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URBIS Decision Support for Integrated Urban Governance

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1 ABSTRACT

The challenges for the management of cities and city-regions in addressing the economic and societal dynamics facing Europe and Europe's cities today is evident in the complexity and interconnectedness of the global and pan-European drivers of change and their associated socio-economic, environmental and territorial impacts for urban environments. Integrated urban management processes emphasising horizontal integration across the sectoral agencies at the local level, and vertical integration between government agencies from city to EU level is identified as critical to the management of the city-region in relation to the key political objectives defined at both local and EU levels.

The clear need for enhanced intelligence to support inter-agency collaboration and decision-making on territorial development as a central feature of integrated management is identified as a prime opportunity for URBIS solutions. Accordingly this paper presents an overview of the EU funded URBIS project (ICT PSP 2014–17) www.ict-urbis.eu. The project coordinated by GISAT, Prague investigates vacant land potentials in urban areas, and the opportunities for previously developed land or brownfield to support urban regeneration safeguarding greenfield sites. URBIS delivers assessment methodologies and tools to provide accurate up-to-date intelligence on urban vacant land opportunities that is comparable across European cities to support the definition and implementation of sustainable planning and governance strategies in cities and city-regions throughout Europe.

The background to this innovative research and city pilot development are growing pan-European concerns with land taken for urban use, which annually converts almost 1000 km2 of agricultural or natural land into artificial areas, as part of a wider European land degradation process. This land take process is driven by urban sprawl and infrastructure development, for example when new urban industrial or commercial areas are built on highly fertile agricultural land, rather than recycling abandoned or underused artificial sites. Land use efficiency is today a prime political objective at both European as well as city level, and the EU Land Communication aims to establish “zero net land take” across the EU by 2050. Central to the delivery of this policy is accurate intelligence on the availability and supply of previously developed “brownfield” land, as a key component of land-use decision making, maximising the net socio-economic benefits from land-use without degrading natural capital.

The core objectives of URBIS presented in this paper aims to deliver this intelligence via urban planning decision support tools methodologies and assessments to realise the development potential of vacant and underused land in urban areas.

2 URBAN SPRAWL IN EUROPE

European urban and regional planning on all levels is increasingly being challenged by economic globalisation and this will continue to intensify over the coming decades. Traditional European cities have developed into regional agglomerations, but planning methods and the associated management tools have not progressed and these are still applied within a “traditional” model of land use planning and non-integrated environmental management. In addition, poorly integrated and unsystematic approaches in land use policies with limited linkage to environmental quality will further impact on the environmental problems seen in many European cites. It could also be claimed that this may increase land-related conflicts in densely urbanised regions and in turn seriously threaten the social function and competitiveness of all European cities and regions, including those in the new Member States. Moreover the current financial and economic crisis has the potential to enlarge land related problems due to the reluctance of financial institutions to take higher risks for projects in the existing urban context.

The never ending extension of built-up areas and migration of the population from rural to urban areas across Europe has been recognised as a long term trend as most of the economic activities are concentrated around major urban areas. A more recent trend is the migration of population and some economic activities from city centres to the urban fringe and neighbouring rural areas encroaching onto “greenfield” land, i.e. land that

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has not previously been developed. This phenomenon is referred to as urban sprawl and has been recognised as one of the most significant land use changes in the last two decades across Europe (EEA 2006). Urban sprawl is accompanied by the conversion of land to artificial surfaces resulting in soil sealing, thus further increasing the environmental consequences of urban sprawl. Indeed over this period, the extent of built-up areas in many western and eastern European countries has increased by 20 % while the population has increased by only 6 % (cf. Figure 1).

