

# EARLY WARNING: TELE-MEDICINE AND LOGISTICAL RESPONSE

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**University of Koblenz-Landau**

**ReGLaN - Health**

Research Group Learning and Neurosciences

Prof. Dr. E. Niehaus

# Central Project Objective

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**EARLY WARNING &  
LOGISTICALLY OPTIMIZED  
RESPONSE BY USING ADAPTIVE  
SPATIAL DECISION SUPPORT**

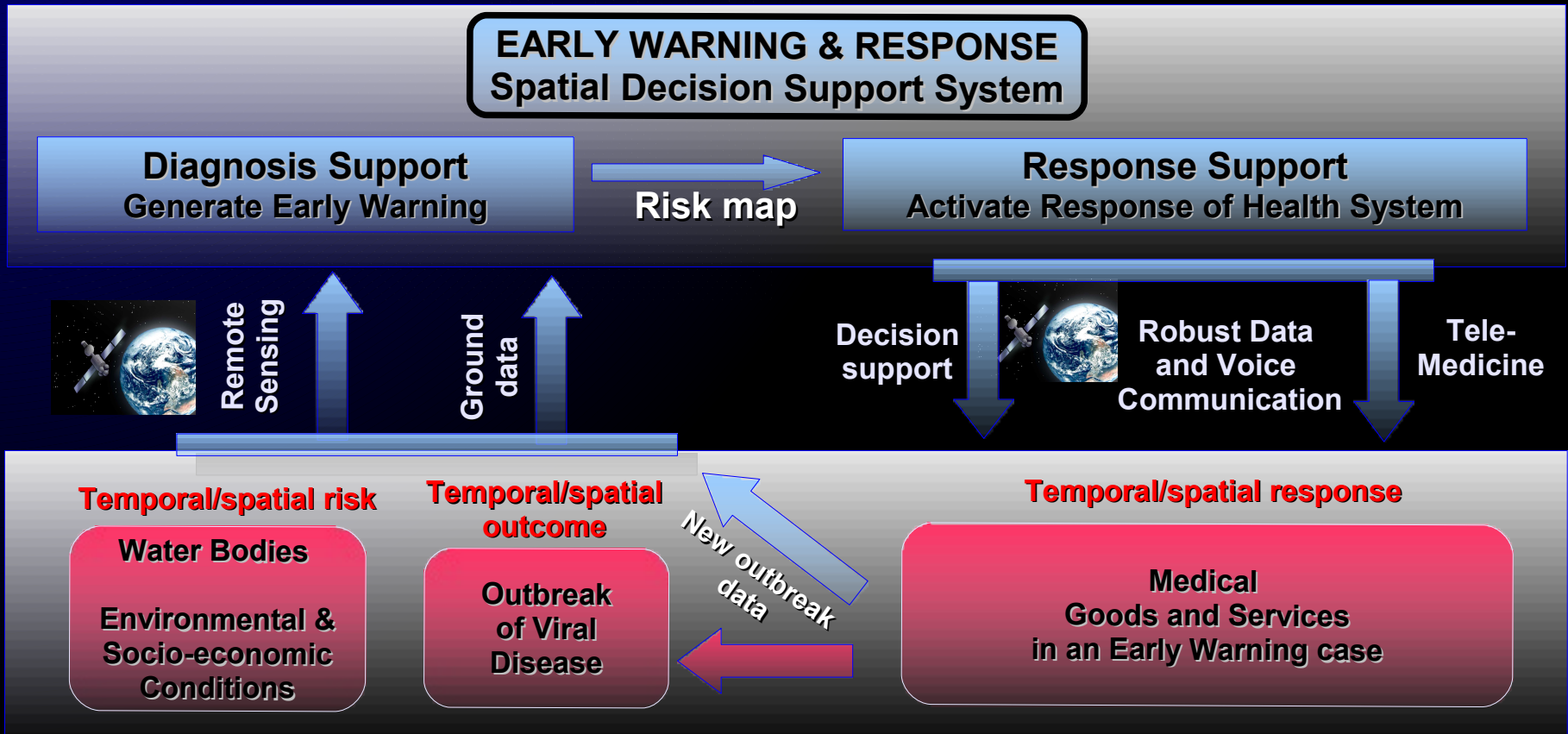
**ASSIST DECISION AUTHORITIES  
by providing additional information  
tailored for decision maker**

# Project Objectives

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- AIM:** EARLY WARNING: TELE-HEALTH & LOGISTICALLY OPTIMIZED RESPONSE  
(Spatial Decision Support)
- HOW?** MODELLING OF VIRUS DISSEMINATION AND EFFICIENT DISTRIBUTION OF MEDICAL GOODS AND SERVICES  
(Tele-Medicine = Medical Service)
- WITH:** DELIVERY OF AN ADAPTIVE SPATIAL DECISION SUPPORT SYSTEM (Open Source)
- TO WHOM?** GOVERNMENT, ADMINISTRATION, DOCTORS, NURSES (= Decision Makers)

# Early Warning & Response Cycle



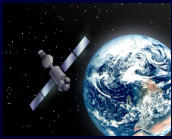


# Early Warning & Response Cycle

## EARLY WARNING & RESPONSE Spatial Decision Support System

**Diagnosis Support**  
Generate Early Warning

Risk map



Remote  
Sensing

**Temporal/spatial risk**

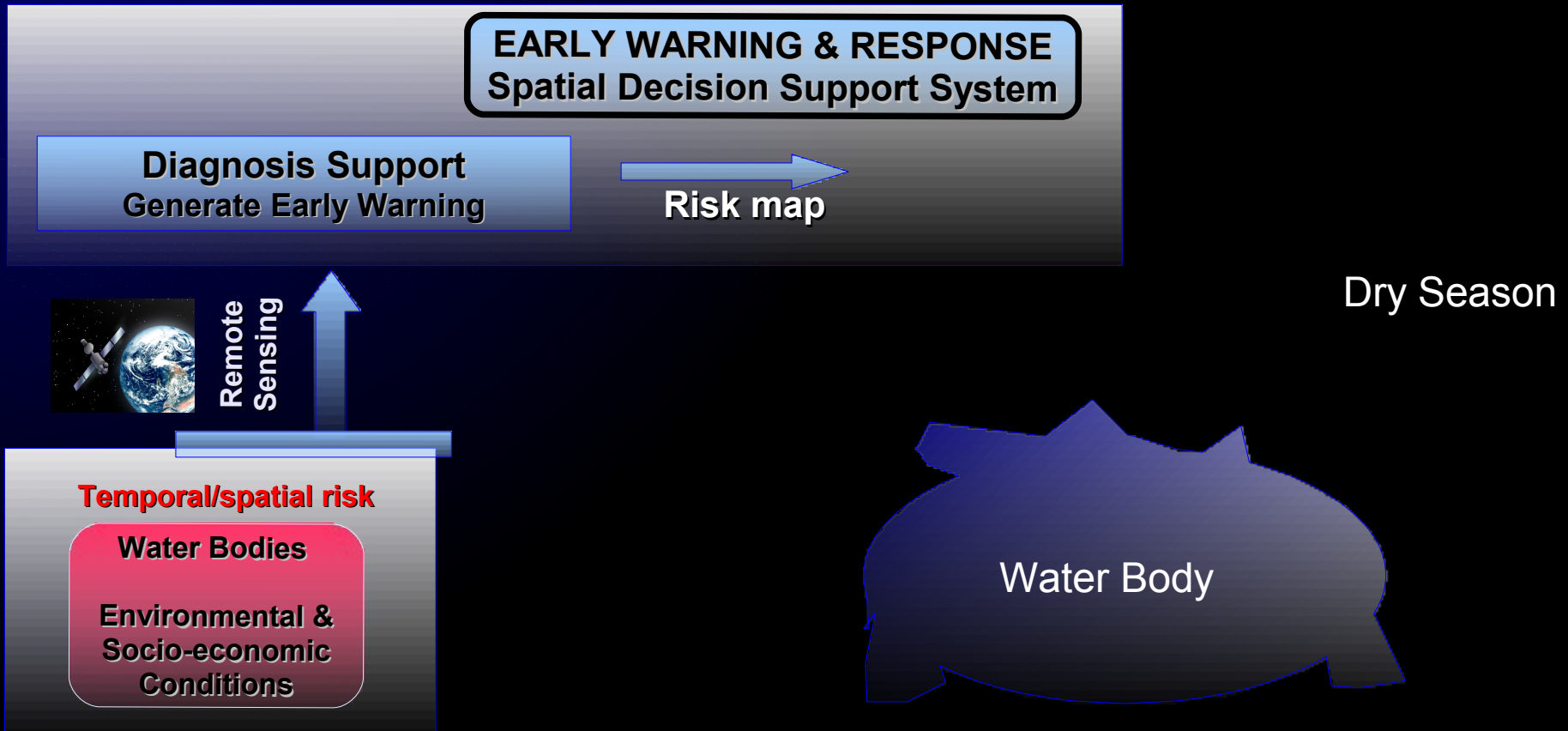
**Water Bodies**

**Environmental &  
Socio-economic  
Conditions**

Water Body

Dry Season

# Early Warning & Response Cycle

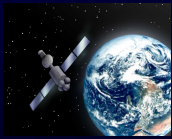


# Early Warning & Response Cycle

## EARLY WARNING & RESPONSE Spatial Decision Support System

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Remote  
Sensing

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**Water Bodies**

**Environmental &  
Socio-economic  
Conditions**

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Remote  
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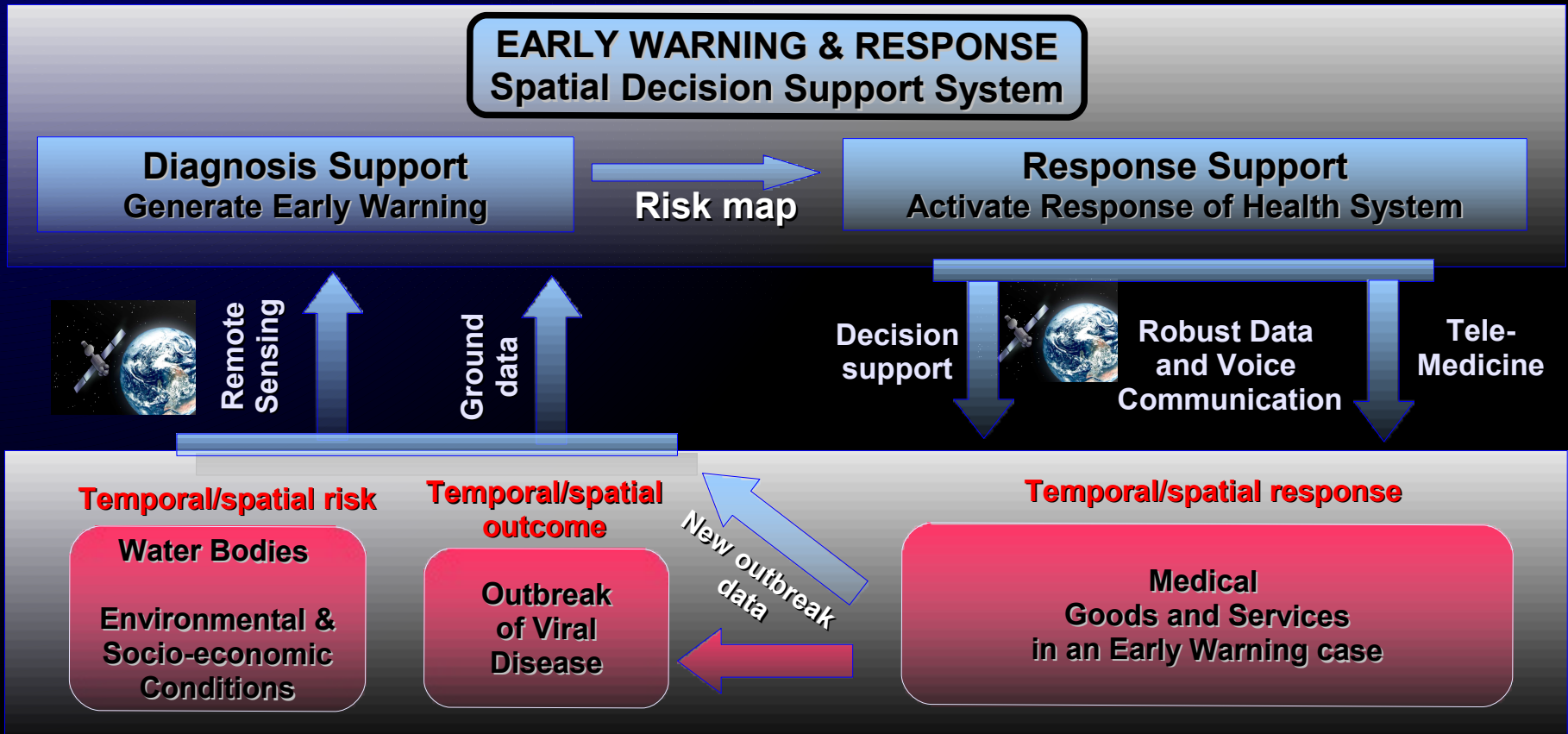
### Temporal/spatial risk

Water Bodies

Environmental &  
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# Early Warning & Response Cycle



