MCC GAIA v1.0

Greater Artificial Intelligence Awareness

By Spirit, 17-01-2014

Contents

Introduction

GAIA stands for Greater Artificial Intelligence. Ever since I typed my first 2 lines of MCC code it has been going through my mind. What if the AI did…? Why isn't this….? …..These and a zillion other questions have haunted me for too long. GAIA is my answer to most of these questions. So, now you know my personal motivation, let's move on to the system itself. This document tries to focus on the intent of GAIA and the design decisions that have been made. I won't try to explain how all of the code works, but after reading this document you should have a clear understanding of what GAIA stands for, what choices she makes and how she operates.

Goal

GAIA can best be seen as a higher level lead organization that is tasked to make all groups work towards (a) common goal(s). GAIA does not improve and tries not to influence the behavior at group level.

So what is it that GAIA wants? The main goal of GAIA is to defend territory. To do that she makes sure that:

- All assets are used intelligently. Know your units, what can they do, what are their weaknesses.
- Responses to threat are in proportion. Do not send more troops then needed, but also make sure it is enough to deal with the opposing threat.
- Understand the priorities. The closer a threat is to the center of the territory (zone), the higher the priority.

In future versions of GAIA goals will be expanded and might even grow to fully commanding offensive battles.

About version 1

The plans with GAIA far exceed what has been put on paper and what has been realized in code. For all that stuff to happen, I had to have a good foundation. GAIA v1 is only that, the foundation of something that has yet to be build but is making my head spin :)

Requirements

GAIA is in the first place created and designed as 'the new engine' of MCC (Mission Control Centre). For more info see the BIS forums. MCC makes use of UPS, UPSMON, BIS Patrol etc. Although all of them deliver great functionality, they were not created with the intention to be used by MCC. It is exactly the other way around. As we (Shay Gman and I) had, and have, great goals in mind for MCC, the idea was born to build our own AI 'engine'. This is where I took off and for that am back on my original project MCC. So with what did I take off?

GAIA should outperform UPSMON as the currently used 'engines'. Not for the sake of beating them but for the fact that we want to expand the AI numbers and their behavior. If you want that, you need good performance.

GAIA should be setup in such a way that it initially can be a simple 'replacement' for the existing 'engines'. This is the reason why GAIA initially supports the commands 'DEFEND', 'ATTACK' and 'FORTIFY', just like UPSMON and UPS do. (see details later).

GAIA should be created such that it is capable of operating all units created by BIS and the community, in a smart way. No more vehicles without guns in the attack!! (Except for Shay and Spirit)

GAIA should be setup in such a way that expansion of AI behavior can be handled easily.

CYCLES

GAIA commands all troops by cycling through organized phases. After she finishes all phases, one cycle is complete. From a very high level view it can be divided into two phases : Intelligence and Orders. The end of the cycle is celebrated by a well-deserved waiting time and then it starts all over again.

The key phases of a cycle are:

1. Gather Intelligence
2. Update Alarm Levels
3. Classify and value
4. Define Conflict Area's
5. Issue Orders

Let's go through one cycle just briefly, so you get the idea behind it.

Gather Intelligence

In the 'Gather Intelligence' phase GAIA gathers information on the whereabouts of her own and the enemy's troops.

For her own troops she notes where they are, where they have been and where they are going. This information is used to optimize the patrols. It is not necessary for forces to patrol a certain area if a friendly force has recently been there or is planning to go there.

Apart from her own forces, GAIA takes note of all enemy units seen by her forces (including friendly forces not under the control of GAIA). For each target she notes where and when the enemy was last perceived to have been seen. Confirmed kills are scratched from her list without any remorse. Based on the last time an enemy was seen it is categorized in either Targets or Spots. Spots are outdated (i.e. not seen for a while) Targets. Spots are used for patrolling (making sure it is clear), while Targets need immediate response and are used for attacks. A Target becomes a Spot by simple staying unseen by GAIA forces until a certain time has expired.

A Spot can be cleared (by a patrol checking out the location of the Spot) or by the fact that too much time has passed and the Spot is dropped from her list (and forgotten).