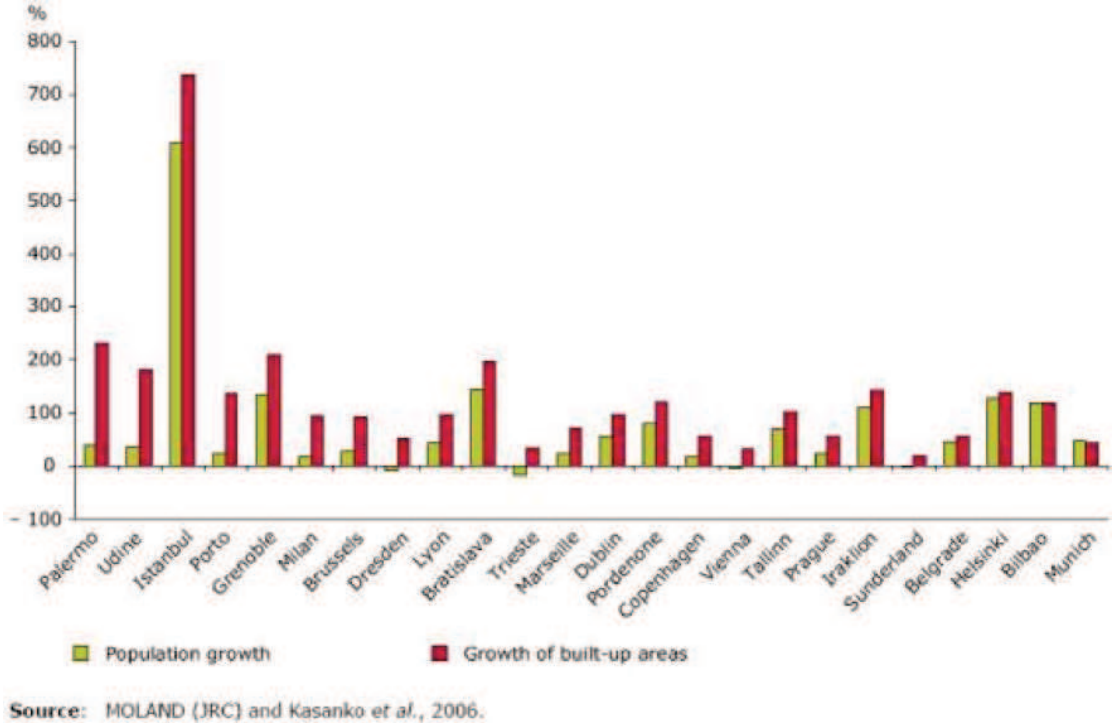

Figure 1:Population growth and the growth of built-up areas (mid-1950s to late 1990s), for selected European cities

The land and property market across Europe is a multi-billion Euro business. It is difficult to separate the land market from the overall real estate market, but a recent study undertaken by the EPF NPdC (Establissement Public Foncier Nord Pas-de-Calais, France) shows that in the Nord Pas de Calais region alone, the land property market amounted to 850 million Euros between 2000 and 2002, a 6% increase on the previous period 1997-99. The annual average land area developed represented around 1,000 ha. However, vacant land represents less than 1% of the total of land developed, despite an estimated 1,800 ha of vacant land available for redevelopment in 2006. Moreover, in another report linking urban sprawl and recycling of land, EPF NPdC estimated that if all 1,800 ha of vacant land located within the urban area was recycled it would save an equivalent of 8000ha of mostly agricultural land in the periphery of urban areas. This is possible because vacant land is already close to transport and utilities infrastructure, and so not requiring the construction of new infrastructure.

Unbalanced and uncontrolled development puts high risks on competing market led developments in the redevelopment of urban land and brownfield projects, and could lead to market failure as illustrated in several American cities (e.g. Detroit). These risks are also highlighted in a report by the RICS Foundation (RICS 2012) on the development of land and property markets in central and Eastern Europe where the Czech Republic and Poland are respectively ranked second and third in a combined growth and stability/risk indicator in the region. However, the authors of the report stress the importance of reliable market data and transparency.

At the same time, a significant proportion of artificial areas is not actively used and could potentially be redeveloped instead of encroaching on non-urbanised land. In this context, vacant sites are defined as previously developed land or derelict and vacant land and building sites. This includes any form of development, e.g. former housing estates as well as disused industrial or military sites as well as disused social or technical infrastructures. The term “vacant sites” is preferred to brownfields which are often associated with previous industrial or commercial sites that are potentially contaminated. In some cases, vacant sites can be represented by gaps in urban structures, without any current nor previous use. They can

also include patches of agricultural or natural land surrounded by urban areas. Vacant sites are a natural reservoir of land that can potentially be redeveloped.

