DATA 61

VoxelNet

- An Agent Based System for Spatial Data Analytics

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- An Agent Based System for Spatial Data Analytics

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Paper Lay-out

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III. The IoT
    i. Unmanned Aerial Vehicles
IV. How can the VoxelNet and the IoT coexist?
V. Technical Approach
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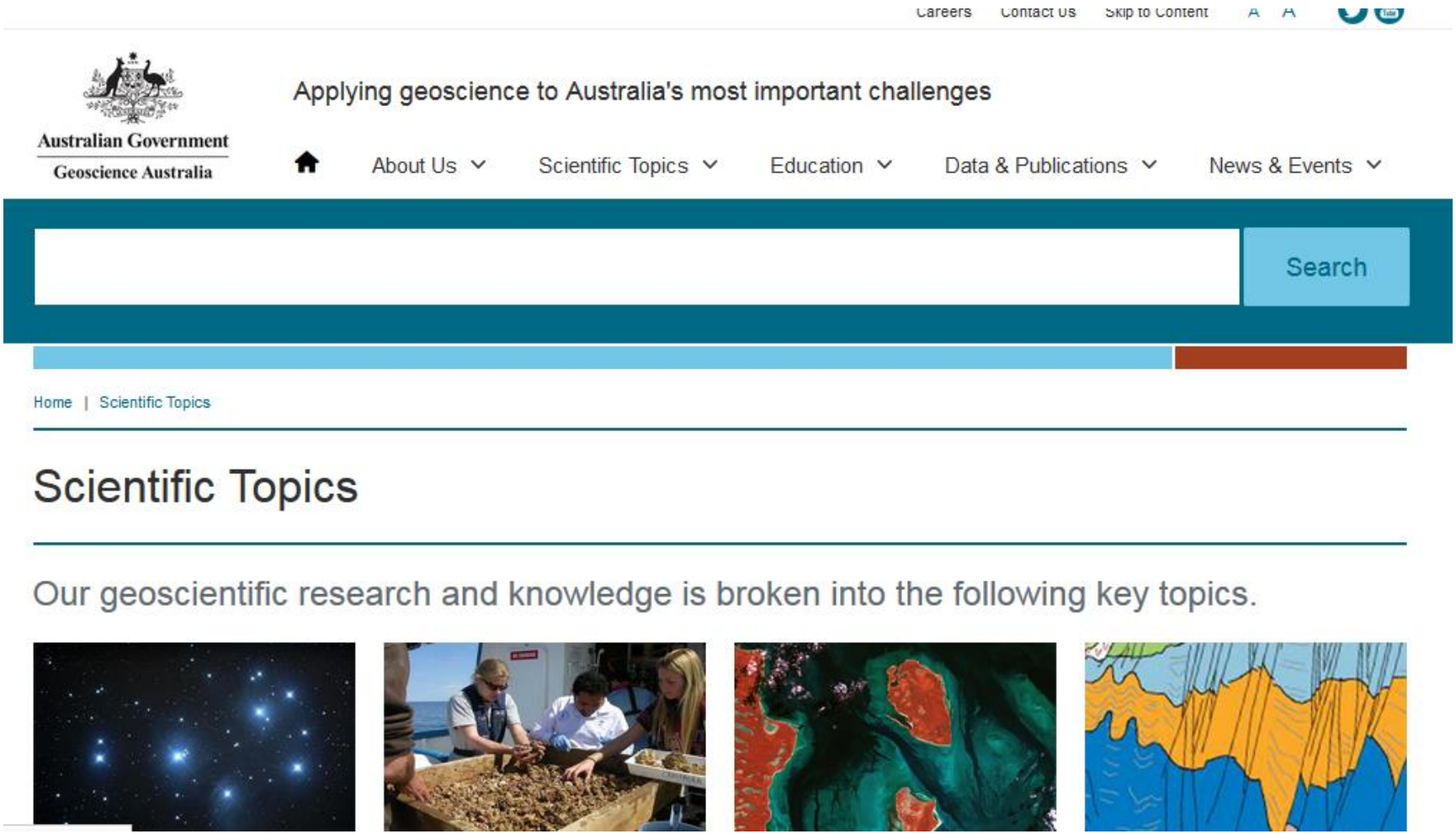
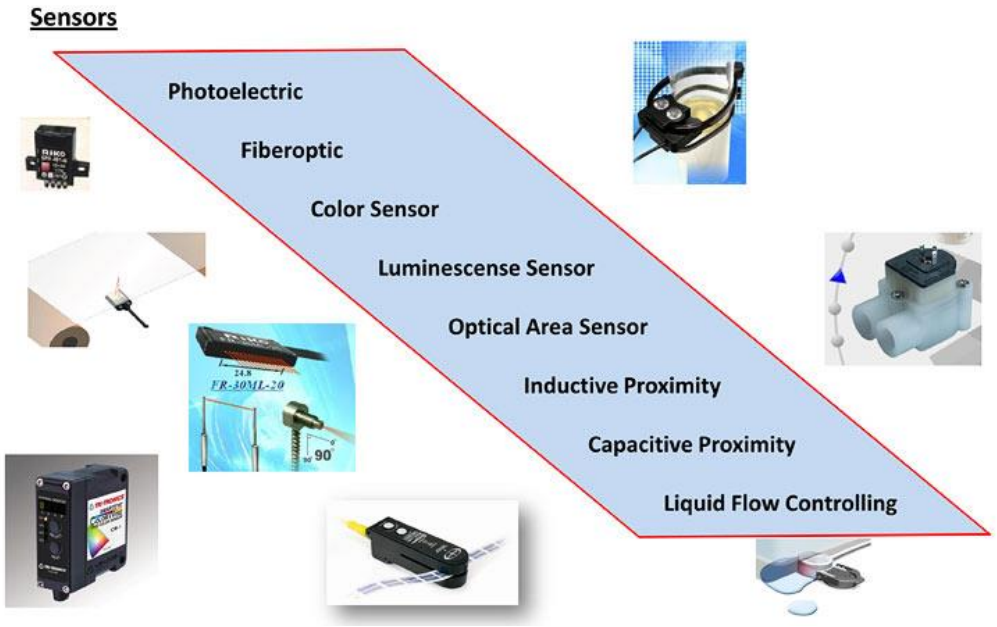
I. Introduction