So Targets can be scratched from the Target list in the following ways:

1. The target is killed.
2. The Target is lost and becomes a Spot.

Spots disappear from the Spot list in one of the following ways:

1. The enemy unit is seen by GAIA forces and the enemy unit becomes a Target once again.
2. GAIA forces have been at the location of the Spot and seen noone. We call that active clearing.
3. GAIA forces fail to actively clear and the Spot simple becomes outdated (too much time has passed by). The Spot is scratched from the list and forgotten.
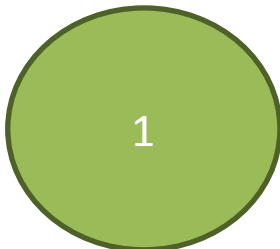
Update Alarm Levels

Every group under GAIA control operates in a certain area. We will call these areas zones. During this phase GAIA starts to check if each zone still has active forces. If a Zone contains no more forces then GAIA forgets all about this zone. Put another way: GAIA produces a list of active zones and considers zones without forces as lost.

Secondly GAIA checks the alarm level of each zone. The levels are Green (No enemy seen), Orange (Enemy's close), Red (enemy in the zone). These alarm levels affect the behavior of all the groups that are operating in that zone. Green means, all is ok and the groups are moving around "SAFE". Red means the highest alert and they move "FULL" speed and AWARE. Combat status is never given. Combat status is defined by the group itself. As soon as it gets into active contact with the enemy it moves itself into Combat Status (BIS default behavior). The combat status excludes it from most orders GAIA can give (but not all!).

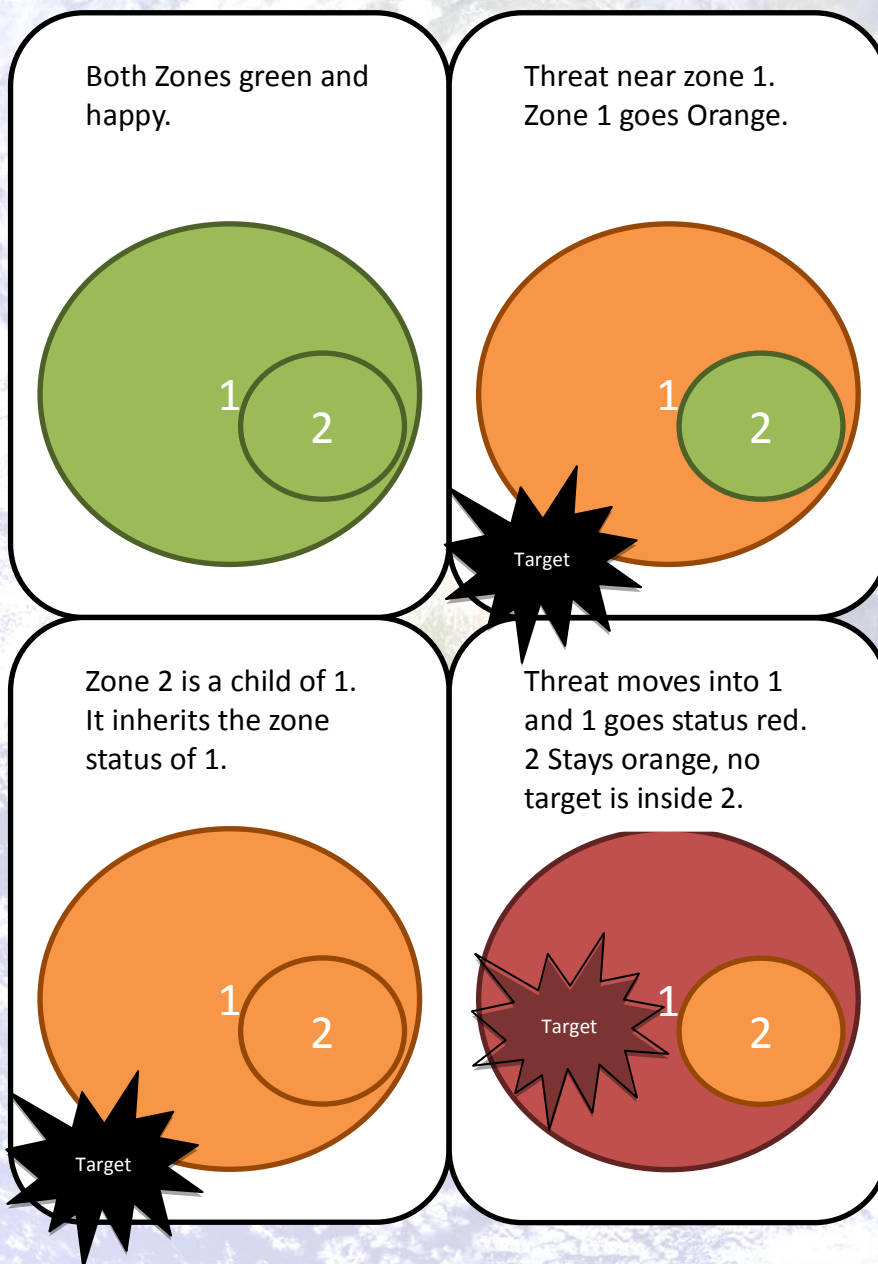| Zone one is happy. No threats are near, the zone is in status Green.	A threat is seen near the zone. The alarm rises to status Orange.	A threat is inside zone one. The alarm rises to status Red.
1	1 Target	1 Target