One important key to unlocking the vacant site potential is the provision of accurate and up to date land cover/use information. The implementation, validation and wide European adoption of specific inventory, typology and decision support services for vacant lands provide the basis for a system aiming at mitigating urban sprawl. URBIS services enable consideration of the land reuse strategies in the context of ecosystem services whereby the supporting, regulation, provisioning and ecosystem services provided by the vacant sites could be identified to inform future planning policy and decisions to foster a more holistic planning approach critical to sustainable urban development.

3 ROLE OF COPERNICUS LAND MONITORING CORE SERVICES (LMCS)

Vacant urban land can present very different characteristics depending on the level of development and previous use of the land. As a result, depending on size, location and previous use, vacant land may be redeveloped with minimum inputs (for example development of a green park from land with no previous use) or at the other extreme require substantial remediation work (for example development of a housing estate on potentially contaminated land). However, lack of knowledge about site conditions and characteristics typically hampers redevelopment, whatever its readiness for redevelopment. Although information exists locally, it is often patchy, incomplete and distributed between different organisations. Moreover, there is a lack of consistent information at the European level making it difficult to exchange and compare data. However, opportunities exist to overcome these constraints via the development of a methodology to develop a European information service on vacant land with the deployment of Copernicus LMCS. In particular, the Fast Track Services (FTS) on Land Monitoring developed by a number of EU research projects including geoland (1 and 2), and the follow-up GIO Land pan-European and local components (Urban Atlas 2012, High Resolution layers) introduce new more detailed layers of information focused on urban areas essential for the development of an information service aimed at identifying and characterising vacant and derelict urban sites. The development of such an information service will play a major role in the promotion of the recycling of existing urban sites, thereby directly addressing the reduction of urban sprawl.

Such an information service currently does not exist or is incomplete. In addition, the various initiatives that exist are locally based and lack a common methodology making it difficult to exchange and compare data. The availability of Copernicus LMCS open data makes it possible to develop new EO services for urban planning. In particular, availability of the GIO Land five High Resolution layers (Imperviousness degree for 2006, 2009 and 2012, tree density, grassland, water bodies and wetlands for 2012) and the Urban Atlas (2006 and 2012) combined with outputs from geoland2 regional and local Core Mapping Services (CMS) and Spatial Planning Core Information Services (CIS) concerning spatial planning provide realistic data to explore and build such a service. The Urban Atlas in particular with its characterisation of “land without current use” facilitates the development of the URBIS proposed vacant land inventory and typology information service. Furthermore, EO data acquired for LMCS services can be easily re-used to gather additional information about urban vacant land, which is not available in the Urban Atlas thematic layer so far (because it often lies under Minimum Mapping Unit of this dataset) as well as to tailor the proposed URBIS service to the specific thematic needs of the users. Without it, the development of such a service would be very costly and time consuming, and the level of sustainability on the data supply side would be questionable.

The Urban Atlas and other core services are primarily for use at European level, but URBIS is also focused on providing an information service relevant at the regional and local levels. In addition, other land cover/use data sources can be used as a basis for URBIS should they be available from user organisations.

4 OPEN DATA AND GIS

URBIS services will be built upon various sources of open geographical information data from local, regional, national and European level. According to the a recent communication paper from the European Commission (Com 2011) the market size and growth of the geographic information sector shows the potential of public data as an engine for job creation. The German market for geo-information in 2007 was

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estimated at 1.4 billion euro, a 50 % increase since 2003. In the Netherlands, the geo-sector accounted for 15 000 full time employees in 2008.

Recently, a number of initiatives have made it possible to open up the access to geographical information. At institutional level, these initiatives are encouraged globally notably through the GEO. The aim of GEO is to build a GEOSS whereby the duplication of data and initiatives is minimised through the development of a system of systems. In Europe, the GEO initiative is supported through Copernicus and INSPIRE. INSPIRE fosters interoperability between information services whilst Copernicus provides core information services on which to build value added services. The fact that most of the Copernicus core services adopt an open data policy facilitates the development of downstream services.

Crowd sourcing initiatives such as Open Street Map will also contribute to the development of URBIS services. Worth noting is that Copernicus core services were initially integrated in Open Street Map for areas where precise field observations were lacking such as in some Eastern European countries.