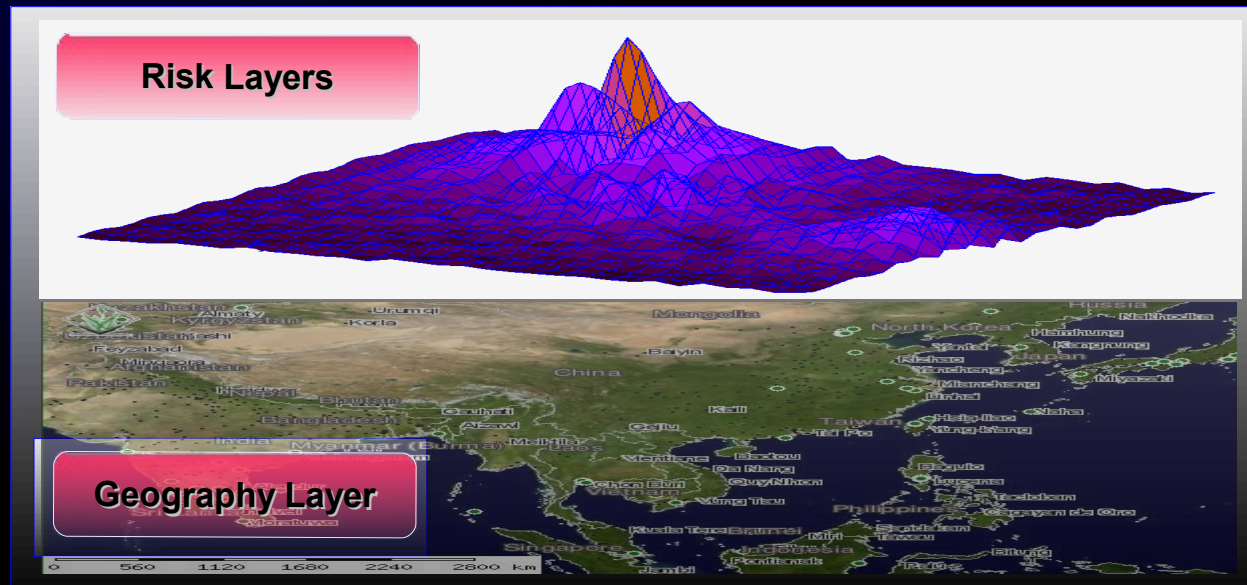


# Early Warning & Response Cycle

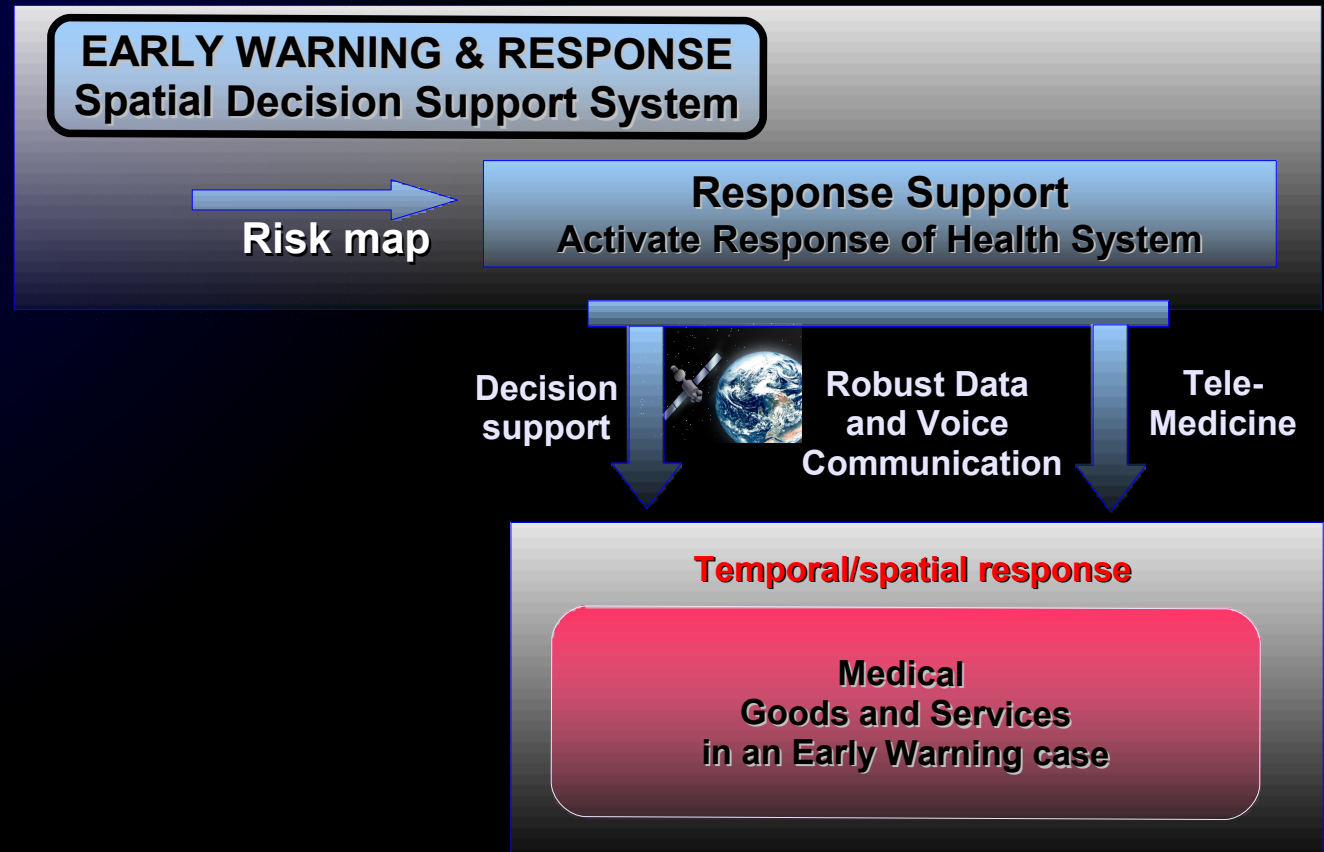
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Generate Early Warning

→  
**Risk map**



# Early Warning & Response Cycle





# Early Warning & Response Cycle

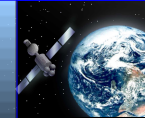
## EARLY WARNING & RESPONSE Spatial Decision Support System

Risk map

Response Support  
Activate Response of Health System

Medical Resource

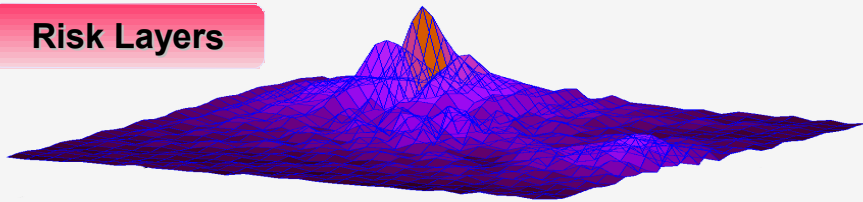
Decision  
support



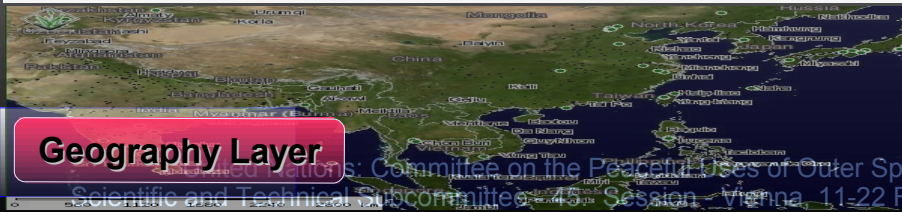
Robust Data  
and Voice  
Communication

Tele-  
Medicine

Risk Layers



Geography Layer



Temporal/spatial response

Medical  
Goods and Services  
in an Early Warning case

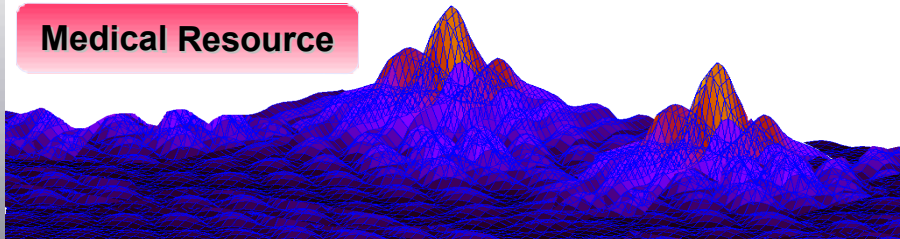
# Early Warning & Response Cycle

## EARLY WARNING & RESPONSE Spatial Decision Support System

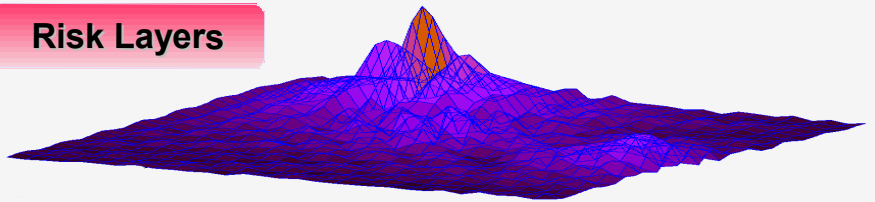
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Medical Resource



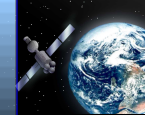
Risk Layers



Geography Layer



Decision  
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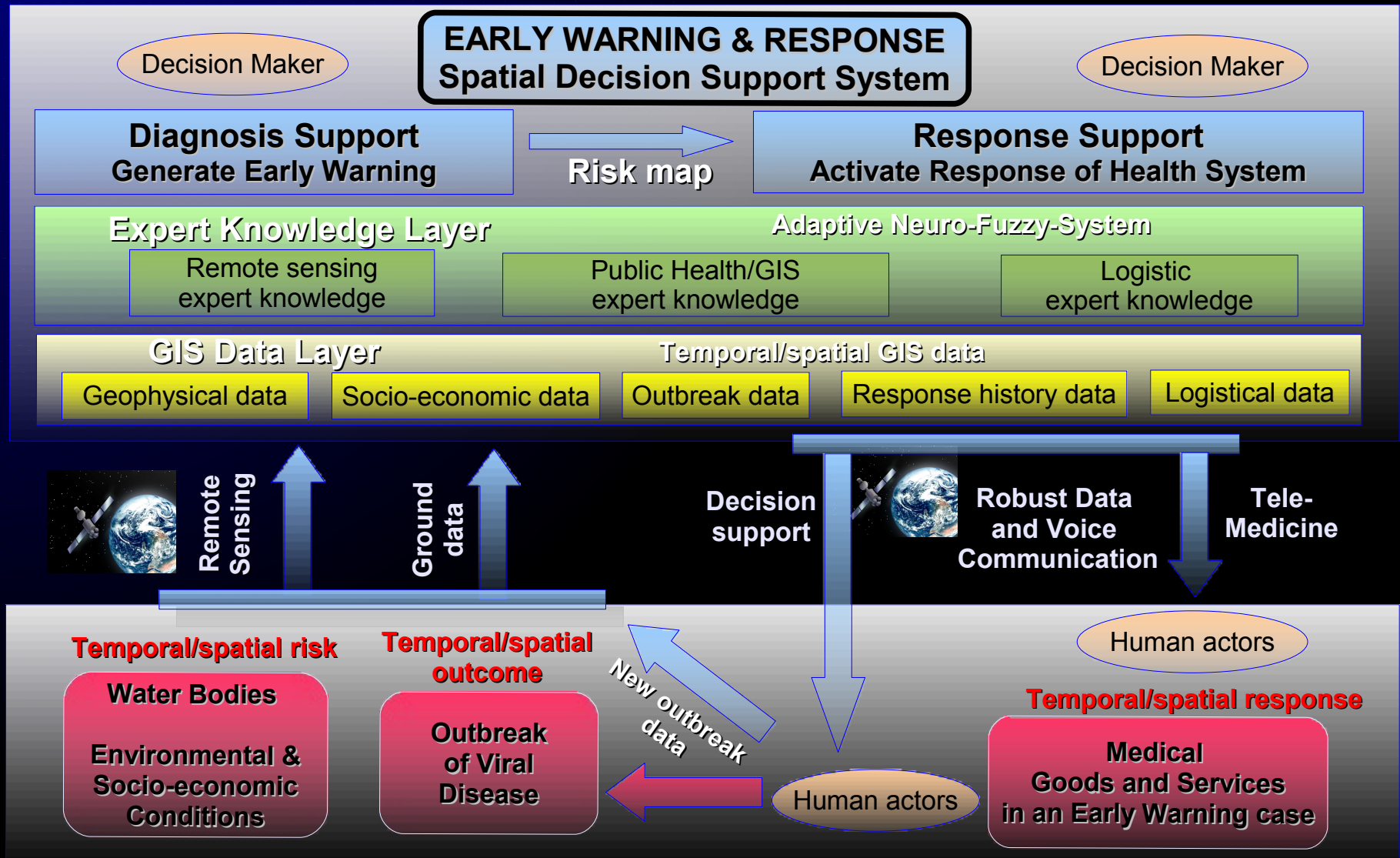
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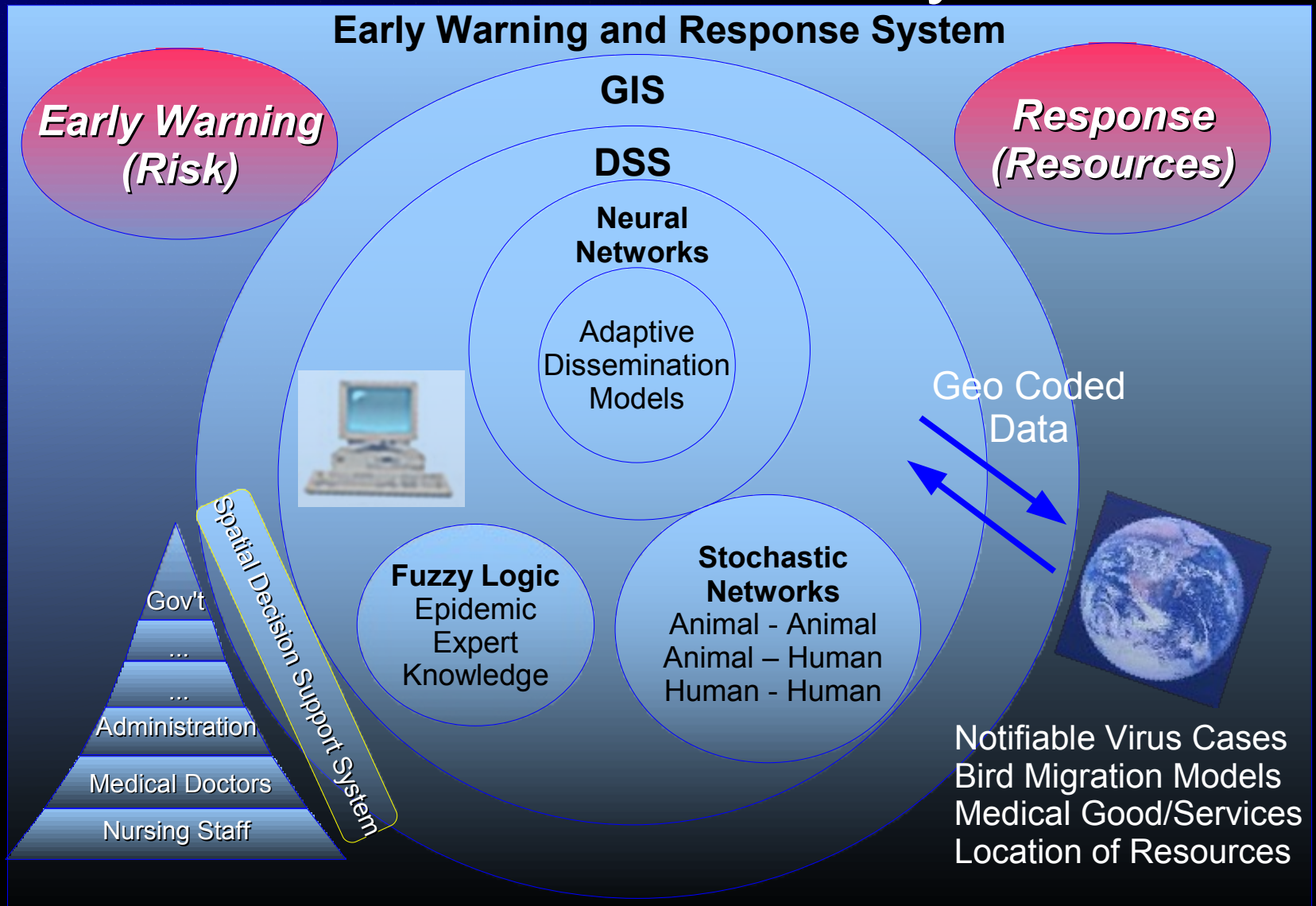
Temporal/spatial response

Medical  
Goods and Services  
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# Early Warning & Response Cycle