Overlapping Zones.

A zone can overlap another zone (a big zone containing another zone). GAIA calls these overlapped zones Child Zones and the one overlapping the child is called the Parent Zone. Child zones are affected by Parent zones. If the Parent Zone becomes Orange (targets close), then the Child also becomes Orange. Red status can only be achieved when there is a target inside the zone, so a Child zone will as a maximum go to status Orange, based on the status of the Parent zone.

Both Zones green and happy.

1
2

Threat near zone 1. Zone 1 goes Orange.

1
2

Target

Zone 2 is a child of 1. It inherits the zone status of 1.

1
2

Target

Threat moves into 1 and 1 goes status red. 2 Stays orange, no target is inside 2.

Target
1
2

Classify and Value

During this phase GAIA evaluates the size of her forces and what they are capable of. Every group will be analyzed and for each group she notes the following information:

- Class
- Speed
- Points
- Portfolio
- Cargo Space

Let's take a closer look at what these value mean, as they are vital for the decisions GAIA makes.

Class

A class is a conclusion we draw from analyzing the units in a group. Some examples will help: If we have 10 normal infantry then GAIA will classify this group as Infantry. If it contains 5 recon units then it will be classified as 'Recon Infantry'. So far these are straight forward examples. Let's say a group contains 5 infantry and 1 Hunter with 2 cargo spaces; this group will be classified as 'Motorized Infantry'.

So why do we need that class anyway? Orders to Recon Infantry are different than orders to artillery units. So when a group is identified as a particular class, it makes it clear what orders can be given to that group by GAIA. Those orders are stored in the so called 'Portfolio'.

The classes that are currently automatically detected and supported are: Infantry, Recon Infantry, Anti Air, Car, Motorized Recon, Motorized Infantry, Tank, Mechanized Infantry, Artillery, Helicopter, Ship, Support, Static Gun, Submarine, Unknown.

The "unknown" means that a combination of units is found that GAIA does not recognize as a certain class. An example would be 2 helicopters and a tank in a single group. It will still be able to give it orders, but it will be very cautious and very unexciting. I would not advise using this sort of group, but it's not up to me, it is up to the mission maker (our most firm MCC belief).

As GAIA moves to release 1.0 candidate, I am sure I will have forgotten some class combinations. Also the list is not complete; that I am aware off. Snipers for example. This is where the famous words come in: "in a future release!"

So I hear you think. A Car? Isn't that rather small, too little to tell what it can do? Yes, it is. What about if we also check whether that car has a mounted gun and if it holds cargo for transportation?

Portfolio

As has been said, the portfolio is a set of orders a certain group can execute. The portfolio is based on the class and its specific details. Let's sum up the possible orders with a brief description of what they do.