5 URBIS OBJECTIVES, SERVICES, USERS

5.1 Objectives

The URBIS project aims to develop, implement and validate in real environment innovative information services related to urban vacant land, based on open geospatial data, to support planning of European Large Urban Zone's (LUZs) in a sustainable way.

The specific objectives of the project are:

- Objective 1: To assess the potential reuse strategies of vacant urban land based on its past uses and characteristics and through wide involvement of end-user organisations, to establish common ground for the development of URBIS services.
- Objective 2: To develop a methodology for an inventory and typology of European vacant urban land based on Copernicus LMCS FTS Urban Atlas and soil sealing layers and the analysis of multi-temporal imagery to determine potential constraints to redevelopment.
- Objective 3: To develop, implement and validate interoperable services on a number of representative LUZs across Europe under operational conditions in collaboration with key European stakeholders/practitioners.
- Objective 4: To develop a sustainable operational and business model for the URBIS information services

The proposed service architecture is illustrated in Figure 2 below and shows the main sources of data for the planned URBIS services and linkages between EO based service providers, land development agencies, land use planning consultancies and end user organisations.

URBIS will rely primarily on the Copernicus LMCS FTS Urban Atlas, soil sealing layers and their associated source image data. In particular, the 'Land without current use' category of the Urban Atlas will be further investigated in combination with historical imagery to determine past use. In situ data when available will be sourced from land development agency partners and stakeholders and used to provide local knowledge and contribute to the development of a validation data set.

5.2 URBIS Services

The project will develop and implement three main categories of URBIS services:

(1) Baseline services: initial inventory and typology of urban vacant land, not only to identify sites that can be used for re-development, but also to identify sites that should be preserved and not used for further development (e.g. high ecological value). The inventory will be based on data from the Urban Atlas.

(2) Update services: an update service, with the regular update of the vacant urban land inventory synchronized with the planned Urban Atlas updates.

(3) Thematic services: a set of added-value services tailored to end-users (local authorities, policy makers).

In the initial phases of the project, a detailed assessment of end-users requirements was undertaken with following list of requirements identified:

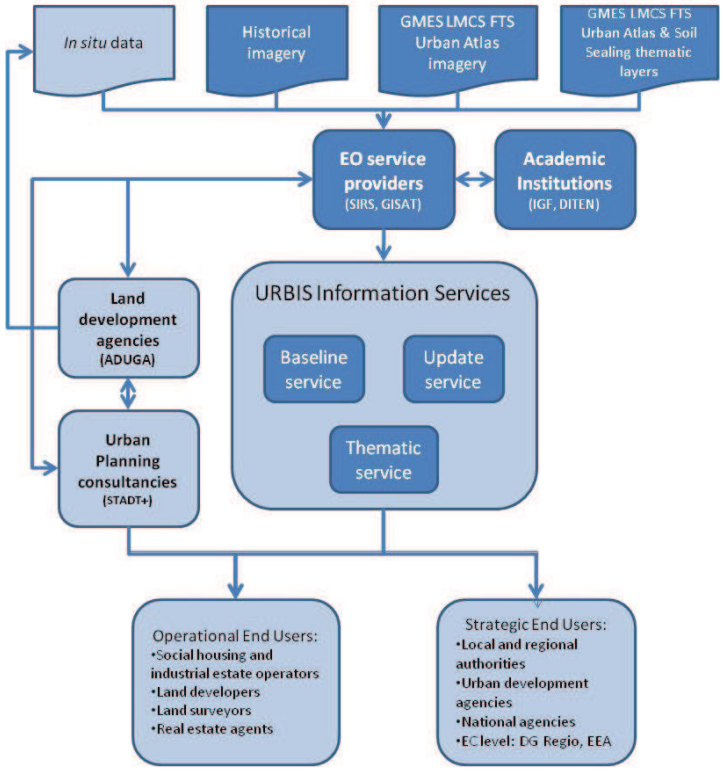

Figure 2: URBIS service architecture

(1) Identification of sub-optimally used or vacant sites

(2) Identification of inner development site potentials for new urban uses (residential, industrial, etc.)

(3) Identification of land use change dynamics (i.e. urban sprawl and urban green areas)

(4) Identification of site specific information (i.e. building material, object volume, etc.)

