

## Approaches to the Evaluation of Intelligence

### Massive Military Data Fusion and Visualisation: Users Talk with Developers

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Traditionally, intelligence gathering has involved three areas of technology: sensor and signal processing, database technology and evaluation technology. The current pace of globalisation, the rapid penetration of Internet usage and continuing advances in sensor sophistication mean that vast amounts of information are being gathered, as never before. Traditional intelligence processing methods are feeling the strain.

MEDAV GmbH is a developer of intelligence processing hardware and software. For the past 20 years, we have been engaged in studies and commercial projects for the German Federal Armed Forces and for other German and international government agencies. Our business is to predict and respond rapidly to the needs of the intelligence community. The current trends are clear:

- 1) An increasing variety of sensors are being distributed over larger and larger areas. The problem is not just the amount of information being collected but the diversity of it. The challenge is to find meaningful ways to integrate diverse information. Humans are not as good at data analysis as computers but they are excellent at pattern recognition. The two should be allowed to complement one another. A visualisation tool should present data in a way that allows humans to recognise the patterns within it – as opposed to presenting only pre-defined patterns. Visualisation software that does not allow users to apply their own pattern recognition intelligence is self-defeating.
- 2) The Internet explosion means that open source intelligence (OSINT) is becoming as important as the traditional HUMINT and SIGINT. Thus we require language processing and document processing software to complement the signal processing software already available. In particular, tools for the visualisation and summarisation of text are required. Another consequence of internationalisation is the necessity to incorporate Unicode capability into software. However the multitude of *ad hoc* solutions to script encoding already in existence will continue to persist in the future despite the adoption of Unicode.
- 3) To cope with information overload, it will be necessary to integrate more closely the three domains of information acquisition, storage and processing. In particular, automated evaluation will be required closer to the point of acquisition in order to filter at an early stage the mass inflow of irrelevant information. Likewise, storage must be more closely coupled to evaluation technologies in order to give users easy and intuitive opportunities to interact with their data.
- 4) In the intelligence environment, information is usually incomplete. For example, the resources necessary to resolve ambiguous or missing words may not be available. And context, which allows information to be interpreted, may also be incomplete. Such *cold start* situations are typical in military intelligence. The conclusion is that information processing algorithms, which are able to process incomplete and fuzzy information, will become the norm.

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## Approaches to the Evaluation of Intelligence

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The rapidly changing needs of the intelligence community place severe constraints on the development of software solutions:

- 1) Hardware and software must be modular, so that parts can be regularly updated without disrupting the whole. Modules must communicate through standard interfaces. Modularity allows a *building blocks* approach to the construction of complex functionality. Because effective visualisation tools tend to have long development times and therefore high costs, modularisation will be essential.
- 2) It is better to have generic modules that can be configured by the user for varying situations as they arise, rather than specific solutions for specific situations. The user, rather than the factory, should be able to reconfigure a visualisation tool, for example, so that it operates interactively in one situation but automatically in another. Open architectures and the ability to modify software are preferable to proprietary black-box solutions. However, visualisation tools tend to be task specific. The challenge will be to find ways of developing generic visualisation tools.
- 3) Solutions to intelligence problems involve compromises. In the real world, it is necessary to make do with what one has. Complex algorithms developed in the ideal world of the research laboratory may not be practical in a world of limited resources. It is easy to be blinded by hi-tech solutions when simpler solutions may be more practical.
- 4) Many of the problems confronted by the intelligence community are also faced by large commercial operations, for example media and finance organisations. It is better to use COTS tools where these are available, rather than “re-invent the wheel”. COTS products make sense if they reduce costs and inventory without compromising quality and security.

Over the past 20 years, MEDAV has developed integrated intelligence processing packages, that acquire, automatically evaluate, archive and interactively evaluate both signals and text documents. The archive is the hub of the architecture. Automatic evaluation serves two purposes - it filters out the mass of irrelevant information but it also serves to enrich the incoming signals or documents with annotations that assist subsequent evaluation.

Different processing and visualisation modules can be incorporated into this general architecture according to need. In studies with the German Federal Armed Forces, we have developed a variety of speech processing, text processing and visualisation tools. While it is true that “a picture tells a thousand words”, we find that users need to have different views over the same data. For example a graphical display of a military command structure can be usefully complemented by a simple tabular display of other information. However, neither display by itself is adequate. As another example, a graphical content summary of a text document may be useful if the document is large but for small documents (or parts of documents), the user may prefer textual summaries.