Do Clear	Group moves to the nearest Spot and checks the area. If nothing seen, the Spot is cleared from GAIA's Spot List (see **Gather Intelligence**).
Do Patrol	Group patrols the zone he is operating in.
Do Attack	Group moves (possible flanking) to the given Conflict Area (CA). (see tbfi)
Do Hide	Group moves to a position in the zone he is operating in that preferable holds forest or other stuff he can seek cover behind.
Do Park	Group moves to a random road position and stands still on the side of the road.
Do Mortar	Group moves to a position from where it will be servicing mortar support.
Do Artillery	Group moves to a position from where it will be servicing artillery support.
Do Transport	Is a combination order. One group moves to a position on the road and waits for the other group to pick them up. The group is then transported to the closest road location of where it needs to be. From there they go their own ways. (See transportation system in the Orders Phase).
Do Cas	Group moves, lands and wait at its designated landing spot, from where it will wait for Close Air Support requests.
Do Support	Group will move to a (preferred road) location in the zone, park its car just off the road and wait for service requests. (Medic, Repair, Fuel etc).
Do Guard	Group will move to a designated position and stand guard.

So how is this all handed out to the group? The following table will shine some light on that. The condition means: does this group have any special requirement before its gets an order added to its portfolio. If, for example, a unit does not hold the ´DoAttack order´, then it will not attack during Order Phase of GAIA.

Class	Condition	Order Portfolio
Infantry	-	Do Clear
	-	Do Attack
	-	Do Patrol
Recon Infantry	-	Do Clear
	-	Do Attack
	-	Do Patrol
Anti Air	-	Do Hide
Car	No Guns + Has Cargo	Do Transport
	Has Guns	Do Attack
	Has Guns	Do Patrol
Motorized Recon	-	Do Patrol
	-	Do Attack
Tank	-	Do Hide
	Guns	Do Attack
Mechanized Infantry	-	Do Patrol
	-	Do Attack
Artillery	-	Do Hide
	-	Do Artillery
Helicopter	-	Do Patrol
	No Guns + Space	Do Transport
	Has Guns	Do CAS
Ship	-	Do Patrol
	Has Guns	Do Attack
		Do Clear (water positions!)
Support	-	Do Hide
	-	Do Support
Static Gun	-	Do Guard
Submarine	-	Do Patrol
Unknown	-	Do Patrol
	Has Guns or contains infantry or holds Recon	Do Clear
	Has Guns or contains infantry or holds Recon	Do Attack

Speed

The value for speed indicates how fast a group can move. GAIA recognizes 'Slow', 'Normal' and 'Fast'. Foot mobiles are considered Slow, vehicles are considered Normal and air units are considered Fast. The group can however contain different unit types in which case the slowest unit determines the speed.

Example: 5 infantry, 1 Hunter with 2 cargo slots. The vehicle is Normal, the infantry is Slow and there is only space for 2 out of 5 infantry in the cargo. The group is considered Slow.

Example: 6 infantry, 1 M113 with 8 cargo slots. The vehicle is Normal and the infantry is Slow. Since all infantry can fit in the vehicle, the group speed is Medium.

So why do we need that speed indication? The speed of the group affects its reaction range. Said in another way: the faster the group is, the further it can travel for attack orders. So foot mobiles are more limited in range to respond to attacks then air units (with exceptions, but that is for later).

Points

Points indicate the threat value of a group of units. That can be either friendly or enemy groups. Points are used to see how much of a response we need to eliminate a threat. GAIA will almost always try to top the enemy points by at least 2 times before commencing an attack.

Examples:

Based on the number of troops we can calculate the point value that is used in the battle system. 6 Infantry = 12 points, plus 1 mechanized armored vehicle makes it a total of 37 points. GAIA calculates the points for vehicles based on a base value of 20 and then 5 points for each turret/gun.

Let's take a look at the current point table:

Class	Points
Infantry	2
Car	5
Tank (*)	10
Artillery	5
Helicopter (*)	20
Ship (*)	10
Recon Infantry	3
Support	1
Static Gun	4
Submarine (*)	0
AA (*)	5
(*) = For each gun add	5

Clarification for the (*): When we have a Hunter (car) it is worth 5 points. If we hold that same hunter and mount a heavy machine gun on top of it we add 5 points. That would make 10 points total.

Why does GAIA need to check on that every round?

Within the GAIA system each class holds a so called Portfolio. This basically means that it becomes clear what sort of activity can be executed by this class. This sounds more vague then it has to be so, let's get some example going here.