# Overview Technical Systems





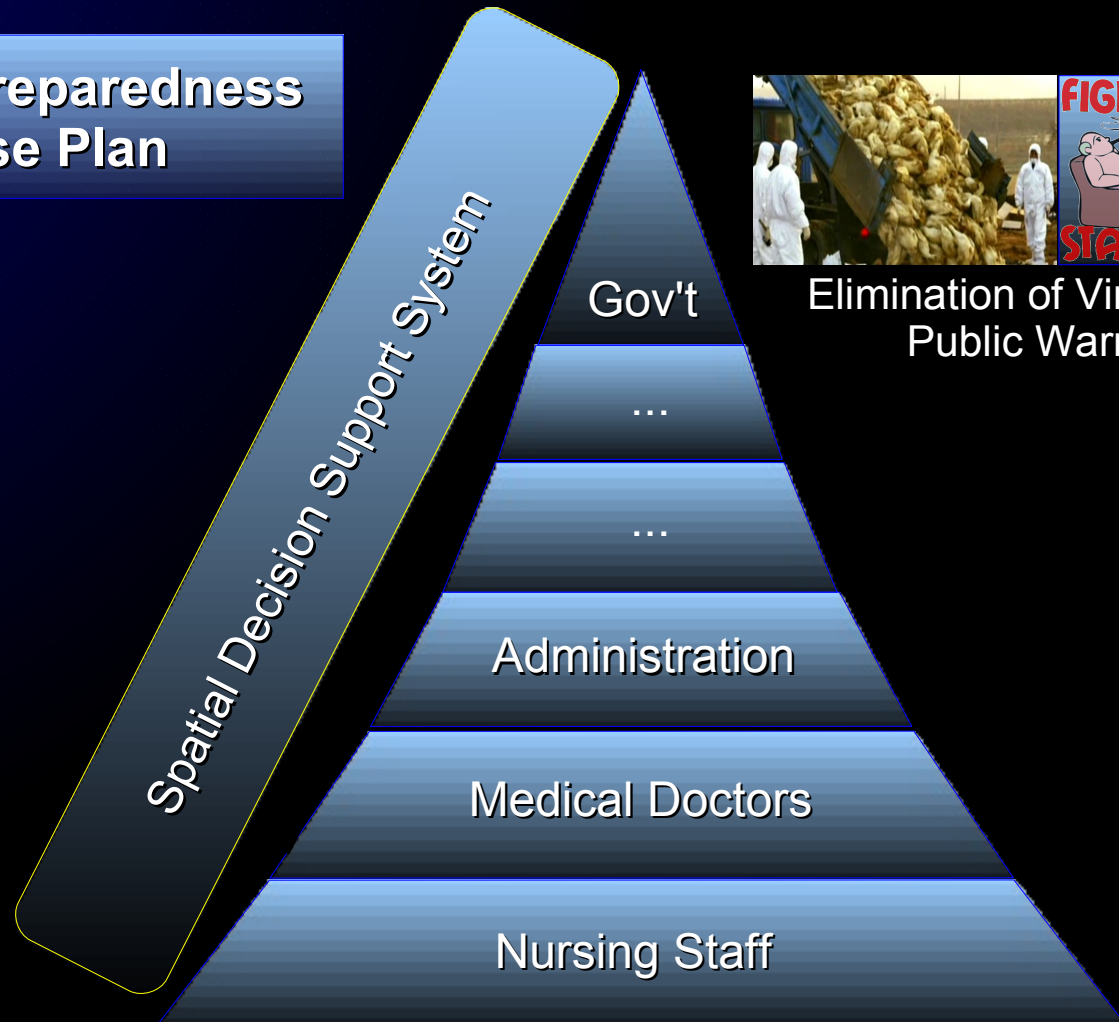
# Space Technology & Decision Support



Elimination of Virus Hosts  
Public Warning

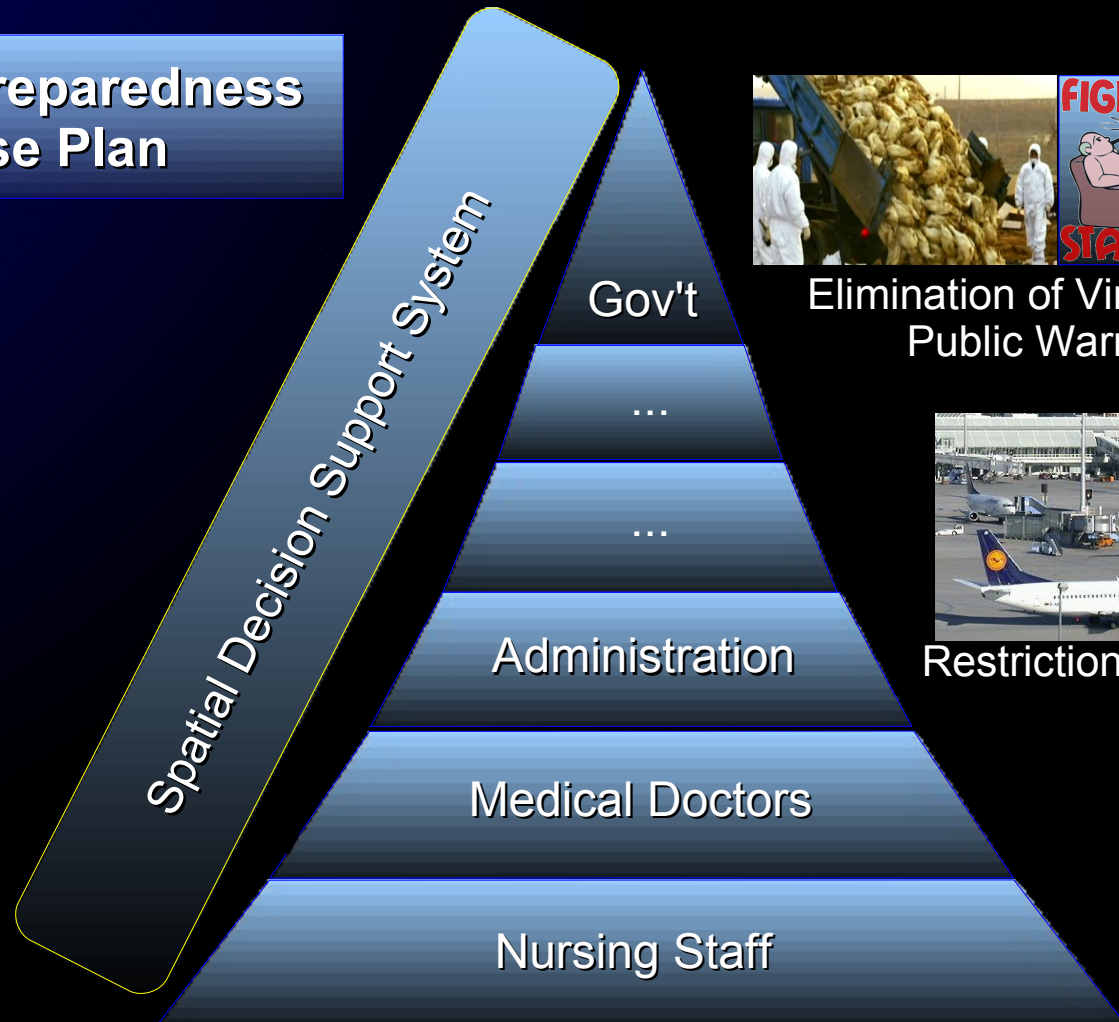
# Space Technology & Decision Support

## National HPAI Preparedness & Response Plan



# Space Technology & Decision Support

## National HPAI Preparedness & Response Plan



Elimination of Virus Hosts  
Public Warning



Restriction of Mobility



# Space Technology & Decision Support

## National HPAI Preparedness & Response Plan

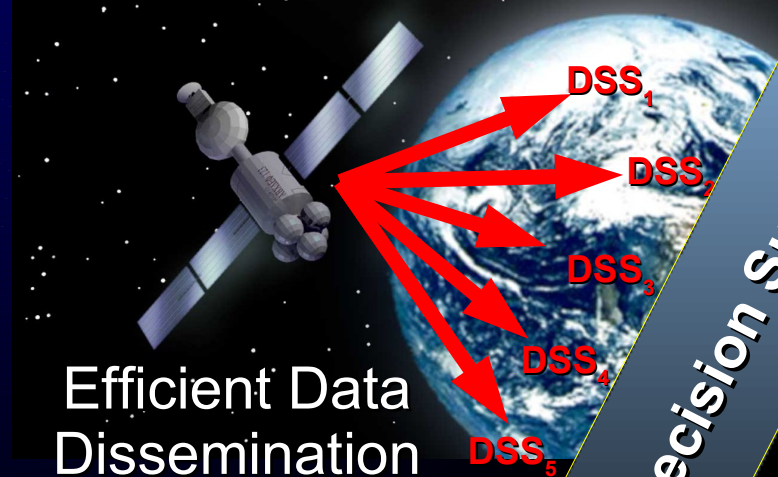


# Space Technology & Decision Support



# Space Technology & Decision Support

National HPAI Preparedness  
& Response Plan



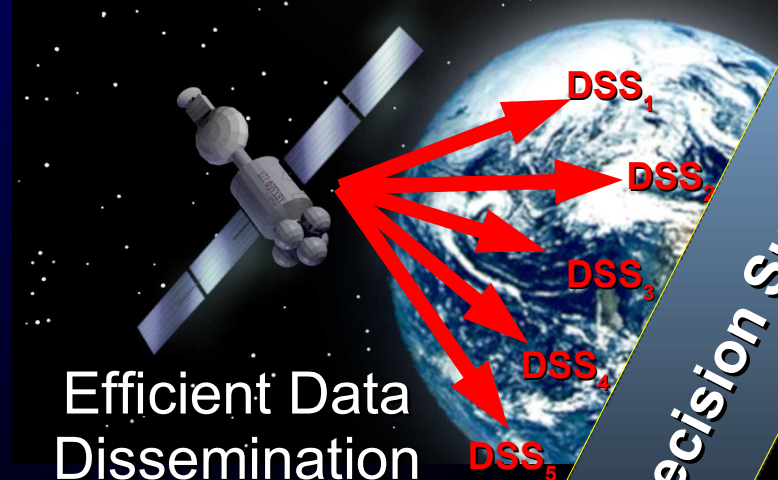
Efficient Data  
Dissemination  
for Early Warning  
by Satellite to  
**DSS-Clients**

Spatial Decision Support System

**GIS**  
Geographic  
Information System

# Space Technology & Decision Support

National HPAI Preparedness  
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Efficient Data  
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Spatial Decision Support System

**GIS**  
Geographic  
Information System

OpenSource  
**GRASS**

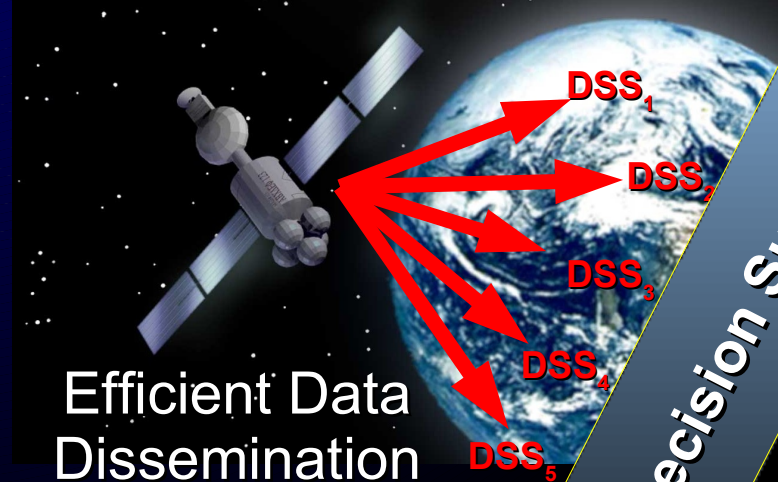
Geographic Resources  
Analysis Support System





# Space Technology & Decision Support

## National HPAI Preparedness & Response Plan



Efficient Data Dissemination for Early Warning by Satellite to **DSS-Clients**

Spatial Decision Support System

**GIS**  
Geographic Information System

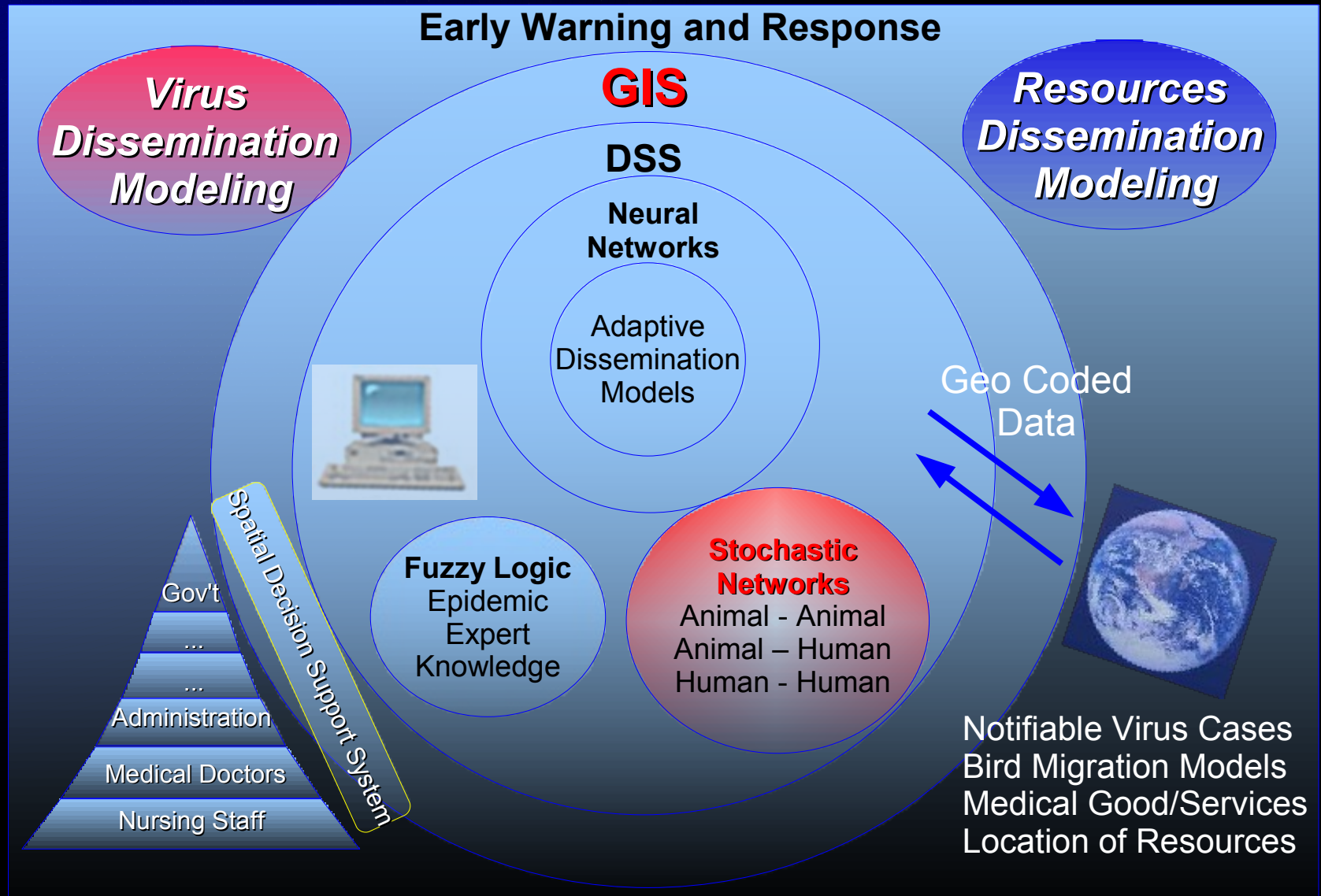
OpenSource  
**GRASS**

Geographic Resources  
Analysis Support System



- > Free Availability
- > Adaption to Early Warning
- > Multiplatform [Windows Linux Mac]