I.I Sensors everywhere



Point sensor networks are also becoming increasingly common, measuring factors such as climate (temperature, pressure, rainfall, wind direction and speed), river and water body temperatures, levels and flow rates, and traffic location and movement information.

I.II Need for a spatial 3D WebTool

Current generic web tools are based upon a 2-dimensional (2D) text and image based presentation model, with few broadly available tools for analysing or even traversing or visualising large and complex data sets.

Voxelnet, as an inter-networked system of volume elements that can provide an intrinsically 3-dimensional (3D) user interaction paradigm structured to readily provide visualisation of and access to spatial data sets. An active voxel system is proposed, where volume elements are also active computational agents that can process the data that they represent.

II. A 3D Indexation and Annotation Editor

1) A functional communication architecture processing an individual spatialised IP address for each voxel

2) Agents accessed via their spatialised IP addresses, performing functions such as communicating what data they store (including 3D content such as 3D models with 3D sub-parts, 3D scanned objects, 3D environmental scans, data generated in a volume/area [x, y, z], etc.),

3) Annotation and indexation functions so that 3D objects and related data can be created, changed, located, processed or displayed,

4) A 4D distributed data base management system so all data can be accessed and projected, and

5) Scripting tools for active transformations and processing of block data.

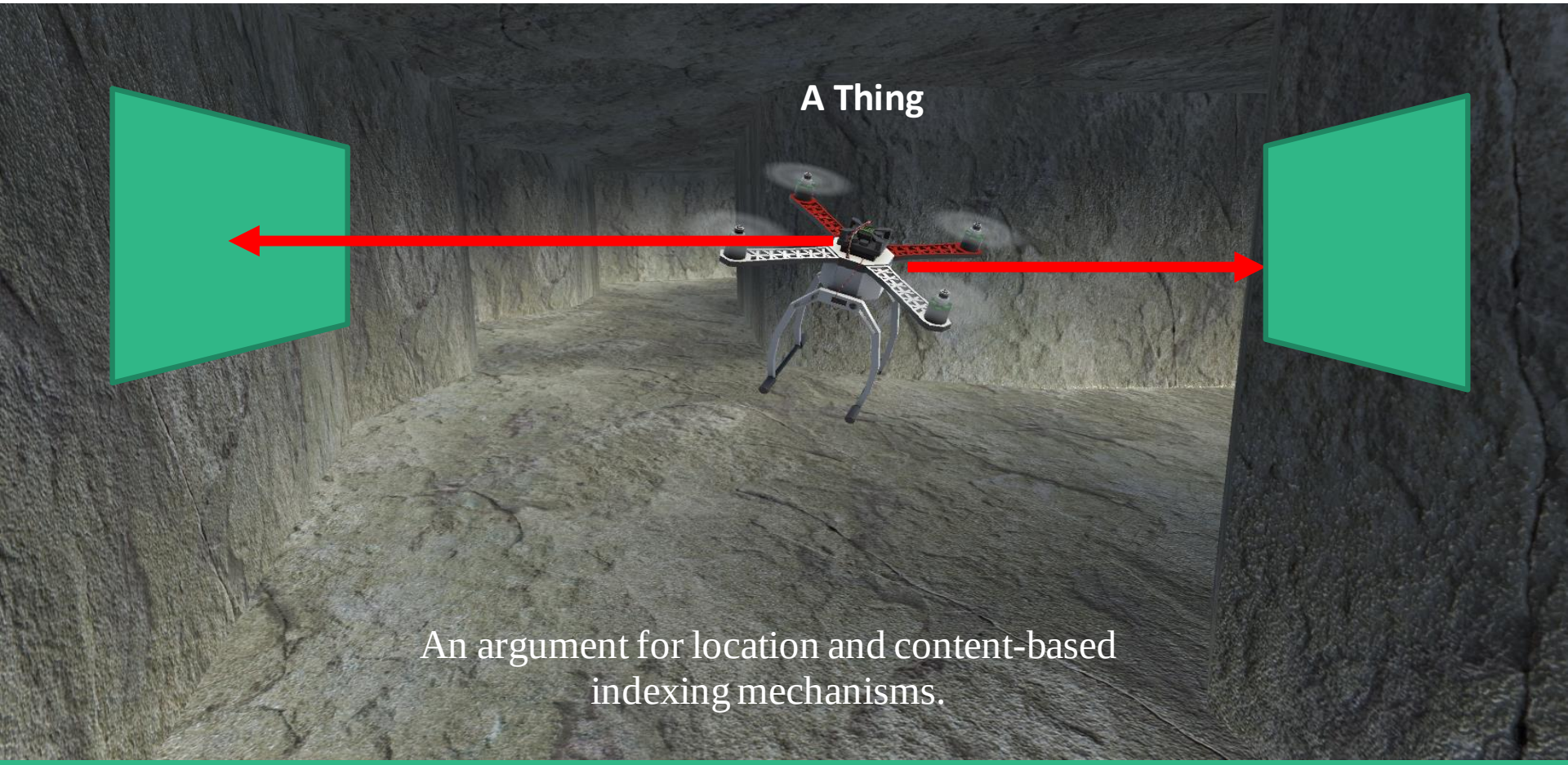
III. The IoT

Internet Protocol version 6 (IPv6) is the latest version of communication protocols providing an identification and location system for computers on networks [4]. As Leibson put it, "we could assign an IPv6 address to every atom on the surface of the earth, and still have enough addresses left to do another 100+ earths … if you take the surface of the earth as a perfect sphere and covered it with 1-layer-thick of atoms packed maximally close together." [5]. Even here the spatiality of the IoT starts to manifest.