Example 1:
A group contains 6 infantry and a transport vehicle with crew. The classification system checks this and, based on the conditions in GAIA, concludes that this is a Mechanized Infantry. The portfolio of Mechanized infantry is: DoAttack, DoPatrol and DoClear. This means that the group can be used during attacks, can actively patrol and is able to clear Spots (see above). Also the preference for its terrain is attached to the class. In this case it would be roads and open areas.

Based on the number of troops we can calculate its point value, that is used in the battle system. 6 Infantry = 12 points, plus 1 mechanized armored vehicle makes it a total of 37 points. GAIA calculates the points for vehicles based on a base value of 20 and then 5 points for each turret/gun.

Example 2:

A group contains one car, has no guns and holds 2 empty cargo s. This 'group' is identified as Car, but because of its content (no guns) it holds the following portfolio: DoTransport, DoHide and DoPark. This basicly means that the car is available for 2 man groups for transportation request, will try to hide during combat and 'Parks' the car somewhere aside the road waiting for transportation requests. As you see the car has no DoAttack. The battle system will for that reason not send the unit into attack. The points for this care
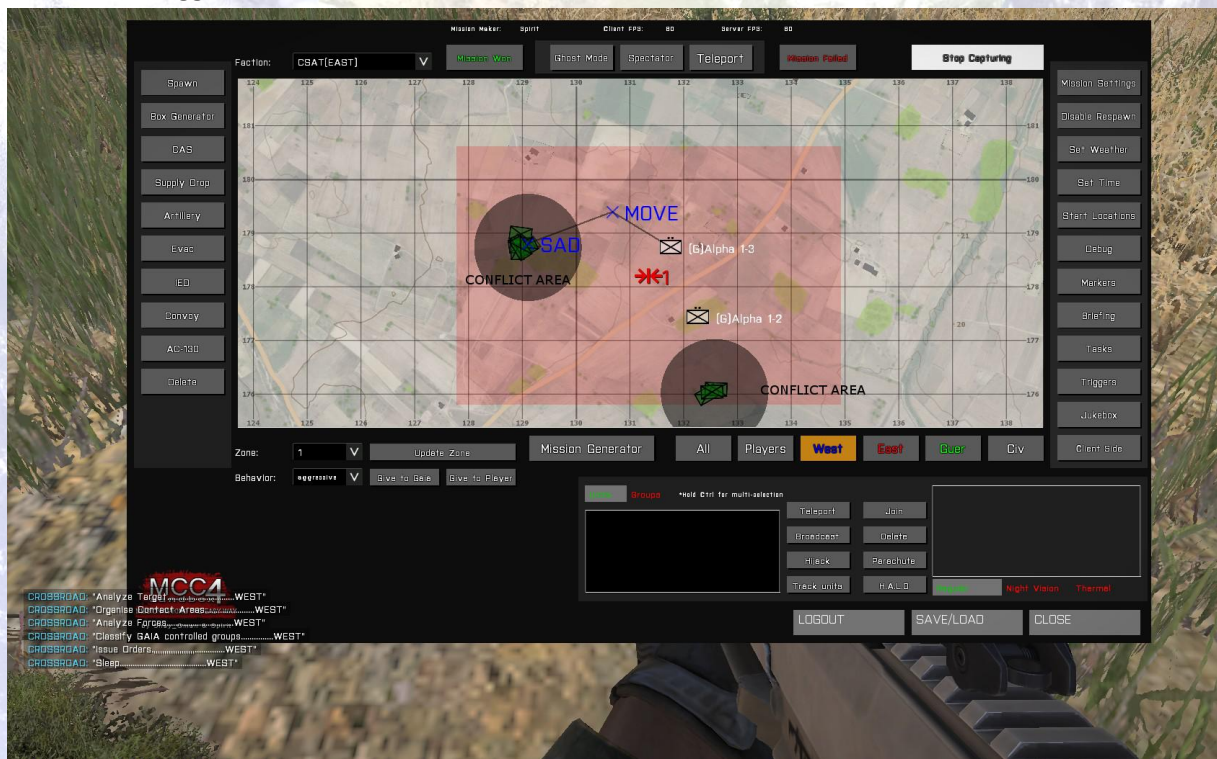
Define Conflict Area's

Each cycle GAIA will ask all the groups on her side what targets they are aware off. She also tries her best to note only the highest quality spots but sometimes that does not go as planned. In other words, there is some randomization created in this process to create the same issues humans face: communication errors.

