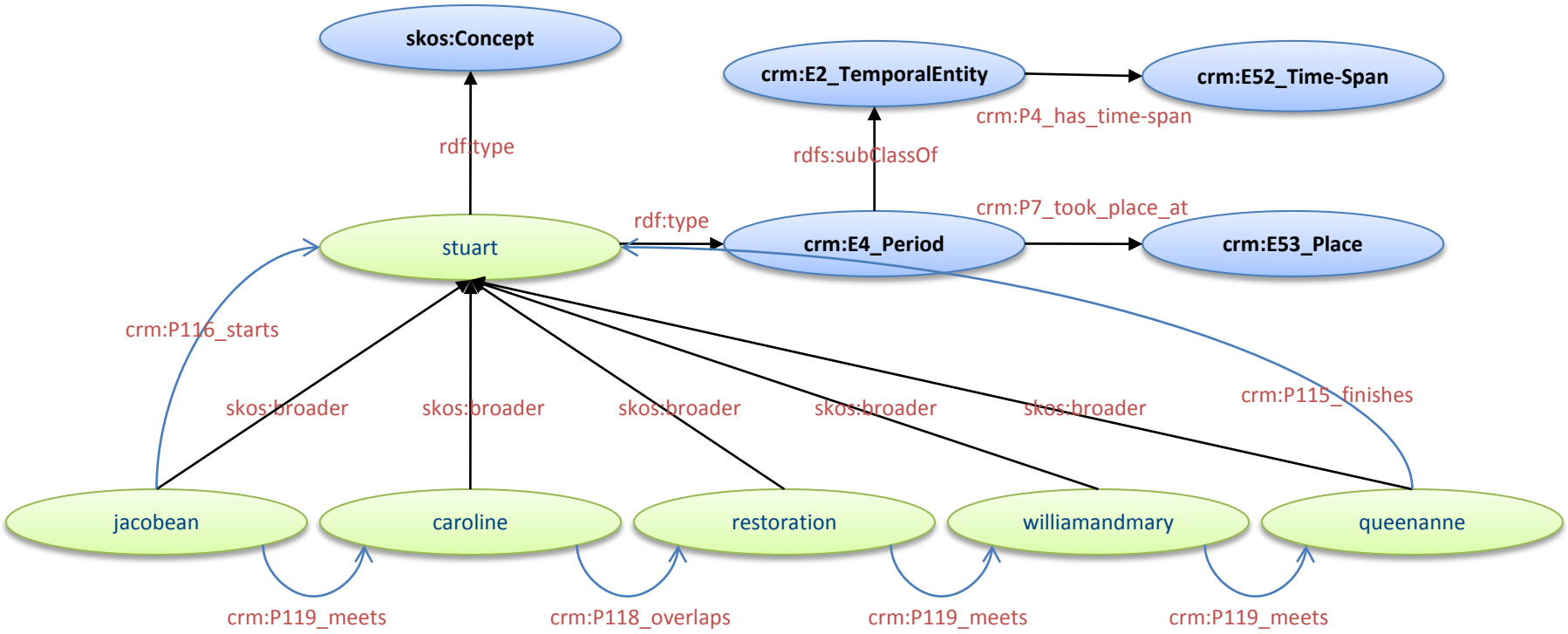
Kryten: "Well, yes."