# Overview



# GIS & Stochastic Networks

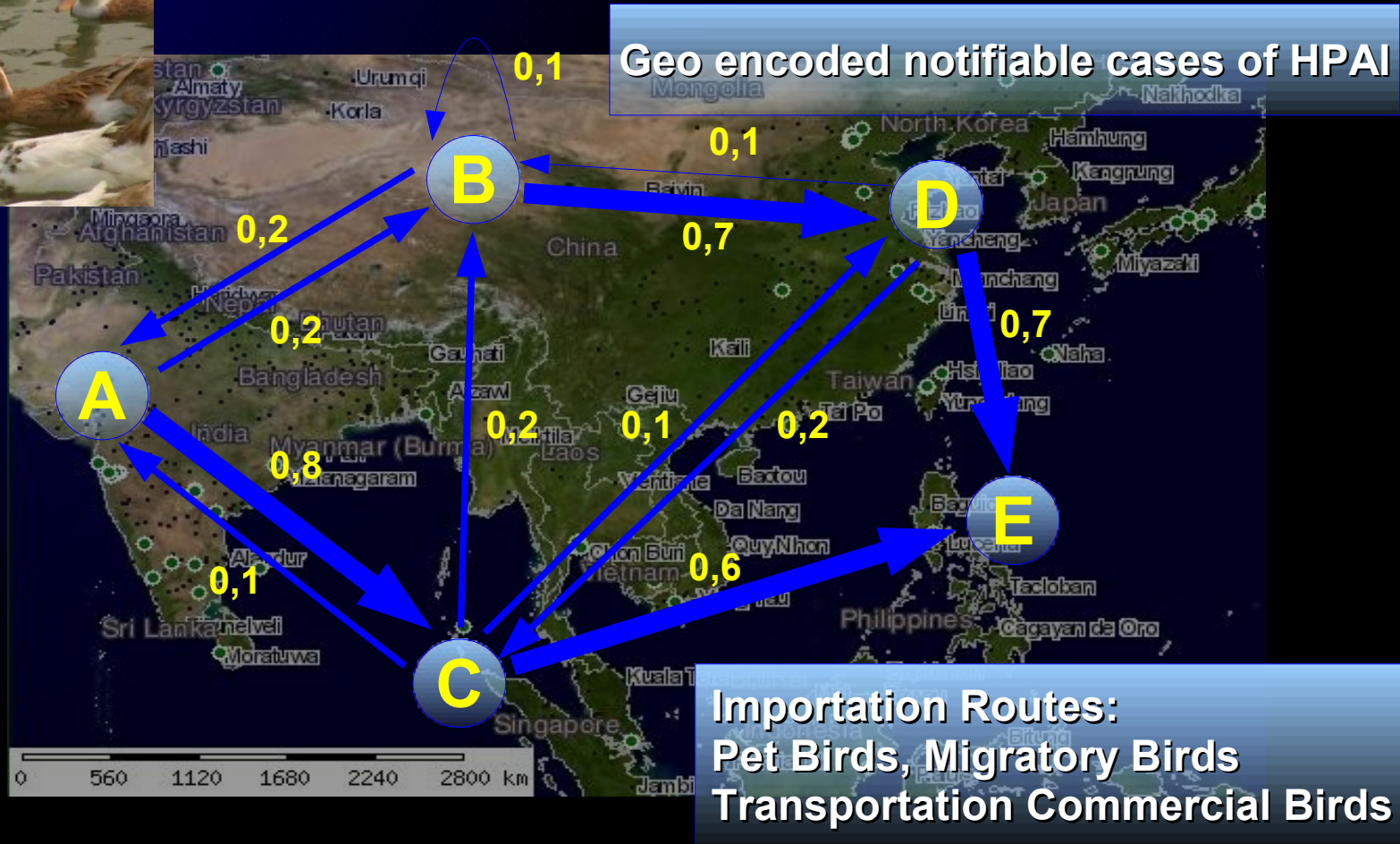
## Virus Host: Birds





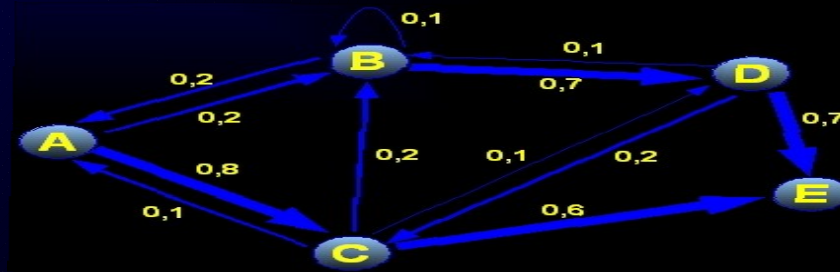
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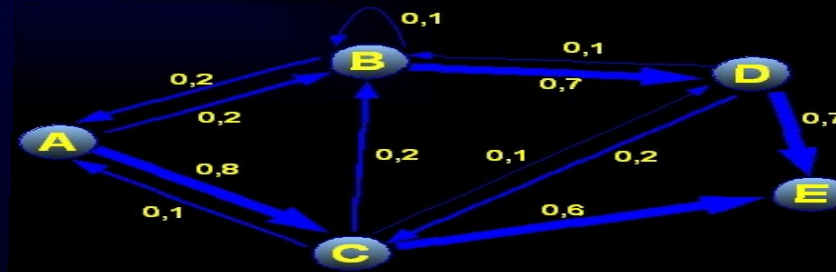
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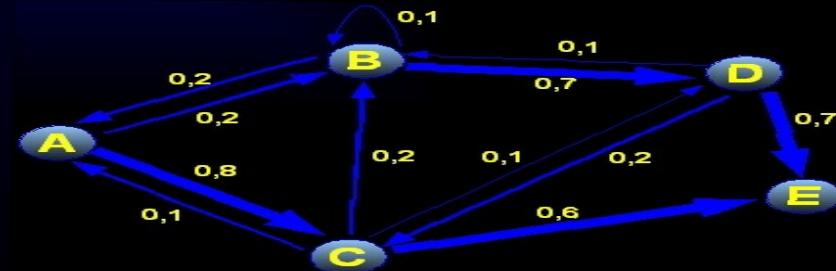


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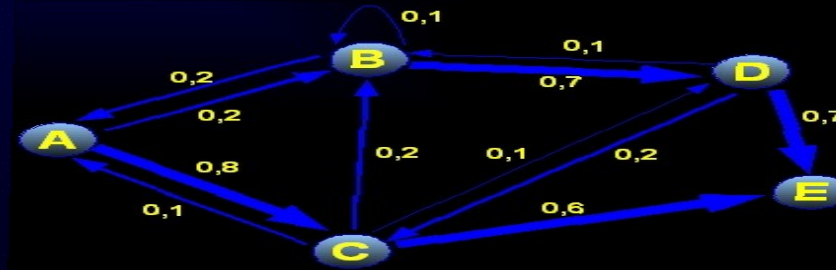


## Virus Host: Humans

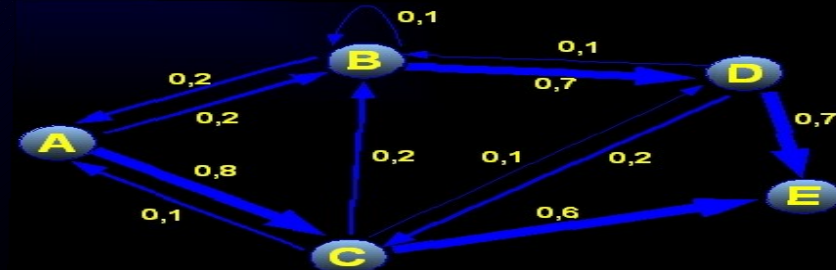


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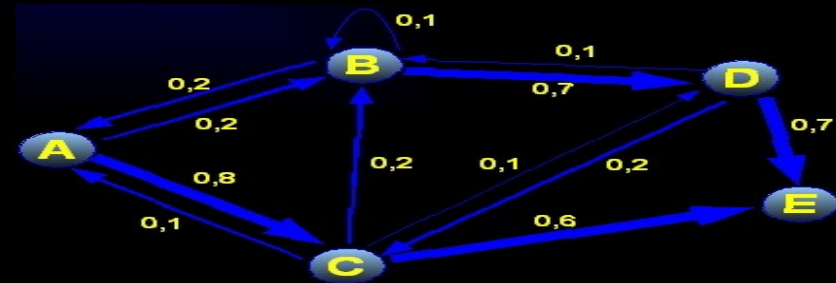
## Virus Host: Birds



## Virus Host: Humans



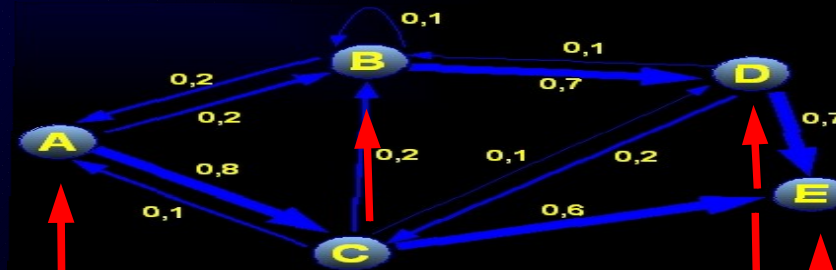
## Virus Host: Pigs



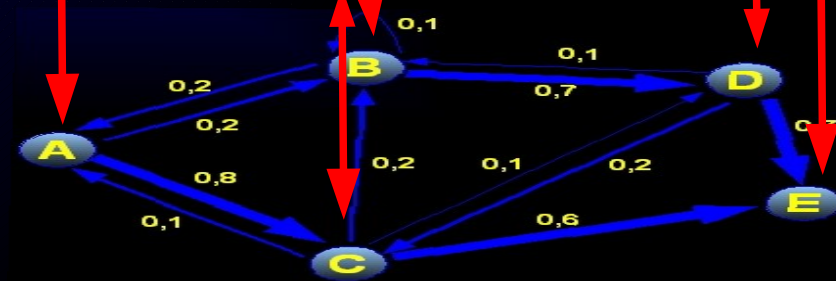


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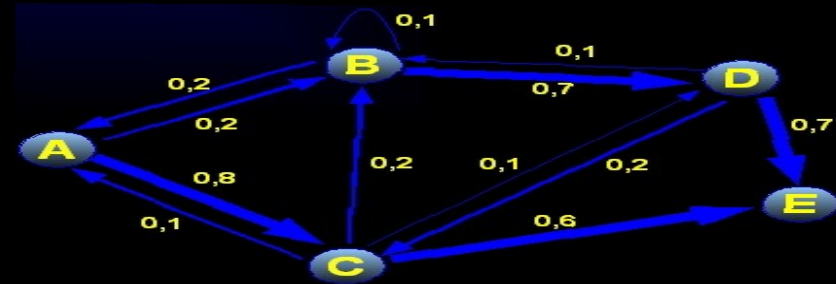
## Virus Host: Birds



## Virus Host: Humans



## Virus Host: Pigs



# GIS & Stochastic Networks

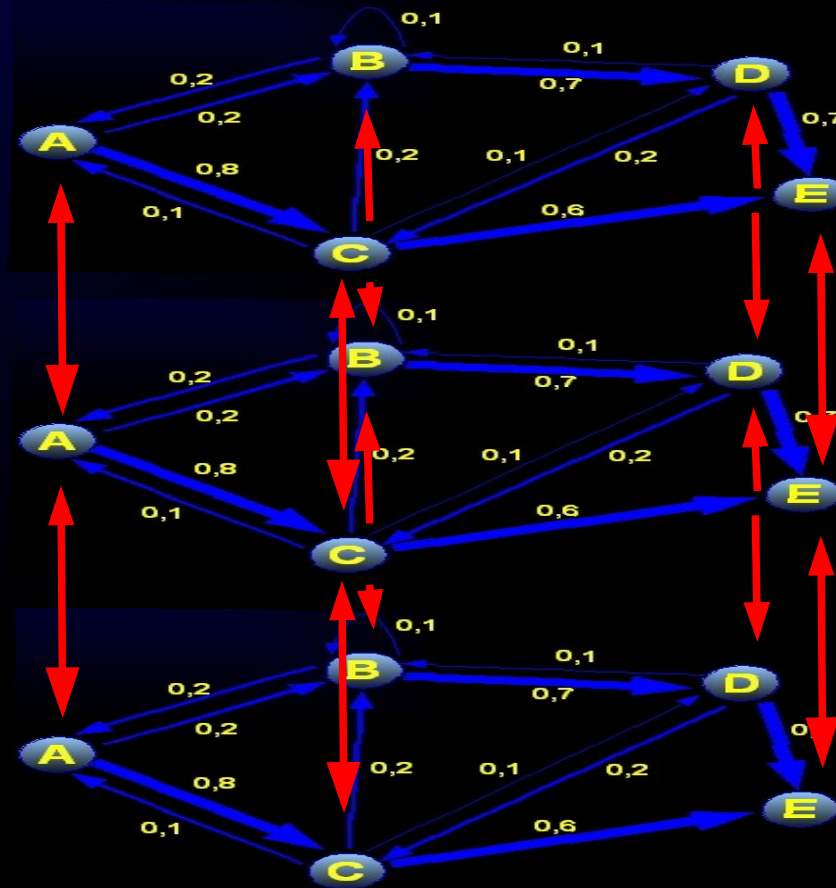
## Virus Host: Birds



## Virus Host: Humans



## Virus Host: Pigs



# GIS & Stochastic Networks

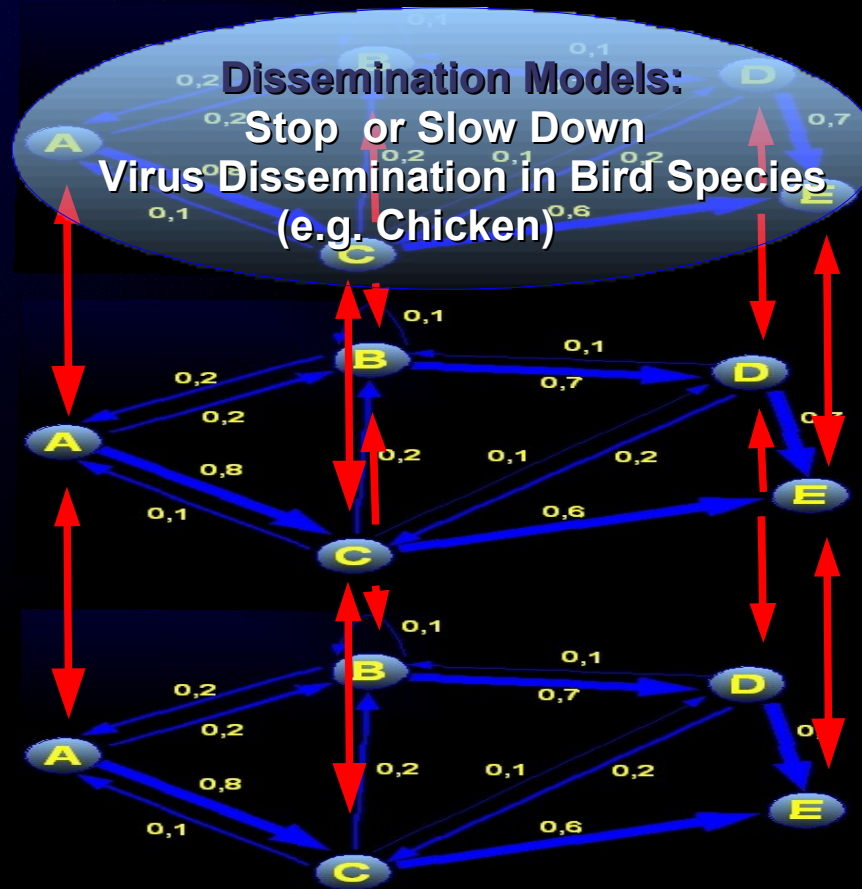
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## Virus Host: Humans