To keep track of all those targets she notes the time and place a target has been seen for the last time. There can be quite a distance between the real position of the unit and the position given to GAIA. The accuracy of it is fully depending of the quality of the spot. So, it is important to understand GAIA works with presumed position. It speaks for itself that the more a target makes itself known to GAIA, the more accurate the spot will be. In case of a firefight at close distance, it will be VERY precise. (so better run :P).

GAIA faces a challenge with all those targets. How do you organize units going into battle if you only know the presumed positions of individual targets? GAIA does not want to bother to much about details. So she draws a circle of 100 diameter around a target and calls that a Conflict Area. (CA). Conflict Area's stand central in the functionality of GAIA. Lets visualize that by an in game shot with the GAIA debugger on.


What you see in the above picture is 2 Conflict Area's (CA's) that each hold one or more targets. If the targets get outdated, they are called Spots. Spots are not used for Conflict Area's (details, details, I know).

So why on earth does GAIA need Conflict Area's. As seen before, we could give points to groups of the AI. So we had an infantry group worth 10 points for example (5 infantry dudes). But what on earth does that hold any value if we only calculate with solo targets/units. The answer is nothing, so we needed a solution for that.

Lets take the Conflict Arae on the top left. We zoom in a little for fun:
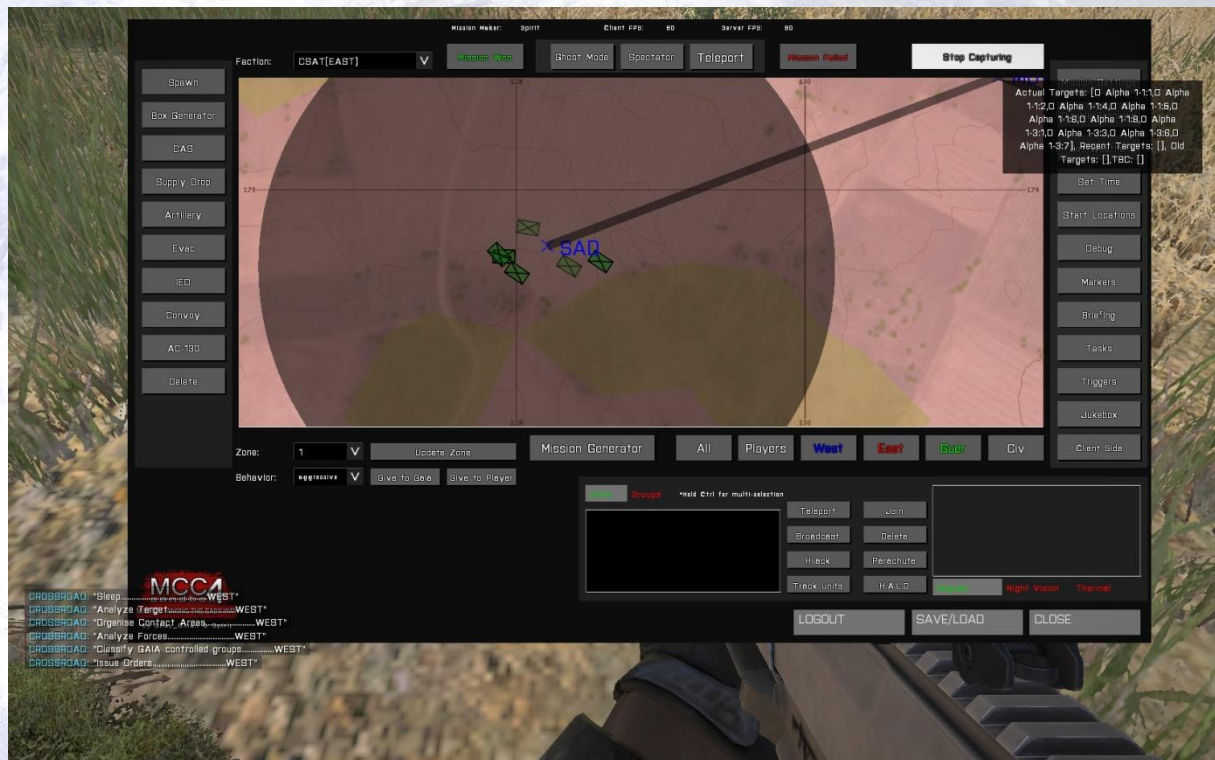
We now see that this Conflict Area holds about 6 infantry guys. That is worth 12 points. So now we know how much points we can send in to respond to this threat.