Modelling time periods with CIDOC CRM

period_id	period_label	min_start_year	max_end_year
134723	BRONZE AGE	-2600	-700

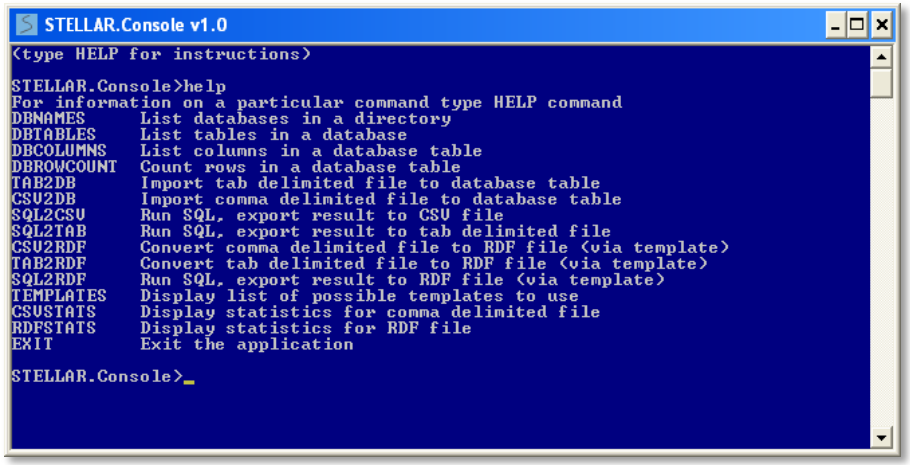


SKOS concepts + CIDOC CRM entities



STELLAR

http://hypermedia.research.glam.ac.uk/kos/stellar/



- Convert delimited data to RDF conforming to specific ontological model, via “templates”

```
59, EARLY NEOLITHIC,-4000,-3300
60, MIDDLE NEOLITHIC,-3300,-2900
61, LATE NEOLITHIC,-2900,-2200
8, BRONZE AGE,-2600,-700
62, EARLY BRONZE AGE,-2600,-1600
63, MIDDLE BRONZE AGE,-1600,-1200
64, LATE BRONZE AGE,-1200,-700
9, IRON AGE,-800,43
```