It is helpful to distinguish three types of display; 1) traditional static predefined displays, 2) augmented reality displays (where interactive iconic and textual information are embedded in realistic terrain images, for example) and 3) virtual reality displays (where the user becomes part of the image). We still have much to learn about how to use all three effectively. The development of effective visualisation tools depends on a keen understanding of the psychology of vision. The conclusion is that the results of fundamental research into human visual processing must be fed into software development projects.

## SYMPOSIA DISCUSSION – PAPER NO: 14

**Author Name:** Dr. Ing. Hans-Joachim Kolb, MEDAV, Germany

**Question:**

What statistical pattern recognition is being used in regards to email?

**Author's Response:**

No features concerning content of the messages are being used, just behavior, such as time elapsed from getting an email to answering it, or the size of the message.

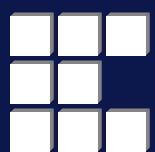
**Question:**

Is there any special storage or computing being used for the high volume?

**Author's Response:**

No. If you calculate how much space you need, you find you can get a great deal of data on one disk. If you are successful in finding an area of interest in an image it makes sense just to keep the area of interest.





MEOPRA

WIR VERSTEHEN  
DIE ZEICHEN DER ZEIT

KEEPING PACE  
WITH THE SIGNAL OF TIME

# Approaches to the Evaluation of Intelligence Data

Workshop IST-036/RWS-005  
Massive Military Data Fusion and  
Visualisation: Users Talk with Developers



## Definitions

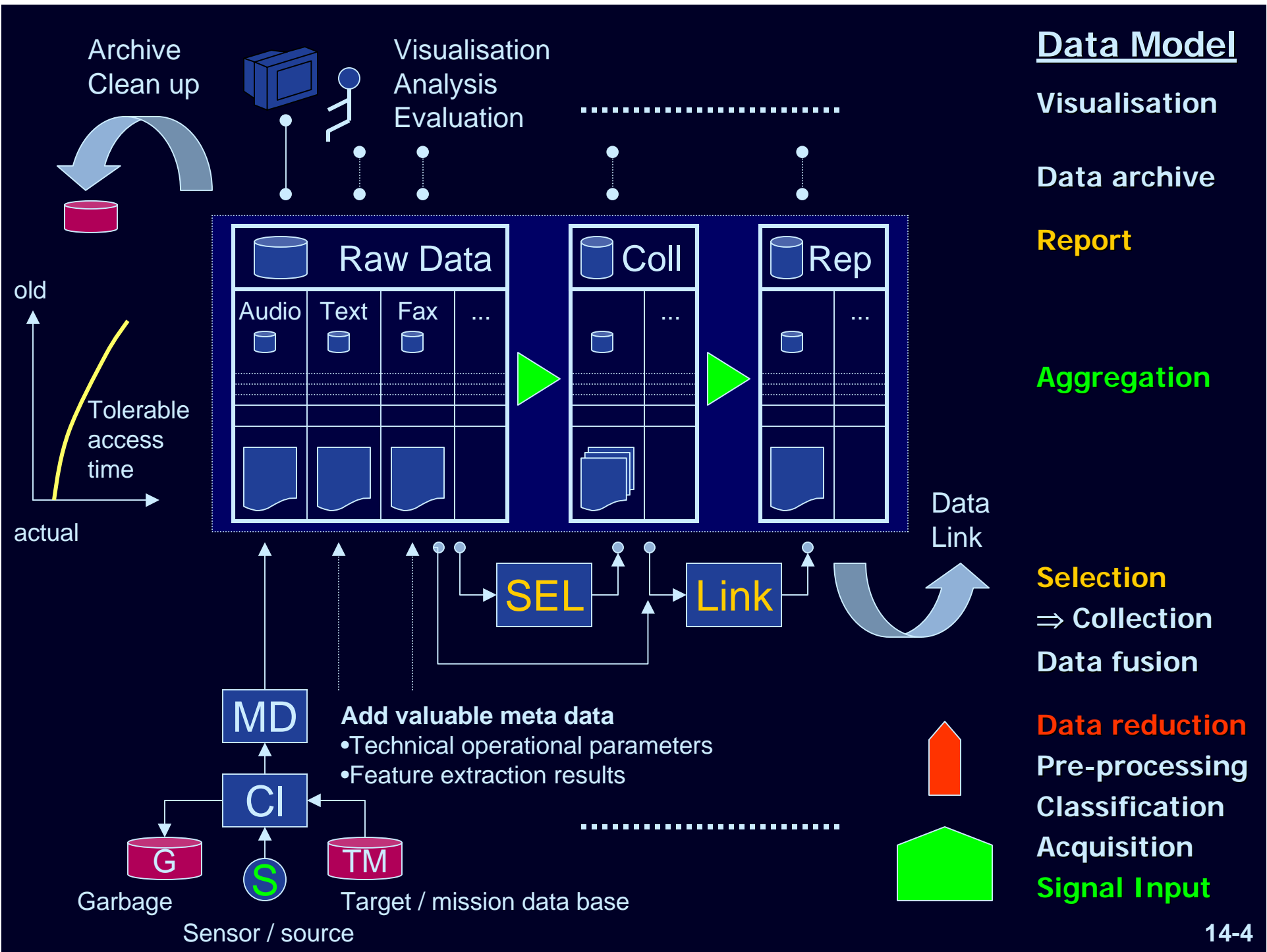
- **Visualisation** should generate an environment supporting the perception process of presented information.
- **Visualisation** should help average users to produce better results and help the "artist" to become more creative.
- **SIGINT** makes contributions to describe the situation for military and political decision-makers on the basis of information intercepted from communication and signal distribution processes.