(5) Identification of site suitability for agricultural purposes

(6) Identification/monitoring of urban green areas (potential for city environment improvement)

(7) Automatic detection of the degree of soil sealing in urban areas

(8) Identification of risks which can limit future use of the vacant site/PDA

5.2.1 Baseline Services

Based on these requirements, as well as on the feasibility of source datasets and available methods, the following three layers representing three main domains of users´ interest were defined to create the URBIS baseline service:

- Green Layer: will include both vegetated and non-vegetated "gaps" in urban structure. A two-step approach is applied for preparation of this Green Layer. First, Urban Atlas polygons assigned to classes 13400 - Land without current use and 14100 – Green urban areas, selected as a first “basic” version of the Green Layer. This basic version of the layer will be limited by Urban Atlas MMU – 2500m2. For these polygons, site specific criteria describing each site, will be further calculated.

Second, sites smaller than this MMU, but larger than 500m2, will be detected, mostly using methods based on EO data analysis, to complement the basic version of the layer and create an enhanced version of the Green layer. This analysis will be primarily based on the original Urban Atlas imageries (SPOT5 Supermode, 2.5m pixel size), but also other ancillary data will be utilized..

- Grey Layer: will include brownfield sites identified on the basis of local brownfields surveys, with a help of OpenStreetMap or information incorporated in the Urban Atlas thematic layer; each brownfield site will be described by using a set of characteristics which can help to identify the potential for optimal future (re)use of the site. These characteristics will include the following site description:

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- Physical properties (location, area, slope)
- Shape characteristics (convexity, rectangularity)
- Statistical and texture characteristics (vegetation index, imperviousness)
- Land cover (degree of sealing, characteristics of potential vegetation coverage, characteristics of non-vegetated surfaces)
- Land use (both current and previous)
- Existing development (number and area of buildings, existence of parking lots, existence of storage sites, degree of site deterioration)
- Existence of infrastructure networks (connection to infrastructure: water, electricity, heating, connection to street system)
- Surrounding local context (proximity to city and regional center, minimum distance to highway, main road or railway station)
- Environmental conditions (presence of environmental risk, contamination, presence of protected area)

- Urban Land Use Typology and Dynamics Service Results: this will include the information related to the characterization of urban land internal typologies, spatial patterns, and their dynamics. Urban Atlas thematic layers will be a primary source of information, but other thematic datasets will be considered as well. Besides the land-use and land-cover results already available in the Urban Atlas, state-of-the-art processing techniques for land-cover classification and multi-temporal analysis will be applied to the related source satellite data (in particular Urban Atlas imageries – SPOT5 and Pleiades) to derive detailed thematic maps of a restricted set of land cover classes with optimized classification accuracy especially in the case of very-high spatial resolutions.

5.2.2 Update Services

Update services are based on the same methodology as the baseline products, synchronized with Urban Atlas updates (year 2012).

In this regard a prime objective of URBIS is the implementation, testing and validation of the above mentioned services in real world environment of 3 Large Urban Zones (LUZ), geographically coherent with regards to partner's location, and which encompass a various set of specific criteria's and requirements in the field of vacant land reuse.

The 3 selected LUZs which will participate to these pilot studies are:

- Greater Amiens (France)
- City of Osnabruck (Germany)
- Moravian-Silesian Region (Czech Republic)

5.2.3 Thematic Services

URBIS baseline and update products will be used to derive a series of thematic services, which can be specific for different pilot studies. The type and detailed characteristics of these thematic services have been defined and developed in collaboration with end user organizations and will include the following:

Greater Amiens:

(a) Vacant land potential for local plan

(b) Brownfields' renewal potential

City of Osnabruck:

(a) Demolition costs

(b) URBIS Street Photos

(c) Activity Map

Moravian-Silesian Region:

(a) Analysis of urban free spaces (including vacant sites and green areas)

(b) Analysis of the urban spatial pattern and its dynamics

(c) URBIS Integration Tool (an interactive web tool which will permit the display and interactive analysis of the results of the URBIS services. This tool will integrate results of all three main domains of URBIS services (Green Layer, Grey Layer and Urban Land Use Typology and Dynamics) with other ancillary socio-economic datasets (e.g. Urban Audit) into user-defined visualizations or interactive analysis.