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# GIS & Stochastic Networks

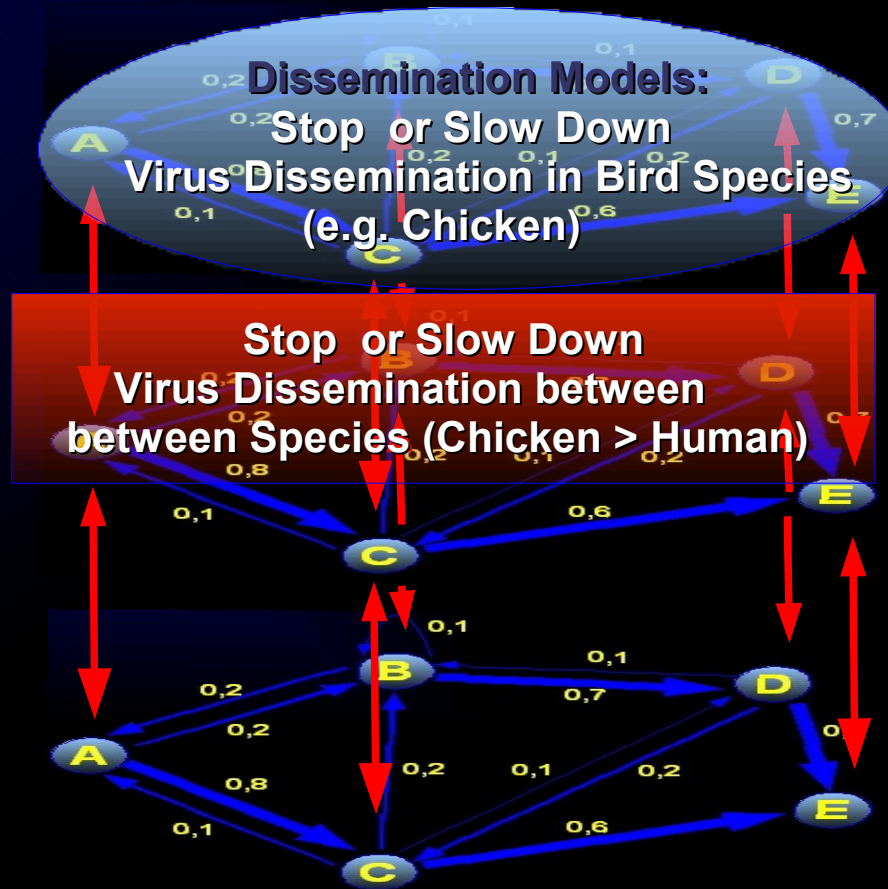
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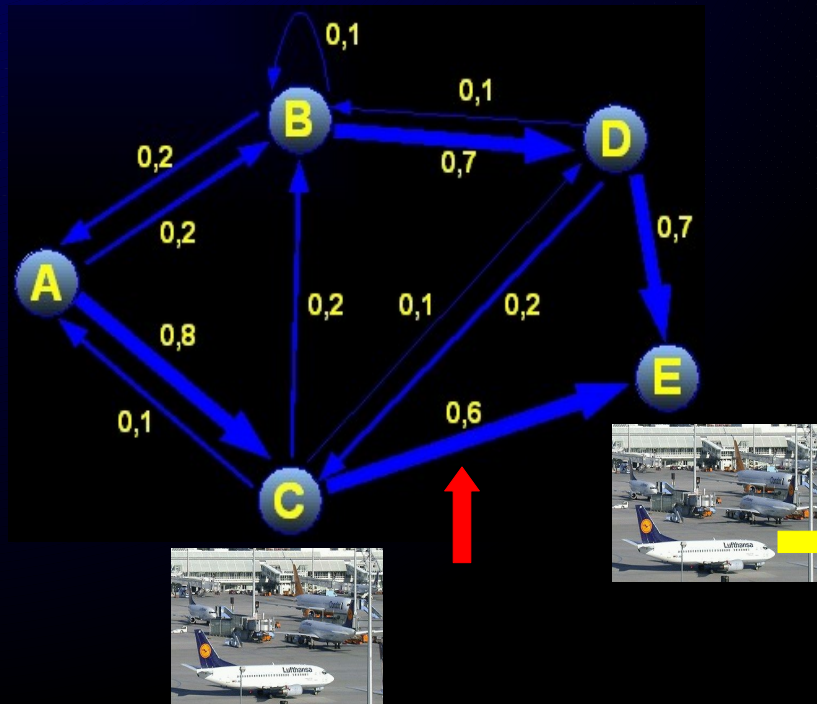
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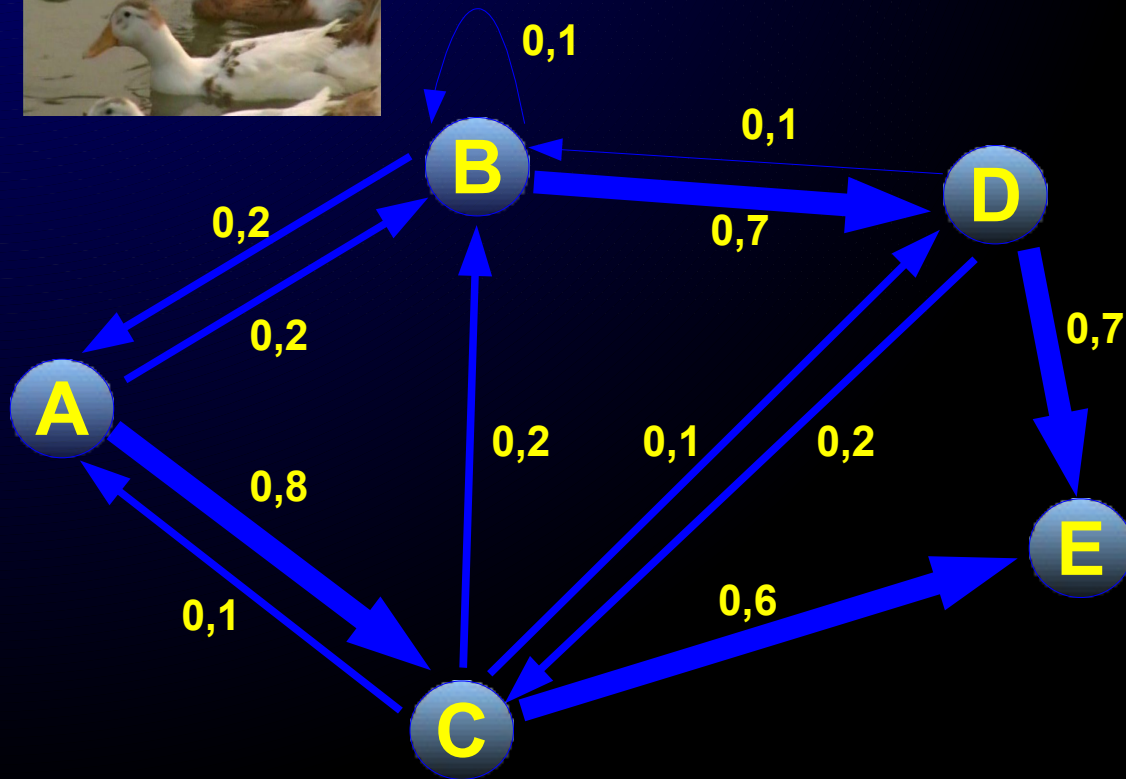


# Stochastic Networks



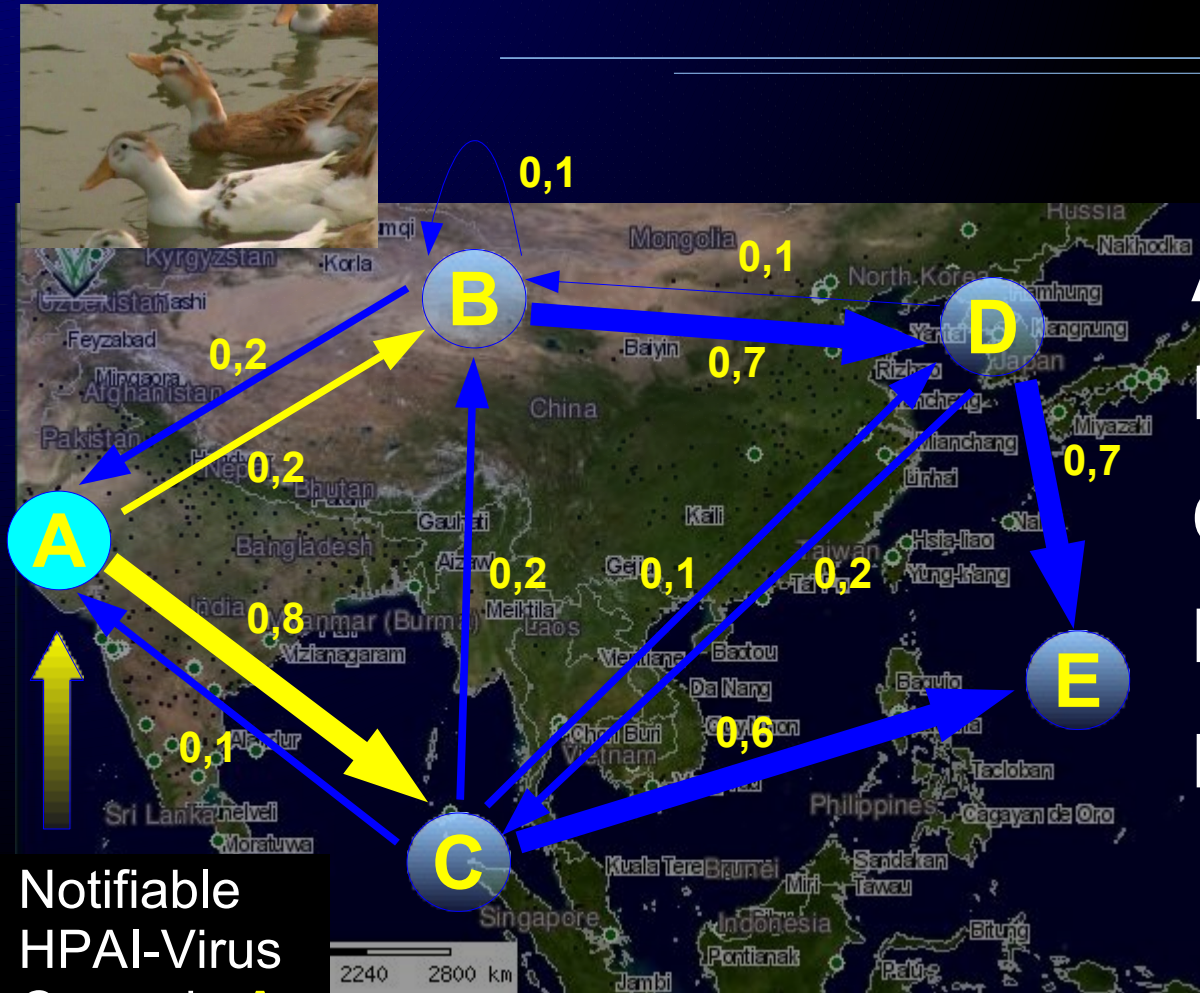
	A	B	C	D	E
A	0	0.2	0.1	0	0
B	0.2	0.1	0.2	0.1	0
C	0.8	0	0	0.2	0
D	0	0.7	0.1	0	0
E	0	0	0.6	0.7	0

# Stochastic Networks



	A	B	C	D	E
A	0	0.2	0.1	0	0
B	0.2	0.1	0.2	0.1	0
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# Stochastic Networks



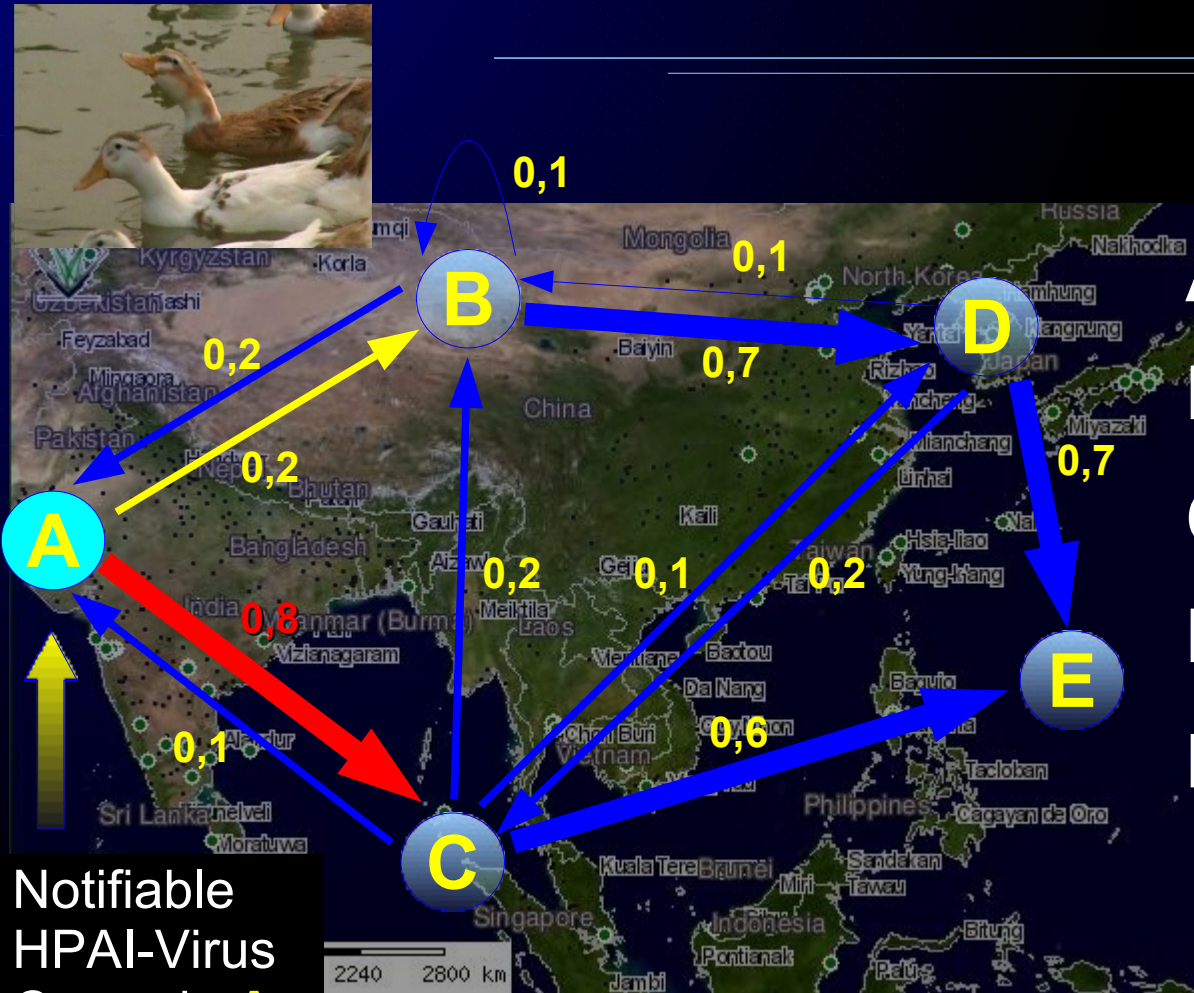
Notifiable  
HPAI-Virus  
Cases in **A**

	A	B	C	D	E
A	0	0.2	0.1	0	0
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Probability Distribution  
Bird Migration Flyways