# Overview

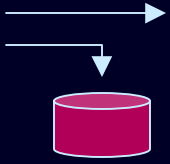

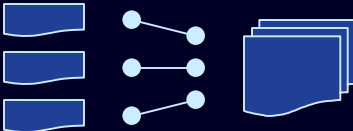

- Data model
- Information processing tasks
- Visualisation examples
- Further aspects







# Information Processing Tasks

Task	Operation	Result	Example
Acquisition	Sensor Signal Processing in Realtime	Raw Signal File	<ul style="list-style-type: none"><li>■ Audio</li><li>■ Text</li><li>■ Fax</li></ul>
Classification	Determining targets of interest in respect of target/mission data base	 Signal of Interest Garbage	
Pre-processing	Adding technical operational parameters and additional features	 Additional Feature File	<ul style="list-style-type: none"><li>■ Time, duration</li><li>■ Frequency ...</li><li>■ Language, speaker, topic, ...</li></ul>
Selection ***	Interactive selection of a relevant signal collection		Signals within a window defined in parameter space
Reporting ***	Fillout a form or edit a result file !		

\*\*\* Visualisation needed !

Aggregation:  
Drill Down:

Data Fusion – Reporting  
~ confidence, security, permission





## Visualisation Examples: Raw Signal - Text

### VIDA – Visual Document Analysis

Dr. Michael Towsey, MEDAV

- Keyword Analysis
- Feature vector generation for automatic classification processes
- Grafical summary
- Textual summary
- Example: the Arthur Enderson / enron story

# The full display

Menu Bar      Graph panel      Information panel

File Options Help

XML File: C:\WINNT\Profiles\tow\bjproject\TMViewer\Output\wid

Topic Information

List of 25 topics

- accounting
- acknowledged
- anderson
- arthur\_andersen
- audit
- campaign\_contributions
- chairman
- company
- criminal

List of 70 topic associations

- accounting==anderson
- accounting==arthur\_andersen
- accounting==enron
- accounting==acknowledged
- accounting>>company
- acknowledged==lay
- acknowledged>>company
- acknowledged>>enron
- anderson==enron

Metadata

- date = WED, 14 AUG 2002.
- timeStamp = 02-08-14-12-24-08
- sourceFiles = enron\_time.txt
- file.gedays = 98
- language = ENGLISH
- encoding = ISO-8859-1
- firstLine = Enron: Who's Account
- totalWordCount = 2781
- lineCount = 69
- paragraphs = 33
- sentences = 130
- analysisMode = BOOTSTRAP
- assocWindowLeft = 10
- assocWindowRight = 10
- userName = tow
- userRegion = US