The concept of the IoT, also referred to as the Industrial Internet, has expanded to encompass machine-to-machine internet connections in general. **From a business perspective it needs to support machine and process-based analytics that are physics based, process deep domain expertise, are automated and are predictive. The analysis of physical machines and systems requires access to data from remote and centralised sources and visualisation in 3D and 2D graphical systems. [1].**

i. Unmanned Aerial Vehicles

As a caste study, Unmanned Aerial Vehicles (UAVs) flying and capturing data underground [6] will be considered as an example of active IoT nodes.



IV. How can the VoxelNet and the IoT coexist?

i) As a repository, spatial browsing and analytics system for IoT connected objects, and

ii) Each voxel behaves as an interconnected “thing” within the IoT. Where the IoT deals with actual physical objects and sensors, the Voxelnet can support virtual objects and sensors that may have been converted or derived from physical world data by agents within the Voxelnet infrastructure.

V. Technical Approach

The possible format for such a spatialised URL can be based upon existing standards for geospatial data systems, such as those specified by the Open Geospatial Consortium (OGC) [12], including netCDF, GeoSPARQL, Geography Markup Language Encoding Standard (GML), KML (formerly the Keyhole Markup Language), etc. However, currently there is no universal access tool that provides a higher level interface for access to the data mediated by these standards and hides source details from users.

Such a tool should have analogous seamless integration across multiple heterogeneous databases as provided by web browsers for data that is unified into a 2D text/image presentation paradigm. The Voxelnet is intended to provide this kind of access.

VI. Summary and Future Work

The Voxelnet concept aims to provide seamless traversal through a 3D virtual space with content generated from diverse and heterogeneous data sources. Content may be multimodal, and can be computed from primary or other computational sources. Development of a demonstrator for this is work in progress that will support underground void mapping by UAVs as a first example use case. The Voxelnet concept is general and can be used for many applications.

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Thank you!

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