# Stochastic Networks

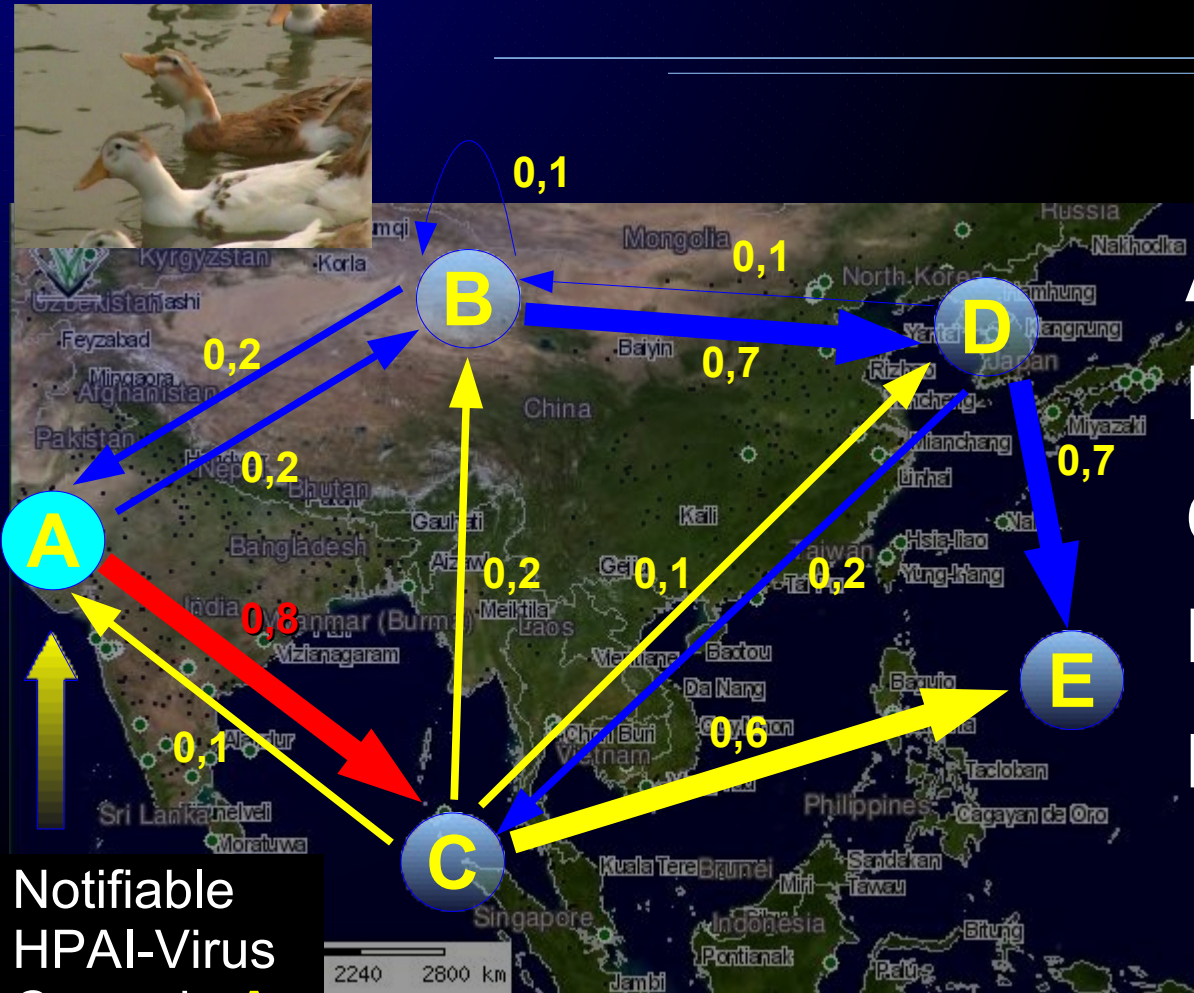


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# Stochastic Networks



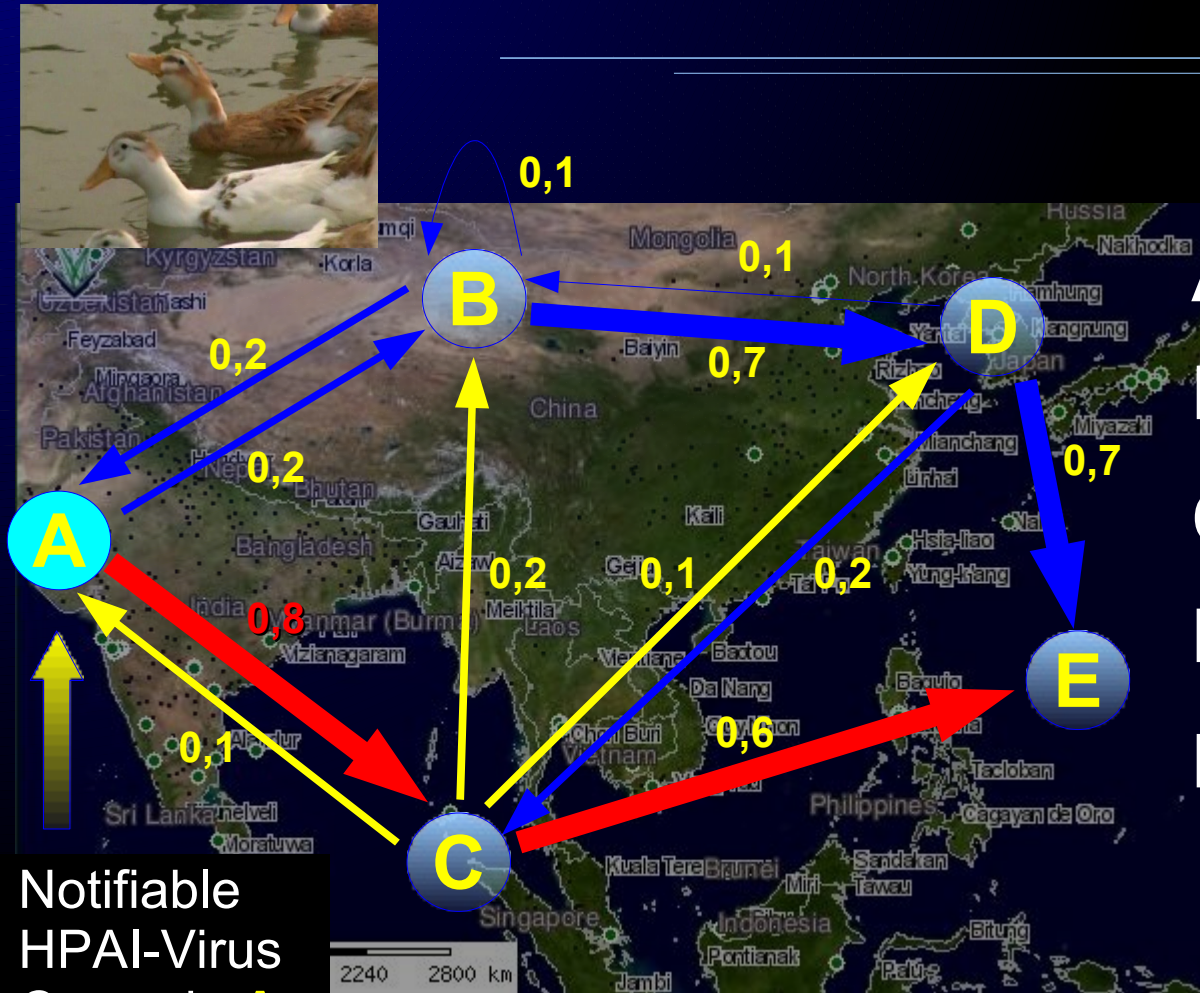
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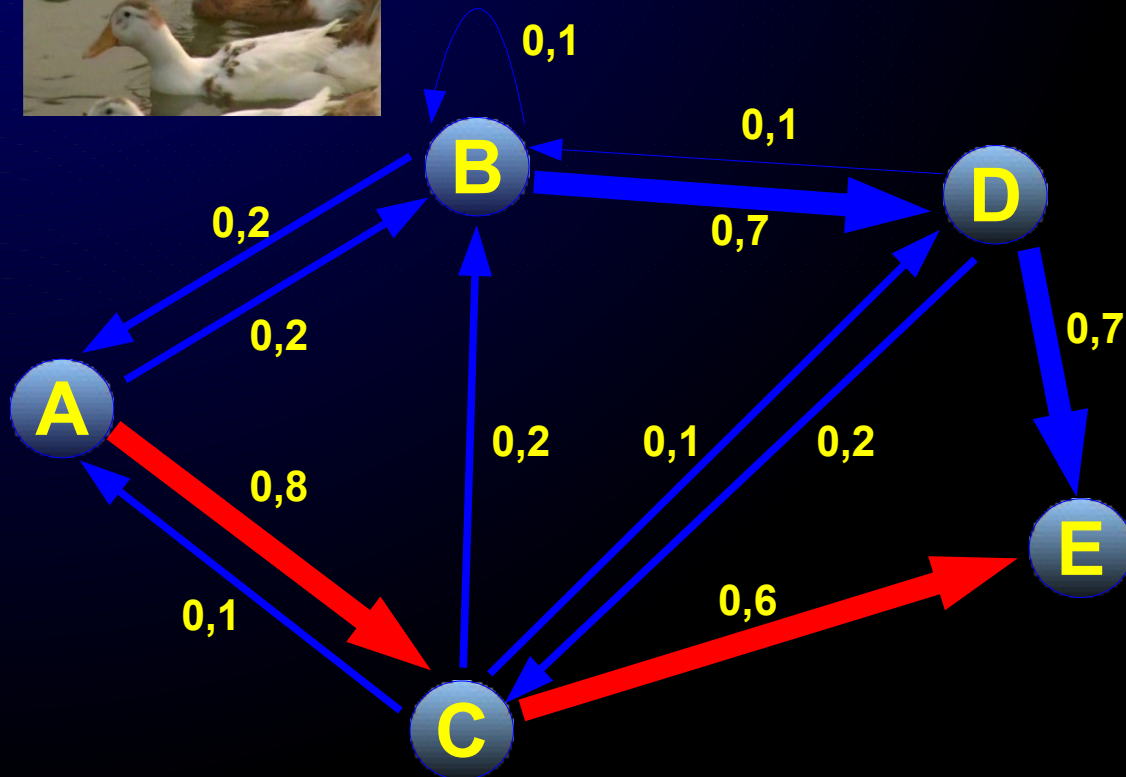


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Probability Distribution  
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# Stochastic Networks



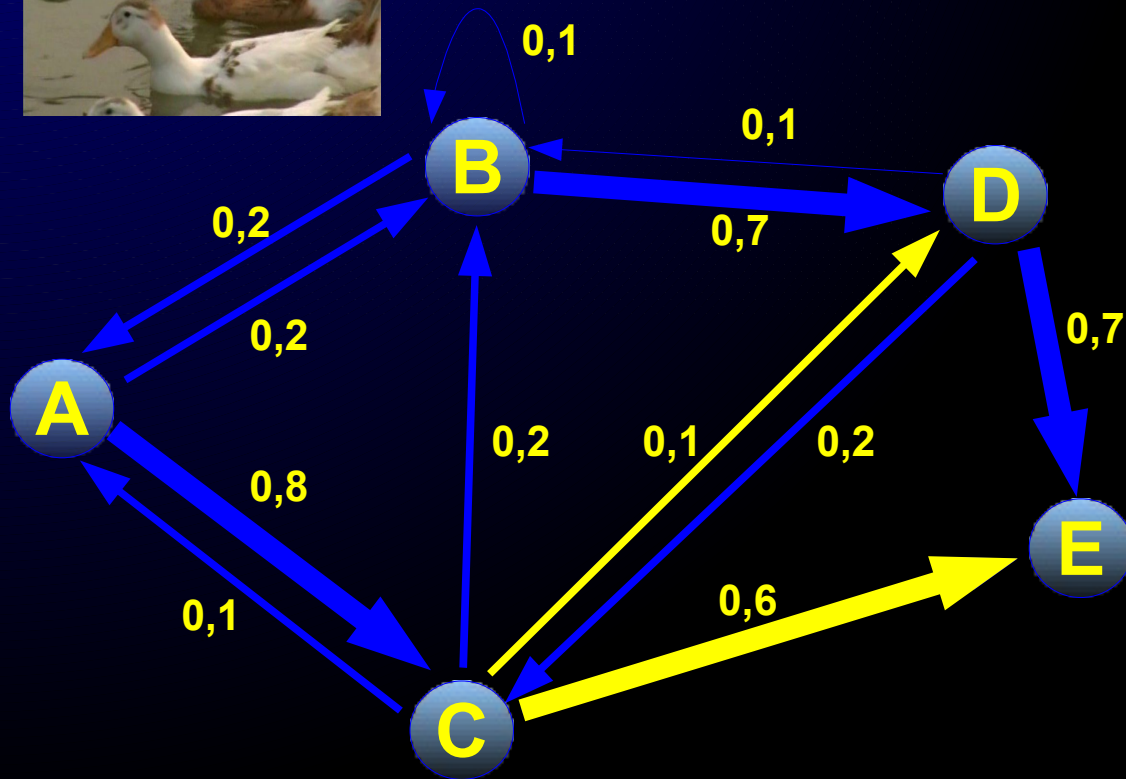
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**Main Migration Flyway of Virus Host**

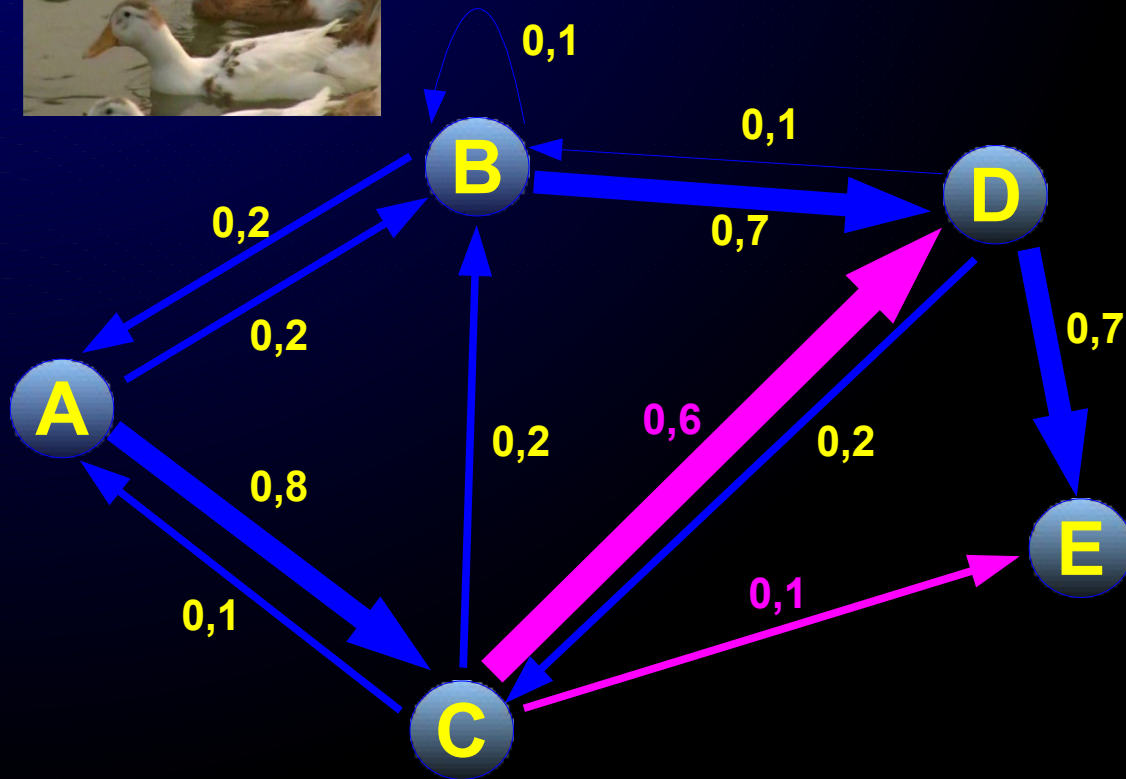


# Stochastic Networks



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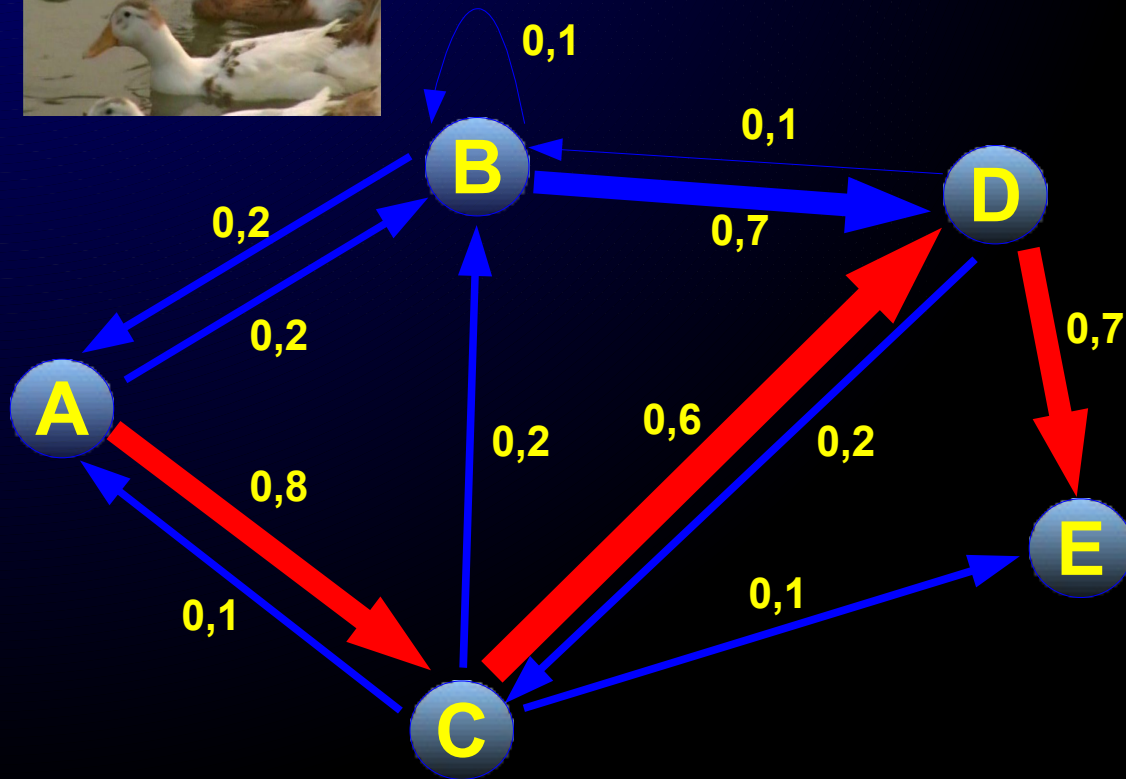


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**parametric learning (Adaptivity)**