These types of services are also planned to be demonstrated at the EU level.

The definition and content of thematic services can be enriched by the experience of the implementation of the pilot studies during project, when the baseline and update services will be developed. This set of specific added value services will also target the private sector requirement, for example:

- Support the establishment of new business activities: logistic platforms, tertiary and commercial activities areas;
- Allow site identification for housing construction;
- Allow site identification to assist shrinking cities strategies (demolition/Interim Use concepts);
- Inventory of sites with conversion potential to green spaces;
- Identification of sites for creation of natural environments (protection of species, blue and green corridor).

5.3 Users of URBIS services

The first priority users of URBIS services are local and regional planners. In more general terms, end users in the URBIS context can be separated in terms of operational and strategic users.

- Strategic users: such as local and regional authorities, European and national agencies in charge of urban planning, would directly benefit from URBIS services as for the monitoring of the implementation of particular territory planning policy (e.g. the 30 ha goal on reduced land consumption in Germany). Furthermore, URBIS services may be used to support the allocation, monitoring and evaluation of ERDF funds in urban areas, or to assess to which extent urban development is meeting targets for the redevelopment of vacant sites.
- Operational users: such as industrial estates operators or private land developers are likely to require the URBIS services for meeting the requirements of a specific need such as a to know where suitable vacant sites are located within metropolitan areas greater than a certain size for the construction of supermarkets, or a local authority in charge of social housing looking for suitable sites for the construction of a new project. Financial institutions might be interested in general land data to improve project business plans. Sites from developers are also required to place renewable energy production. Regional and local planners also need information on the different vacant land development options as a critical component of urban and regional planning in relation to the management of urban sprawl, and more generally in relation to the creation of green belts, nature conservation and leisure areas and their connectivity.

URBIS will contribute to the development of a new market for EO derived information (vacant land inventory and typology) led by EO service providers, SME's based on Copernicus products (LMCS FTS Urban Atlas and Soil Sealing layers) and addressing the needs of various stakeholders involved in land development at an operational and strategic levels

6 EU DIMENSION

This project is in line with the strategy proposed by the Commission to improve land use planning and management. Many reporting obligations in relation to international conventions (UNFCCC, UNCCD, Agenda 21, UNCBD, Ramsar convention) require land use/cover spatial data. Up until now, most of these reporting obligations were fulfilled by Corine Land Cover. However, new European legislation and policies such as the Water Framework Directive, the Soil Thematic Strategy, the Urban Environmental Management and the Thematic Strategy, European Spatial Development Perspective and the Biodiversity strategy, now require more detailed spatial information.

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Reconciling land use with environmental concerns is a challenge that involves all governance levels and sectorial agencies. Monitoring and mediating the negative environmental consequences of land use while sustaining the production of essential resources is a major priority of policy-makers around the world.

In 1999, the European Spatial Development Perspective (ESDP) developed European policy orientations for territorial balance and cohesion, improved competitiveness, access to markets and knowledge, as well as the sustainable management of natural and cultural resources. More recently, integrated spatial development has been addressed by the Territorial Agenda of the EU that aims at mobilising the potential of European regions and cities for sustainable economic growth and job creation.

Efforts to modify land use practices to reduce non-point pollution of air and water include integrated river basin management and, in particular, the Nitrates Directive. Flooding caused by the construction of impervious surfaces (e.g. buildings and roads) and provoked by extreme weather events is addressed by a new European Floods Directive. The cross-cutting nature of land use is also emphasised by the EU rural development and regional policies.

Furthermore, the UNFCCC (UNFCCC 1997) Kyoto Protocol promotes among other practices the reduction of emissions of methane and nitrous oxide from agricultural land. EU policies on climate change adaptation are directly relevant to current and future land use practices and economic sectors depending on this.

The European Environment Agency report demonstrated that urban sprawl is a serious environmental threat evident in city regions throughout Europe. Each country has its own specificities in terms of land and urban characteristics and in terms of indicators and policies as well. Therefore, specific sets of expertise from individual regions are required to develop the URBIS information service based on a common, consistent and up to date Europe wide inventory and typology of vacant urban sites.

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