So in short. Why does GAIA work with conflict area's :

- It makes it possible to define the conflict over the battlefield on a higher level and respond to that.
- CA's dont go run around as fast as Targets. Making it more stable.
- Points can vary in one CA over time. Units die, we find more units in there etc etc. It gives GAIA the chance to evaluate a battle area.

Issue orders

Issue orders is the phase where it all comes together. This is where GAIA sends troops on patrol duties, sends group to Conflict Area's.

The example can be seen in the above picture. So what is the line in the picture saying SAD there? You she GAIA respond there by sending a group on a Search And Destroy order to the conflict area.

FYI: You will not see the above targets and CA's in MCC unless you run into debug mode.

Details

There is much more to say and explain about how GAIA makes her decisions. As I hold no more time and promised tonight to deliver (9-3-2014), i will stop my info here and will come back to it later.

So just a quick one! :) What units hold what preference for terrain for example? You are much more likely to see normal infantry in Urban and Road area's then you would find Recon Units there. Recon units prefer (in the GAIA) system other terrain then normal infantry. There is a lot more to say about terrain preference for GAIA.
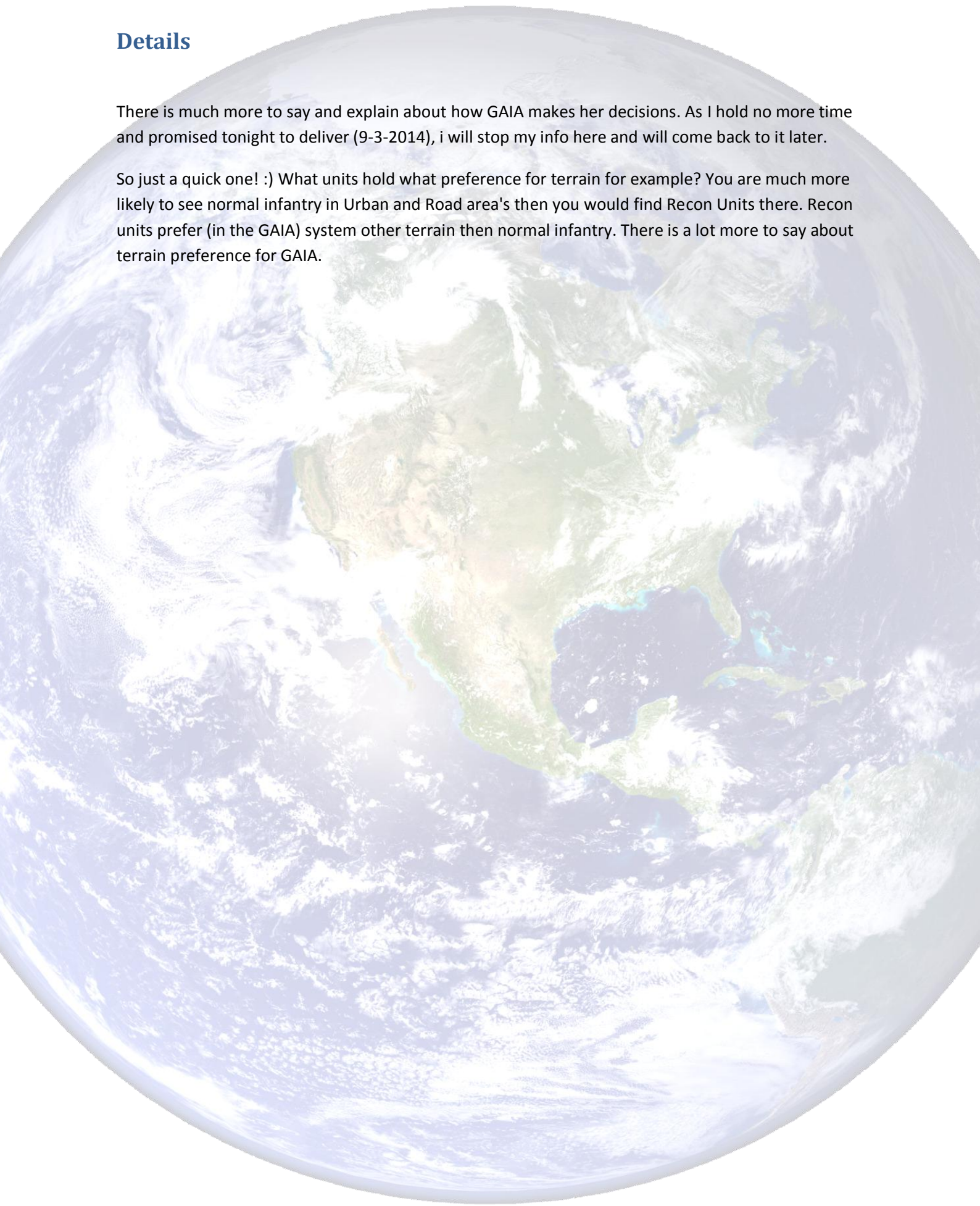
How to use GAIA