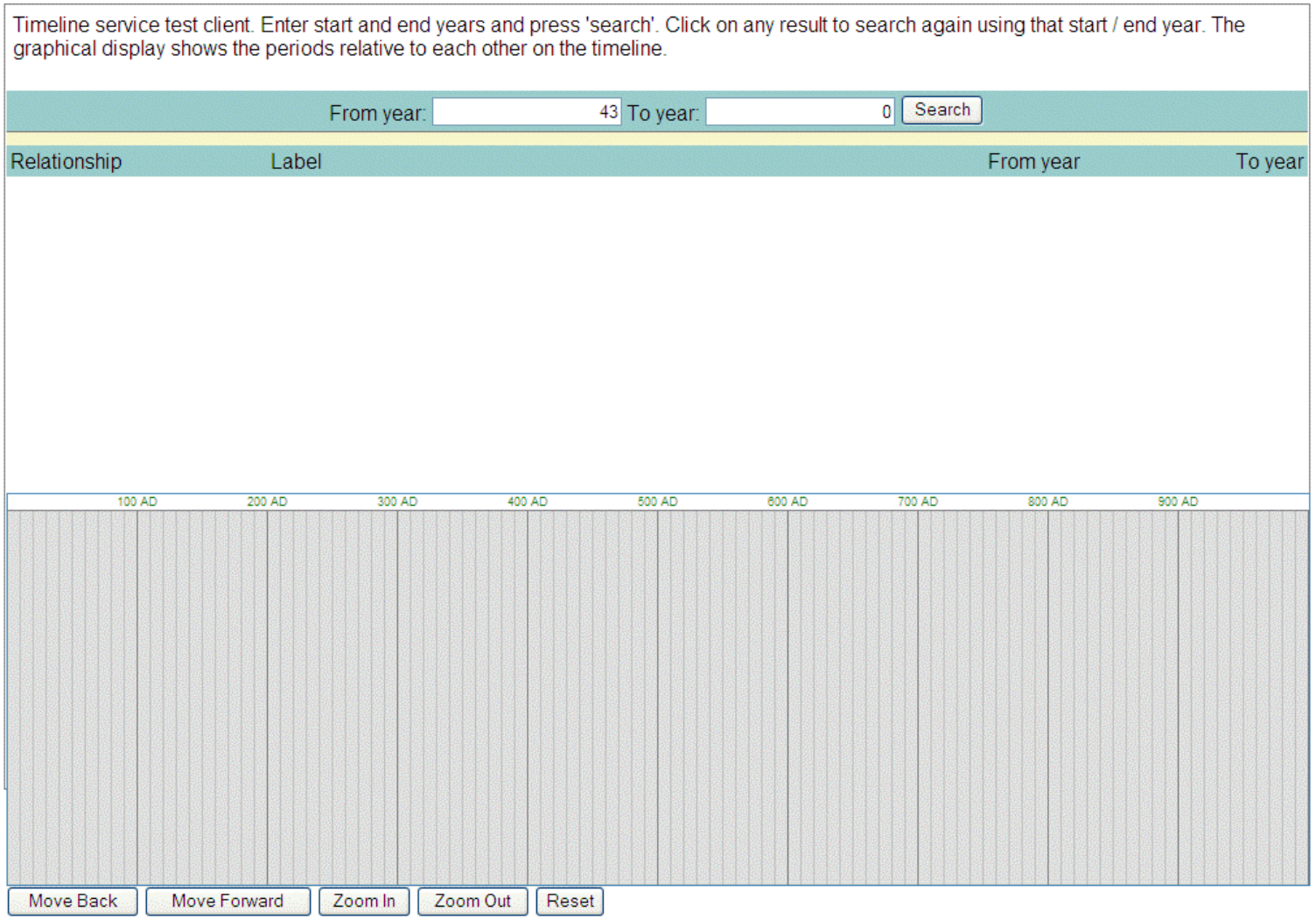
Delimited (CSV) data

STELLAR Template

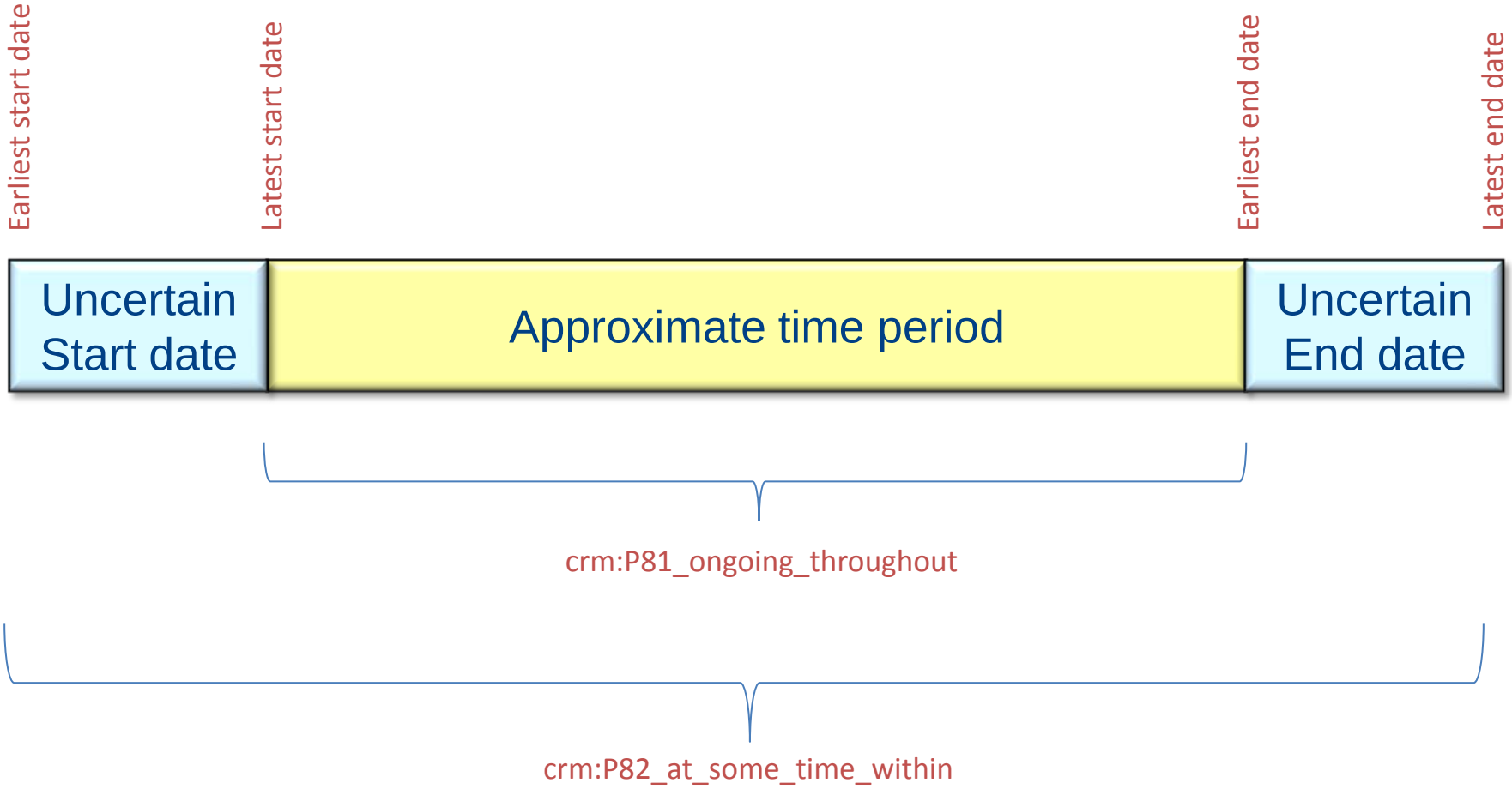
```
<crm:P115F.finishes rdf:resource="http://tempuri/star/concept#134718"/>
<crm:P116B.is_started_by rdf:resource="http://tempuri/star/concept#134735"/>
<crm:P117B.includes rdf:resource="http://tempuri/star/concept#134736"/>
<crm:P115B.is_finished_by rdf:resource="http://tempuri/star/concept#134737"/>
<crm:P118B.is_overlapped_in_time_by rdf:resource="http://tempuri/star/concept#134734"/>
<crm:P118F.overlaps_in_time_with rdf:resource="http://tempuri/star/concept#134822"/>
<crm:P120F.occurs_before rdf:resource="http://tempuri/star/concept#136079"/>
<crm:P119F.meets_in_time_with rdf:resource="http://tempuri/star/concept#134738"/>
<crm:P120B.occurs_after rdf:resource="http://tempuri/star/concept#134733"/>
</crm:E4.Period>
<crm:E4.Period rdf:about="http://tempuri/star/concept#134723">
<rdfs:label>BRONZE AGE</rdfs:label>
<crm:P4F.has_time-span>
<crm:E52.Time-Span>
<rdfs:label>-2500/-700</rdfs:label>
<crm:P81F.ongoing_throughout>
```