Hide Arcs      Slider      Redraw Arcs

Metadata    Keywords    N-grams    Original    Summary    Sequ

List of topics in document

Selected topic

List of word associations

Information text box

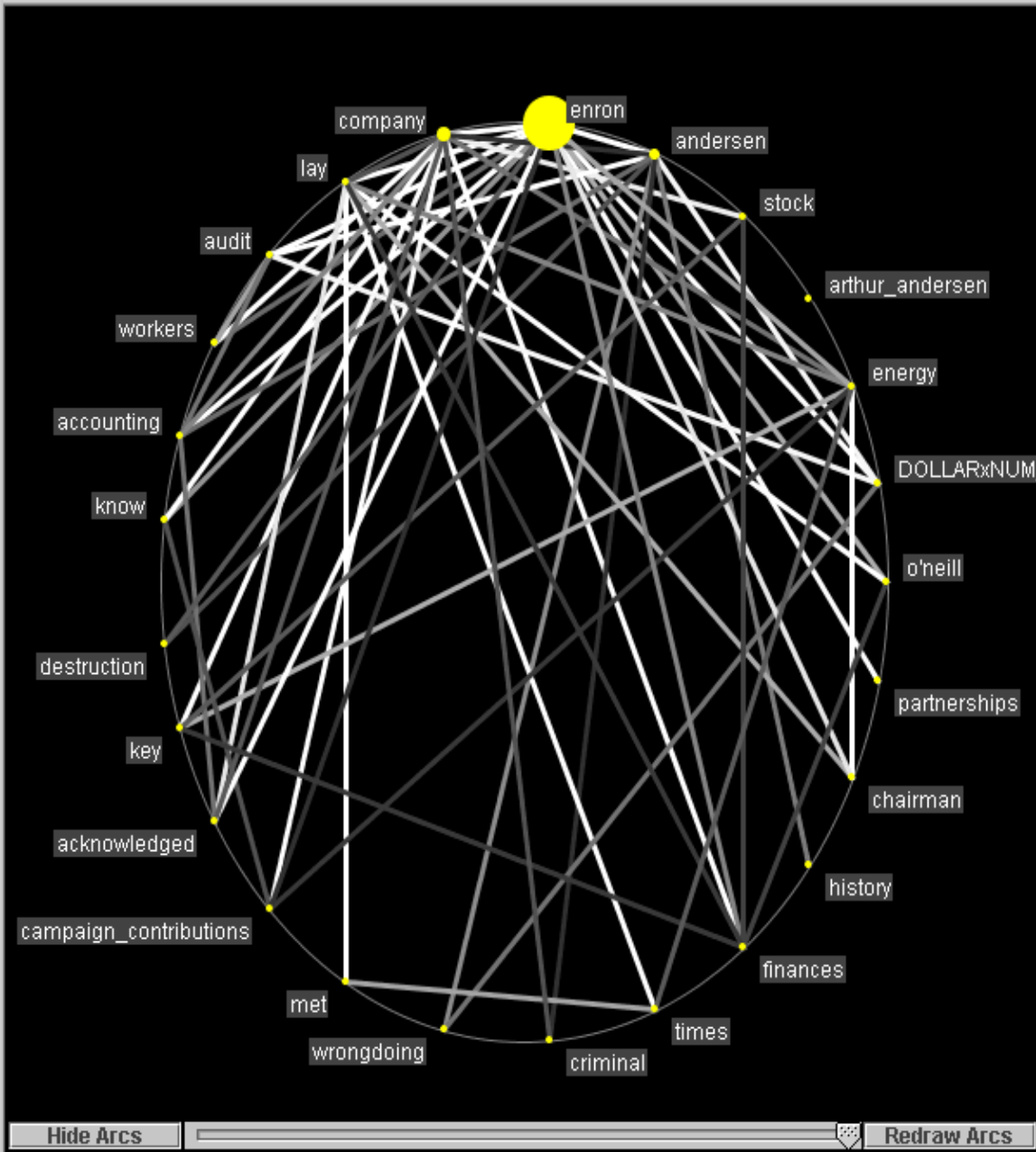
Analysis Tool Bar

Hide Arcs Button

Slider

Redraw arcs button

Movable panel divide



Topic Map Information

XML File: C:\WINNT\Profiles\tow\jbproject\TMViewer\Output\wid

List of 25 topics

- accounting
- acknowledged
- andersen
- arthur\_andersen**
- audit
- campaign\_contributio
- chairman
- company
- criminal

List of 70 topic associations

- accounting==andersen
- accounting==arthur\_anderse
- accounting==enron
- accounting>>acknowledged
- accounting>>company
- acknowledged==lay
- acknowledged>>company
- acknowledged>>enron
- andersen==enron

Metadata

```

date           = WED, 14 AUG 2002.
timeStamp      = 02-08-14-12-24-08
sourceFiles    = enron_time.txt
fileAgeDays    = 98
language       = ENGLISH
encoding       = ISO-8859-1
firstLine      = Enron: Who's Account
totalWordCount = 2781
lineCount      = 69
paragraphs     = 33
sentences      = 130
analysisMode   = BOOTSTRAP
assocWindowLeft = 10
assocWindowRight = 10
userName       = tow
userRegion     = US
    
```