I am really close to out of time, but I will update my document later. Here goes a few things:

'Normal way'
The Spawn MENU on the top left comes the most close to the 'old way'

By 3D editor
It is now possible to give control to the AI at a later stage. So go to the 3D editor by clicking ALT-mouseclick on the map of MCC. Spawn a unit.

The user interface holds a button 'Give to GAIA'. If you click that button then the group you selected on the map will be under control of GAIA. It will go to the zone that is selected (on the left of the button) and in the behavior you selected (aggressive, defensive, fortify).

Behavior

Aggressive   : Units will attack Conflict Areas (see above) outside their zone.

Defensive   : Units will not attack Conflict Areas outside their zone.

Fortify   : Units will search for buildings and wait for scum to get them.

There are a few classes that behave in a more special way so let's discuss them here.

Attack Helicopters
Attack helicopters can be put in the game in two ways. By spawning and by 3d editor. I advise to use 3d editor as scripted 'safe spots' to take-off and land with helicopters are still somewhat strange. Even in 2014.

If spawned: the helicopter will search for a safe position in the zone that it was given. Land there and wait for CAS calls. (conflict area's).

If placed by 3d editor: it will stay where it is and call that home. It will always return here after CAS. This gives interesting behavior ad now you can put a helicopter on the others side of the map that will respond to AI CAS calls.

Defensive: Will go on CAS calls only the zone given.

Aggressive : Will go on CAS calls all over the map as long as it is inside its respond range (currently 8000 for helicopters).

Fortify: I have no clue. I have no clue why you would want that either.

Transport Helicopters

Transport helicopters can be put in the game in two ways. By spawning and by 3d editor. I advise to use 3d editor as scripted 'safe spots' to take-off and land with helicopters are still somewhat strange. Even in 2014.

If spawned: the helicopter will search for a safe position in the zone that it was given. Land there and wait until it is time to patro.

If placed by 3d editor: it will stay where it is and call that home. It will always return here. This gives interesting behavior ad now you can put a helicopter on the others side of the map that will take off to patro.

Defensive: Will only patrol the zone it is active in.

Aggressive : Will patrol all zones that hold GAIA UNITS! So not just units, the zone must hold GAIA units!

Fortify: I have no clue. I have no clue why you would want that either.

Mortar (static)

Mortars can be put in the game in two ways. By spawning and by 3d editor. I advise to use 3d editor.

Defensive: Will only do mortar attacks on CA's that are in his zone.

Aggressive : Will do mortar attacks outside its zone.

Fortify: I have no clue. I have no clue why you would want that either.

Artillery

Artillery behaves like any other unit, other then that it can do artillery. If you want artillery to stay in one place, i advise to give it a zone. It will search for a location to hide and do artillery attacks.

Defensive: Will only do mortar attacks on CA's that are in his zone.

Aggressive : Will do mortar attacks outside its zone.

Fortify: I have no clue. I have no clue why you would want that either.