# Stochastic Networks

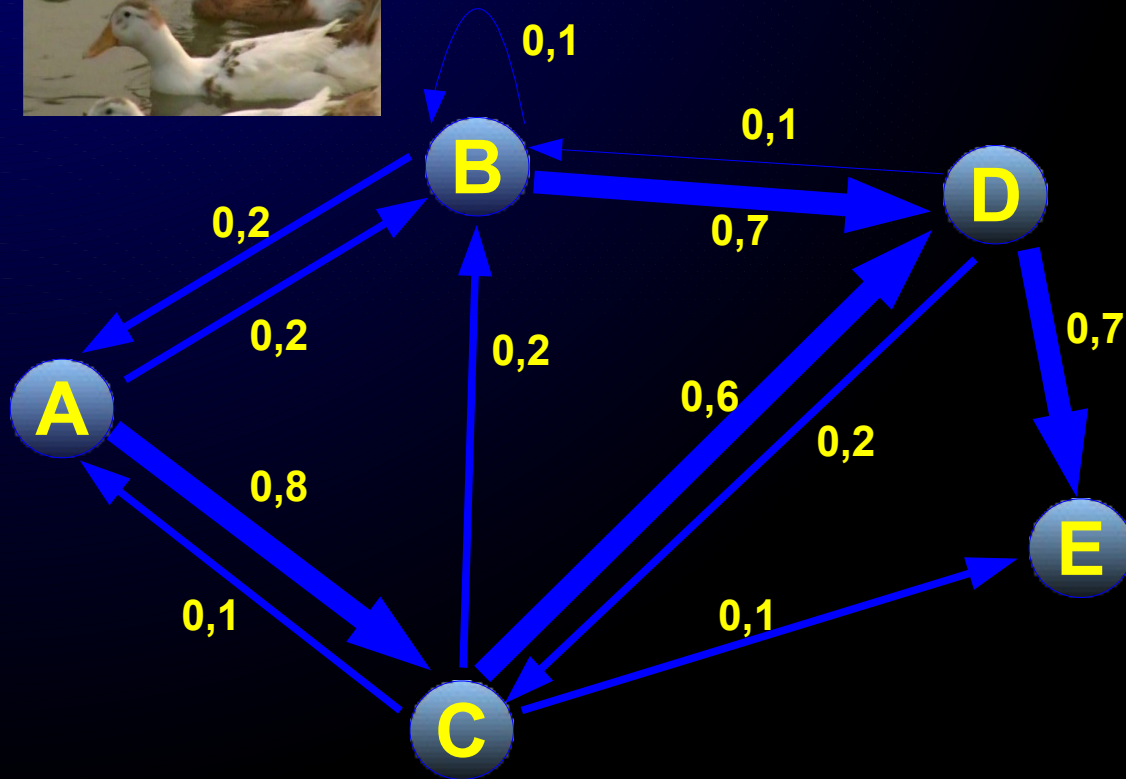


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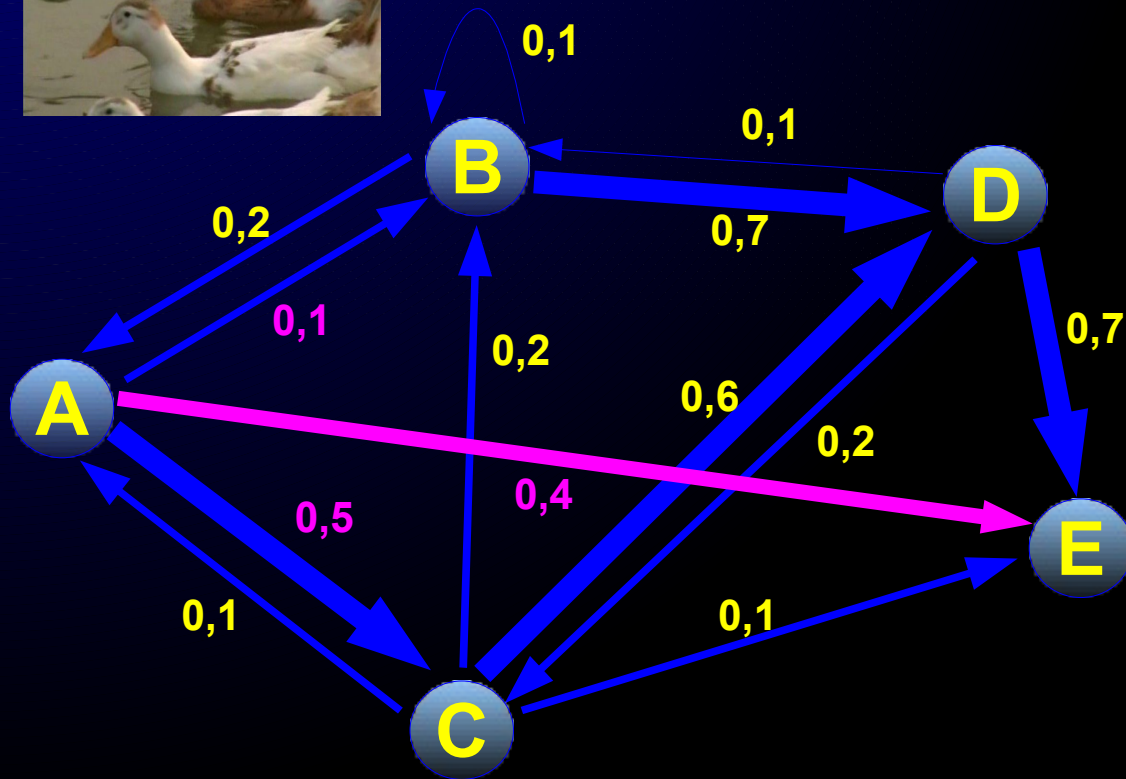
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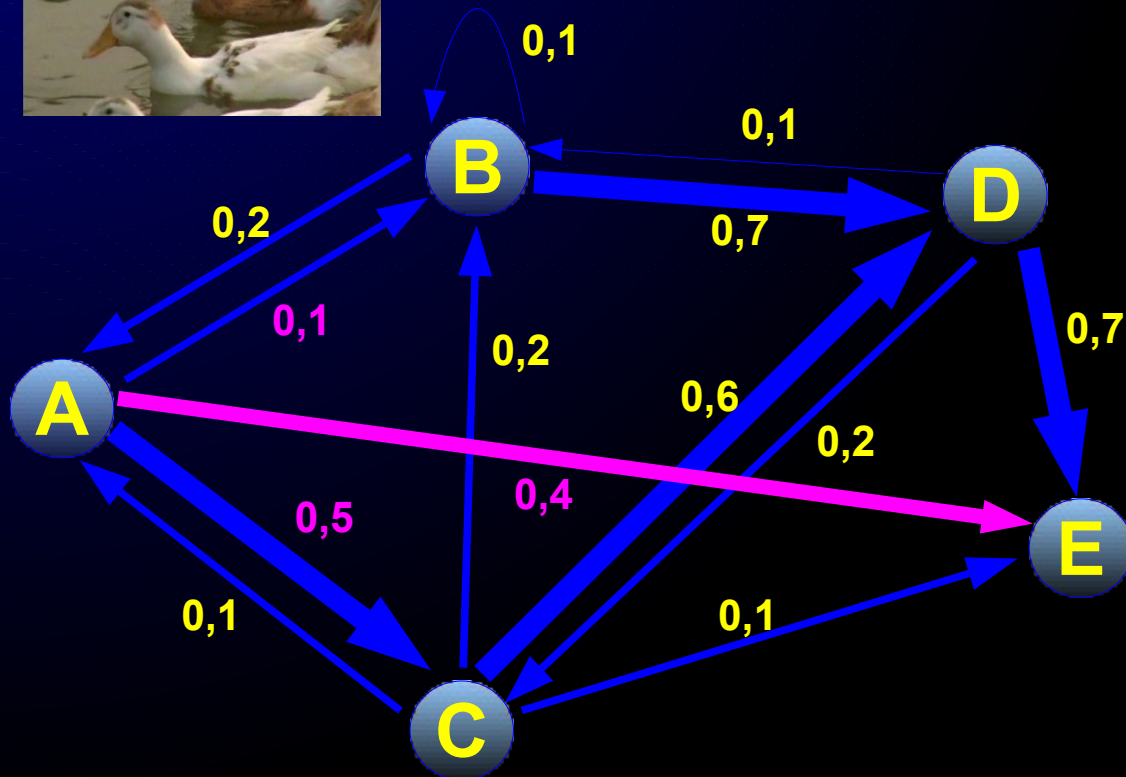


# Stochastic Networks



	A	B	C	D	E
A	0	0.1	0.1	0	0
B	0.1	0.1	0.2	0.1	0
C	0.5	0	0	0.2	0
D	0	0.7	0.6	0	0
E	0.4	0	0.1	0.7	0

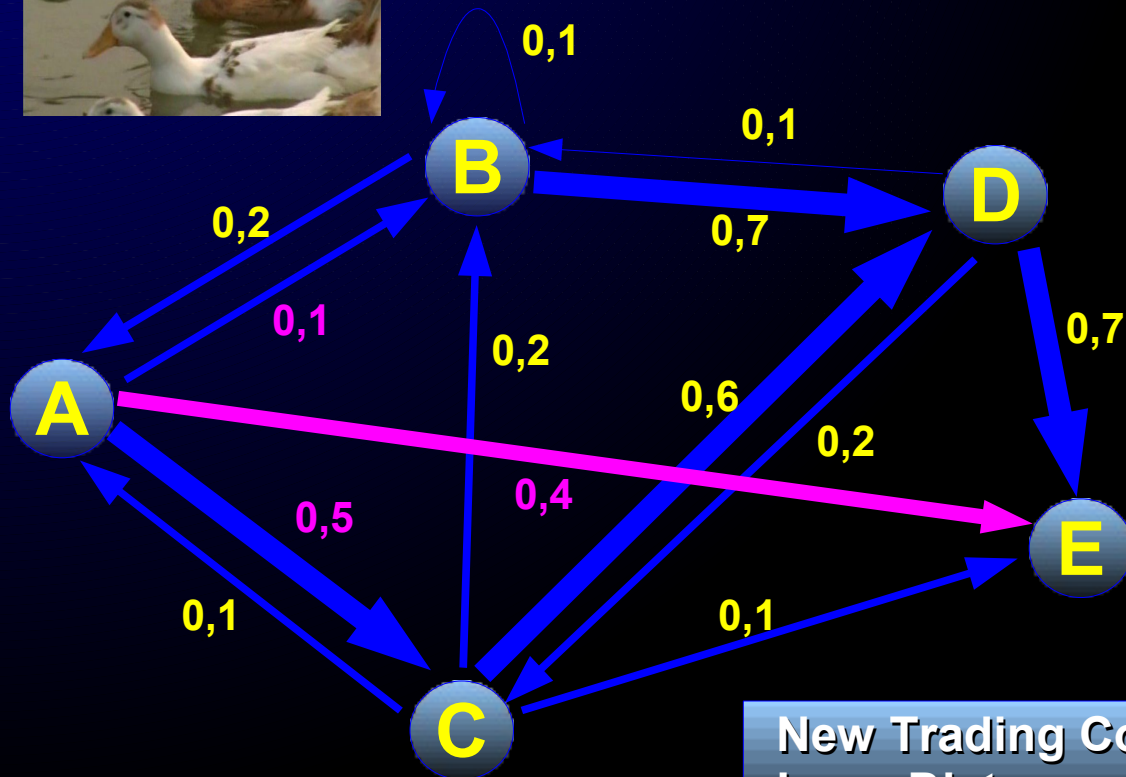
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 **topological learning**

# Stochastic Networks



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New Trading Connection between **A** and **E**  
Long Distance Commercial Bird Importation



**topological learning**

# Data Retrieval & Stochastic Networks

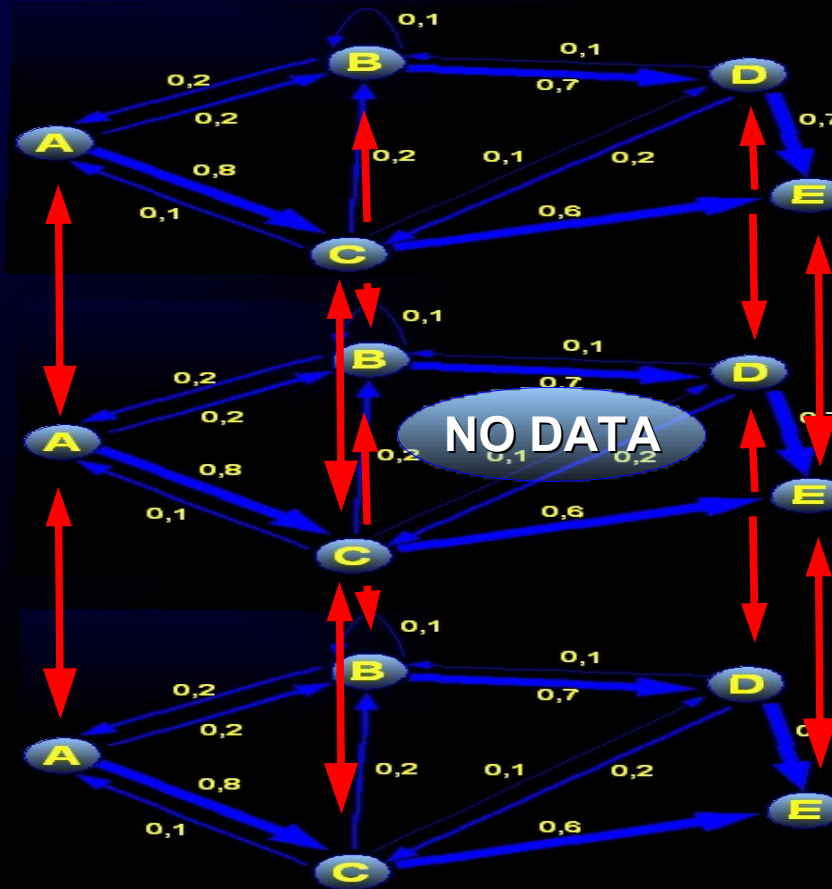
## Virus Host: Birds



## Virus Host: Humans



## Virus Host: Pigs



Commercial  
Bird Trading

Biology  
Bird Migration

Bird to Human  
Transmission

**Low** pathogenic  
high infectious  
Influenza model

Structure of  
Agriculture

Transmission of  
Virus in species

**High Mutation Rate of Virus in all Layers**



# Data Retrieval & Stochastic Networks

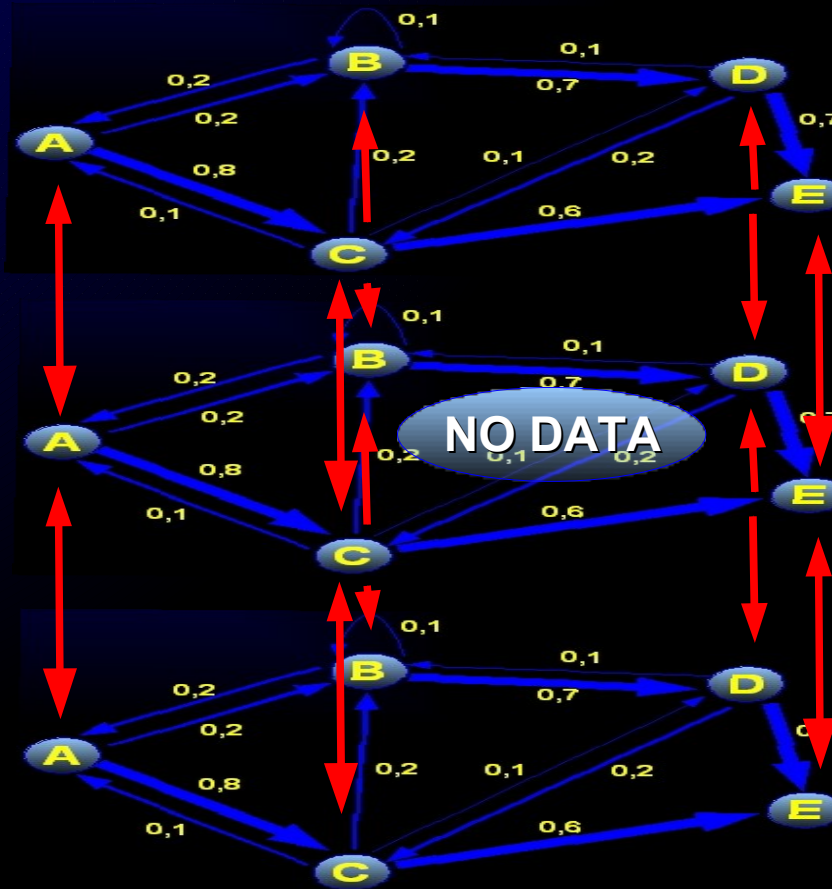
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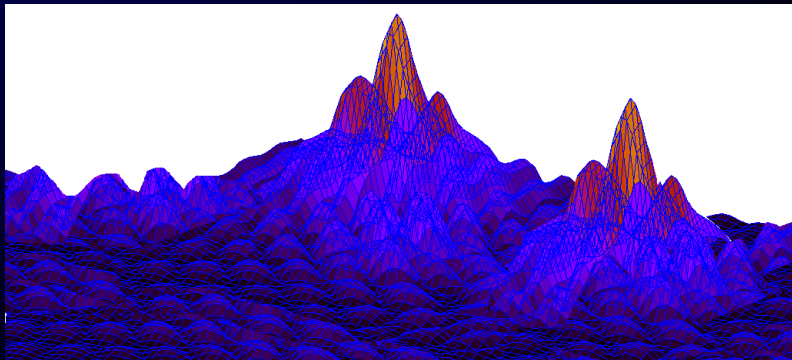
Structure of  
Agriculture