- Metadata
- Keywords
- N-grams
- Original
- Summary
- Sequ

Hide Arcs

Redraw Arcs



# Automatic Keyword Extraction

## Keywords

1. enron
2. company
3. andersen
4. bush
5. executives
6. stock
7. lay
8. DOLLARxNUM
9. arthur
10. last
11. financial
12. workers
13. energy
14. first

Metadata

**Keywords**

N-grams

Original

Summary

Sequential



# n-gram analysis

## N-grams

TRIGRAMS (filtered)	FREQUENCY
oct 12 memo	3
attorney general john	2
BIGRAMS (filtered)	
arthur andersen	9
enron executives	7
DOLLARxNUM million	6
enron stock	4
last week	4
12 memo	3
bush administration	3
justice department	3
oct 12	3

[Metadata](#) [Keywords](#) [N-grams](#) [Original](#) [Summary](#) [Sequential](#)

# Association Analysis – “Arthur Andersen”

```
TOPIC= "arthur_andersen"
```

```
example      = woes workers who audited the company's book
```

```
example      = Supervisors at *Arthur* Andersen repeatedly
```

```
example      = Sources close to *Arthur* Andersen confirm
```

```
frequency    = 9
```

```
queryMatches = arthur_andersen(9)
```

```
stopWords    = the(15) of(10) in(4) and(4) to(3) from(3) i
```

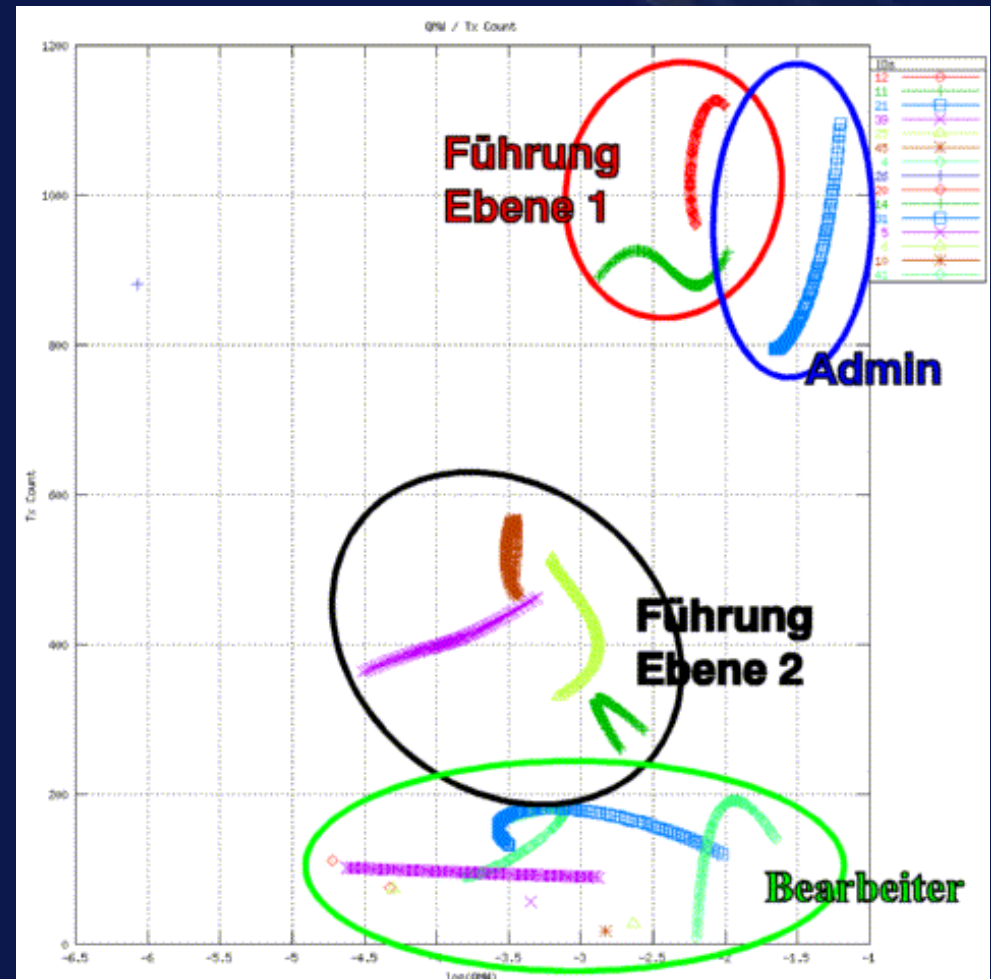
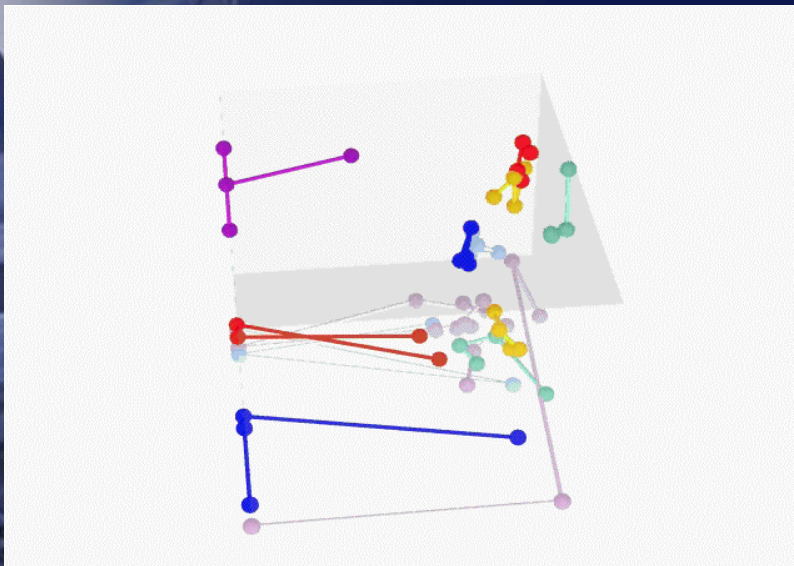
```
Ranked list of 30 non-stop words associated with topic word:-
```