RDF data

Timeline service + test client

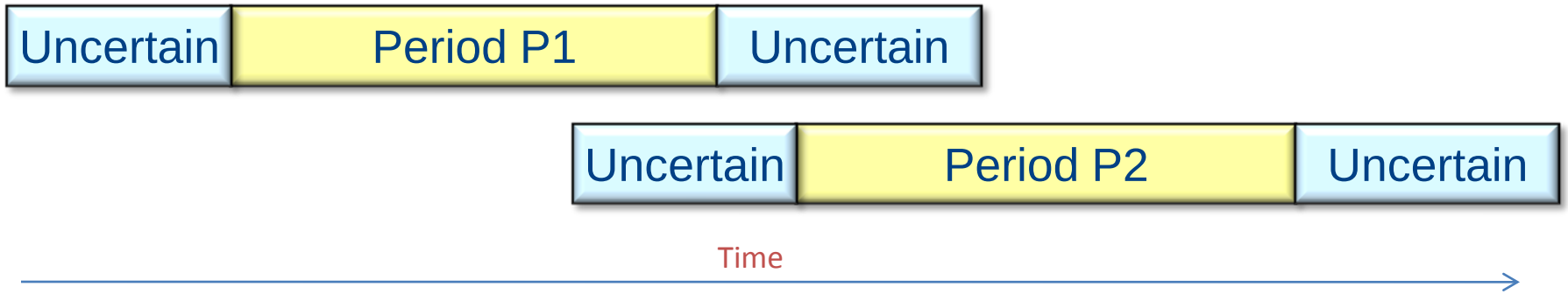


Accommodating uncertainty



Revisit closeness calculation

- Revisit calculation of relationships and closeness to allow for uncertainty



- Period P1 before Period P2?
- Period P1 meets Period P2?
- Period P1 overlaps Period P2?
- Any or all of the above?

All are possible, so calculated closeness then becomes a *range* rather than a fixed value

Conclusions / future work

- Thesauri do not fully describe spatio-temporal nature of period concepts – supplementing with CRM entities and properties facilitates more accurate semantic modelling
- Possibly build approximation into time periods? (revisit closeness calculation)
- Put aligned time period concepts online as linked data?

Relatively speaking – temporal alignment for archaeological data

Ceri Binding
Hypermedia Research Unit, University of Glamorgan, Wales

http://hypermedia.research.glam.ac.uk/

http://hypermedia.research.glam.ac.uk/kos/STELLAR/

http://hypermedia.research.glam.ac.uk/kos/STAR/