Transmission of  
Virus in species

**High Mutation Rate of Virus in all Layers**

# Medical Data, Borders & Security

**Virus does not  
respect borders!**



**Medical data has  
to respect borders!  
(Institution, Law)**



**Public Key**



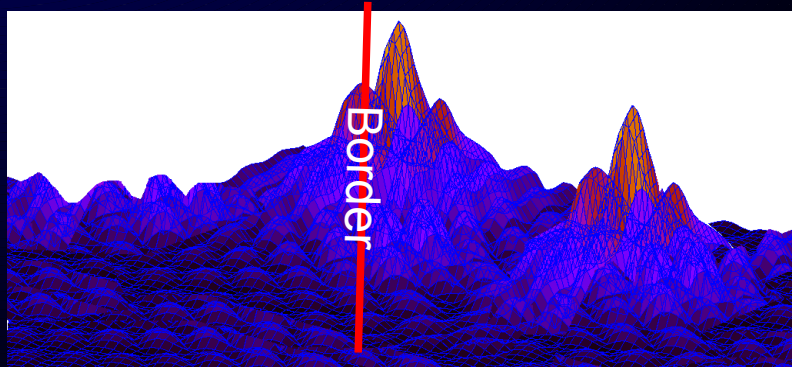
**RSA Cryptology**



**Private Key**

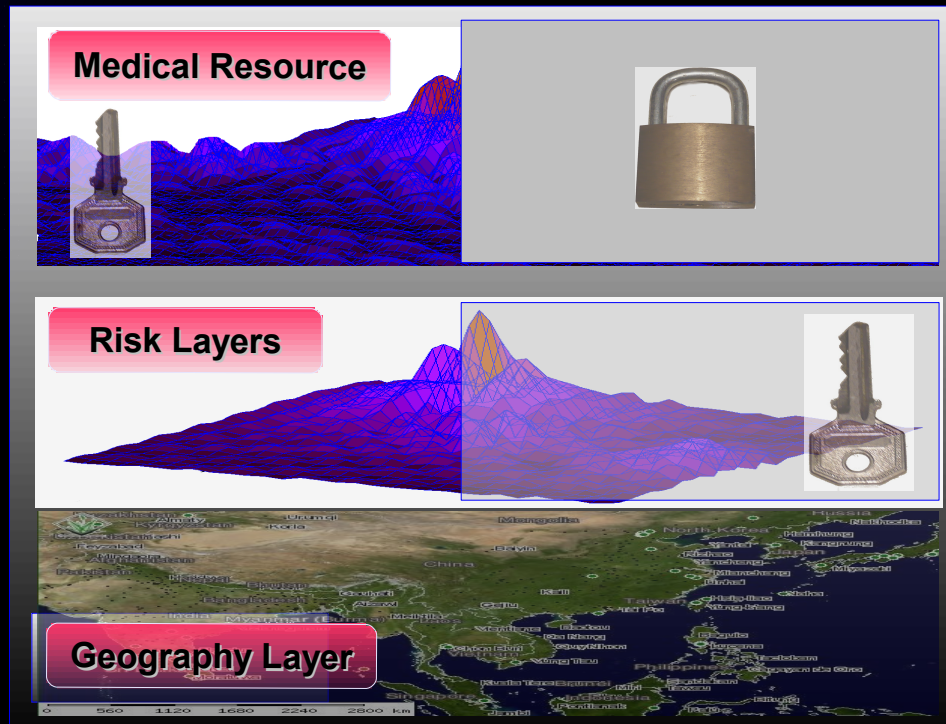
# Medical Data, Borders & Security

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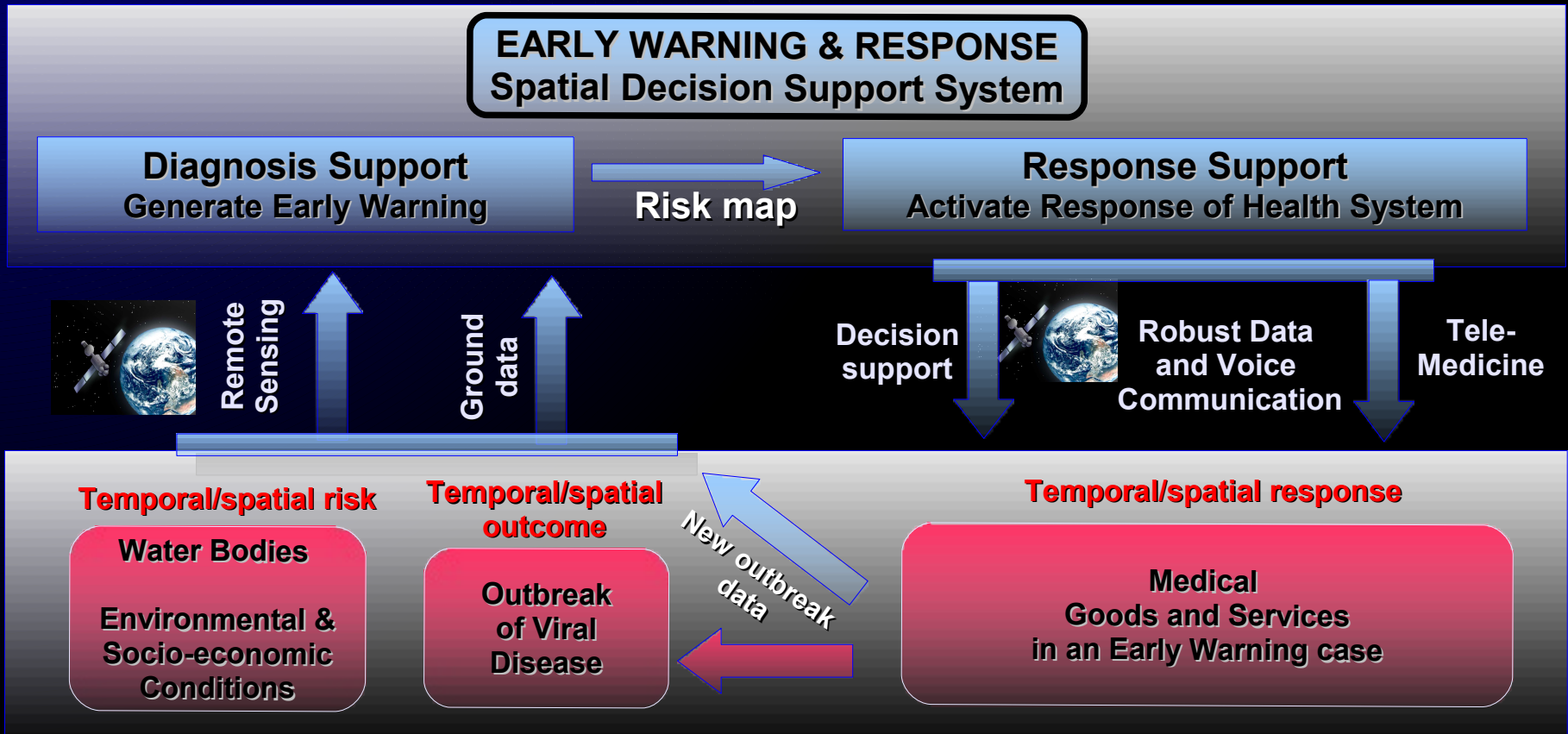


**Medical data has  
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(Institution, Law)**

## National Authorities/WHO



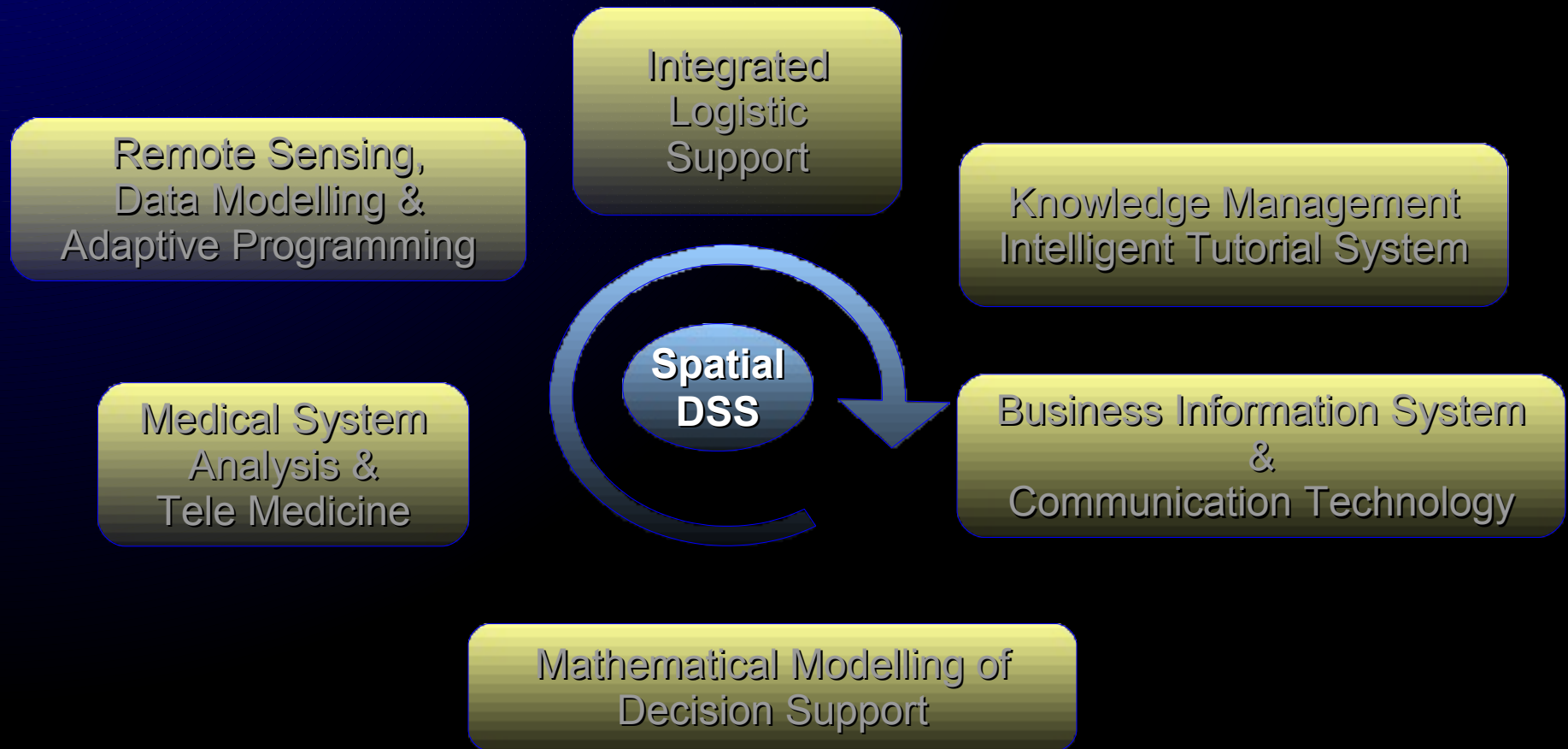
# Early Warning & Response Cycle





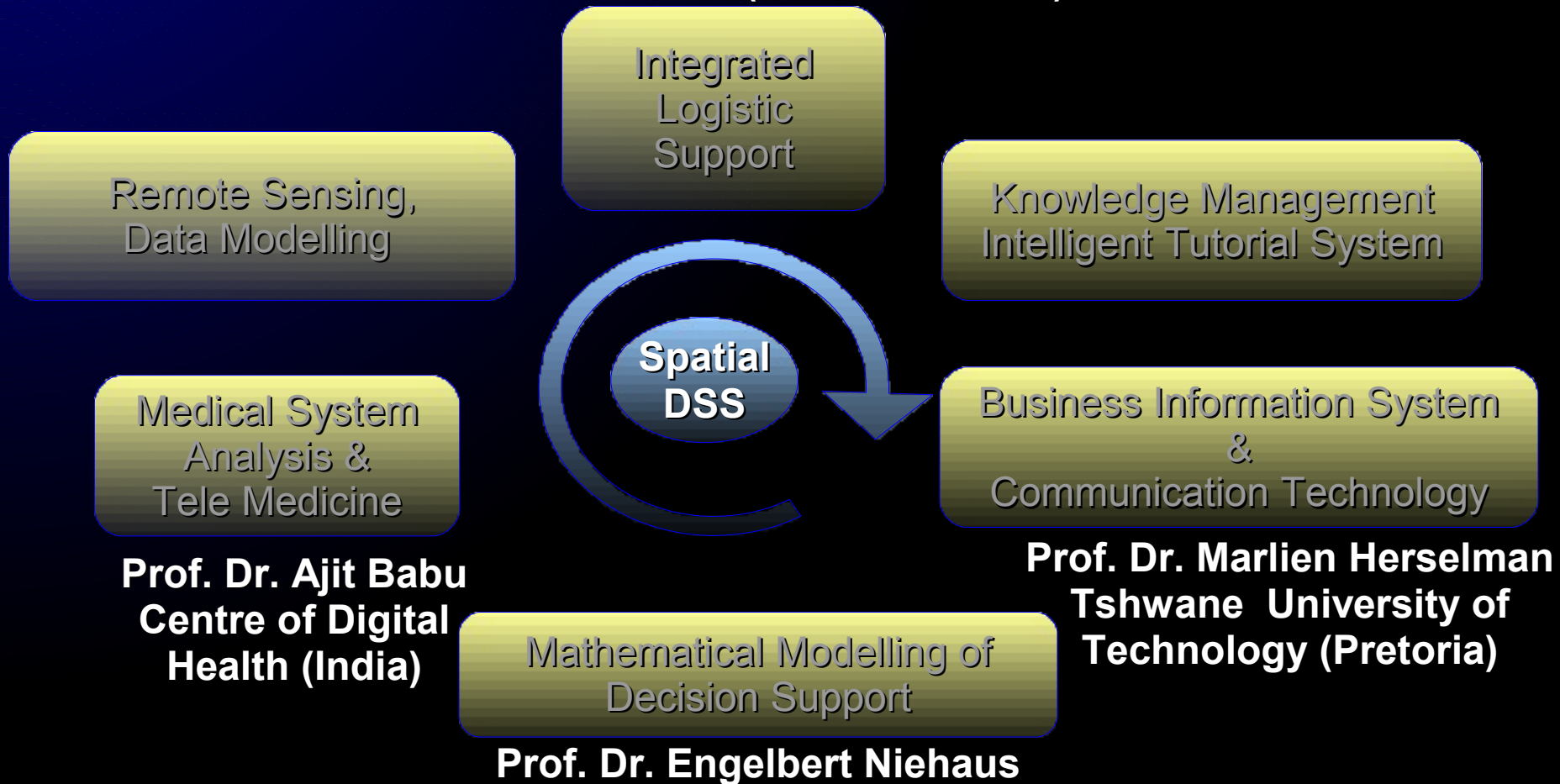
# Multidisciplinary Approach Early Warning & Response

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# Multidisciplinary Approach Early Warning & Response

**Gehard Ackermann (ReGLaN-Health)**



# Multidisciplinary Approach Early Warning & Response

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