	Word	assocFreq	offset	SD	weight	relWeight
1.	enron	4	+2.0	5.2	2.07	1.00
2.	destruction	3	-3.3	9.8	1.02	0.49
3.	criminal	1	+1.0	0.0	1.00	0.48
4.	confirm	1	+1.0	0.0	1.00	0.48
5.	bankrupt	1	-1.0	0.0	1.00	0.48



# Visualisation Examples: Collection – E-mail

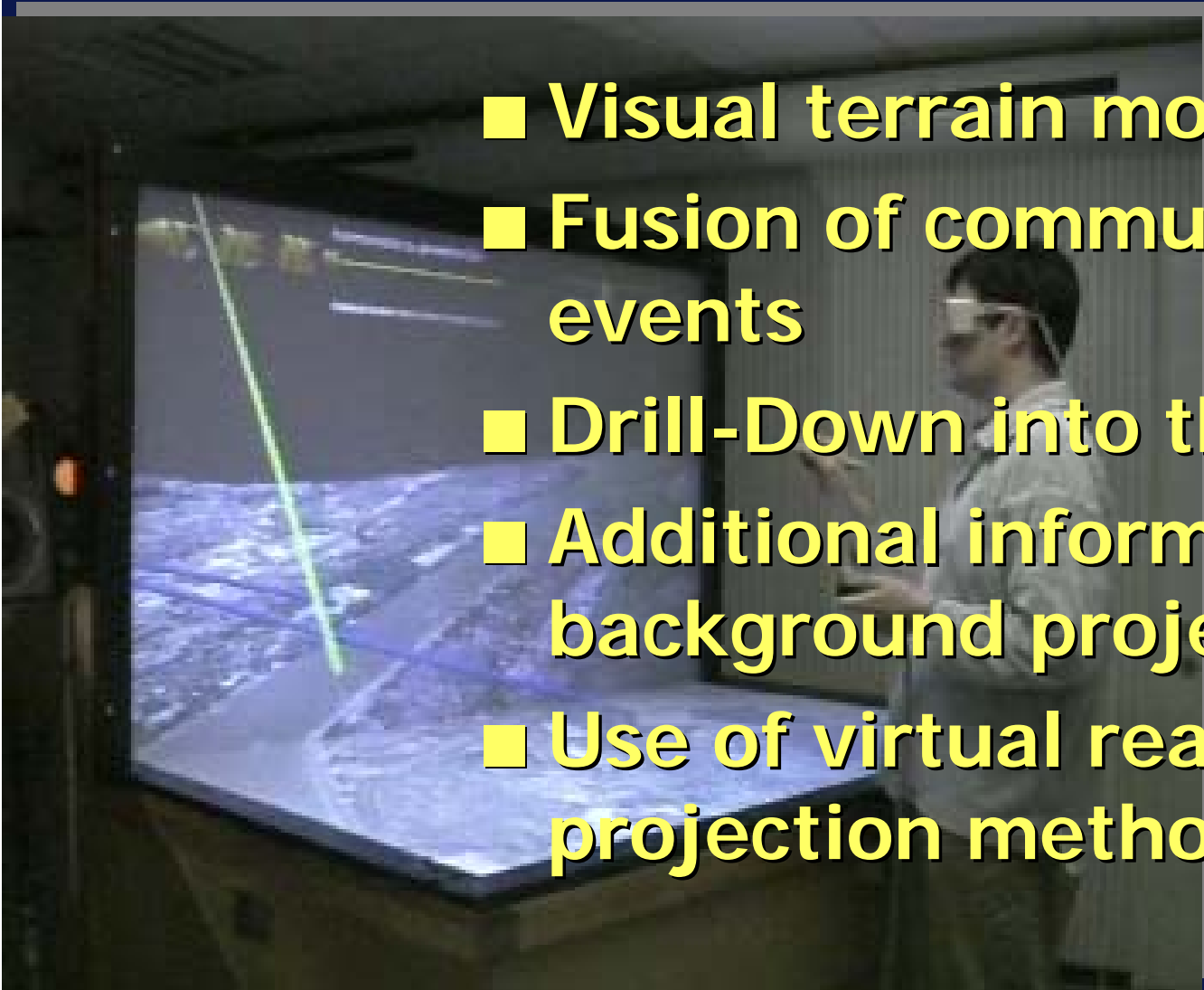
- Command & Control structures
- Using statistical methods of pattern recognition





## Visualisation Examples: Collection – Radio network I

- **Visual terrain models**
- **Fusion of communication events**
- **Drill-Down into the raw data**
- **Additional information by background projection**
- **Use of virtual reality projection methods**





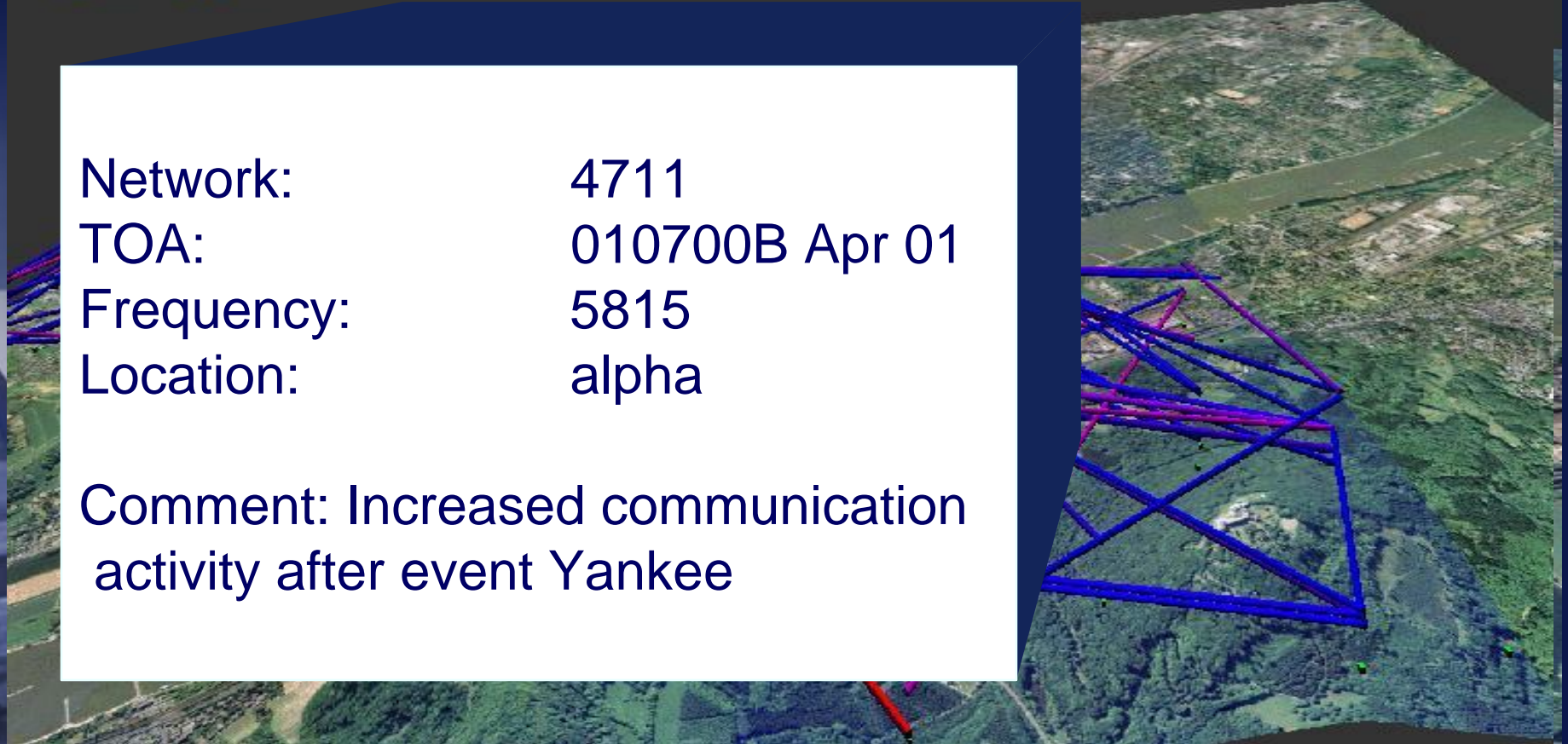
# COMINT-Situation displayed in a terrain model



Kommunikation nach gewaehlter Zeit



11 2h 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60



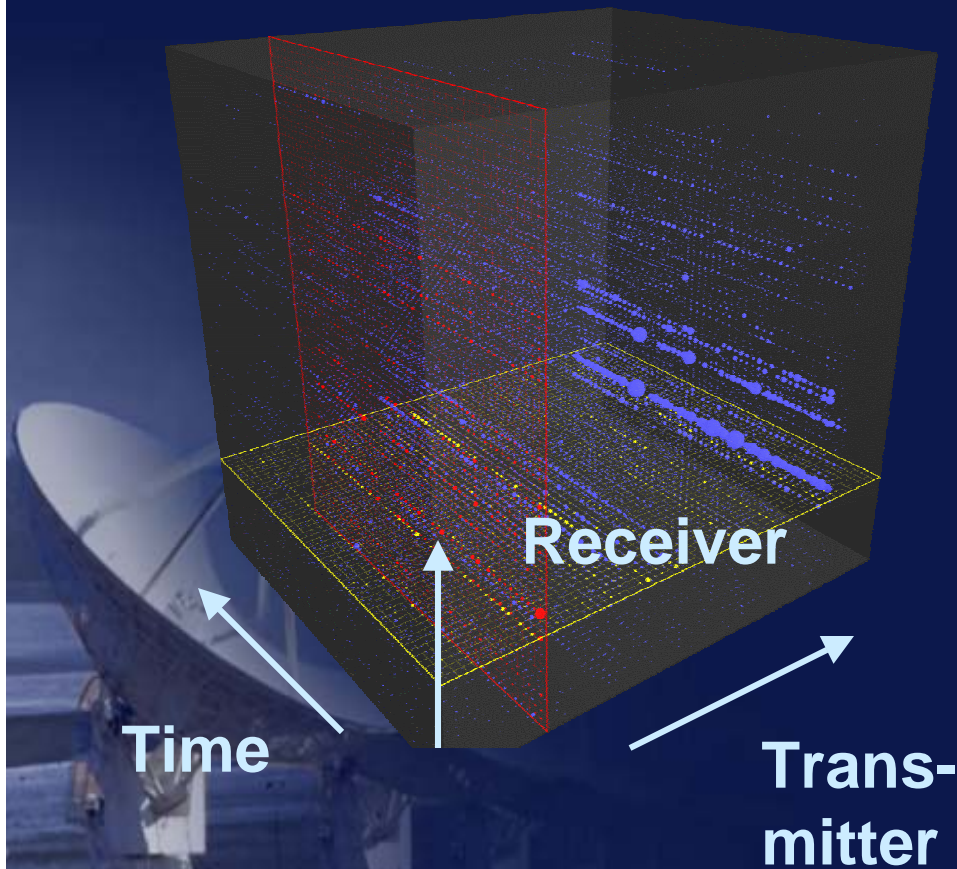
Network: 4711  
TOA: 010700B Apr 01  
Frequency: 5815  
Location: alpha

Comment: Increased communication activity after event Yankee



## Visualisation Examples: Collection - Radio network II

- **technical parameters:**
  - Call sign sender
  - Call sign receiver
  - Time of Arrival



Frequency of contact is described by the size of the sphere

