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Release: Internal only.
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The latest version of this document can be found in CVS under Zex2.3/Docs/Zex Design.doc

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Terms Used In this document

Astronomical Unit

This is the average distance between Sol's Earth and the Sun; typically 149,597,870.691 Km's, or more roughly 149 million Km's.

c

The Human unit for the speed of light, after Albert Einstein who mistakenly believed that nothing could travel faster than light. **299,792,458** metres per second.

CTL

Close to Light speed i.e. an engine that can propel a ship to very nearly the speed of light. These engines are commonly called Linacs after their main manufacturer; Linacs Limited of Corsa Nova Prime. The name Linacs is derived from LINear ACcelerator.

FTL

Faster Than Light. i.e. a propulsion method that can 'propel' a ship faster than the speed of light; typically less than 100 times the speed of light, otherwise known as 100c. We use the word 'Propel' with caution here as to get from A to B faster than light is a little more complex than just simple thrusting.

Hypertransport

FTL travel. See Autpilot section of this manual.

Hyperwave

FTL communications.

Hydrogen line

The galaxy is full of Hydrogen, which has a precession frequency of 1420.40575 MHz (or a wavelength of roughly 21 cm). Humans long ago realized that this would be a great frequency for more advanced civilizations to advertise their presence, as the universe is full of Hydrogen. The 21 cm band is a protected frequency because of this fact. These days it is used for long range, interstellar navigation beacons. The on-board solar and galactic maps use interstellar navigation beacons as one source of information.

Light Year

The distance light can travel in one earth year – about 9.5 trillion Kilometers. Or more precisely 9,500,000,000,000 kilometers. Light Year is abbreviated to LY.

Port
To the left

Starboard
To the right.

Aims of this document
This is a high-level game design document, not an implementation document. It will not go into great detail over the data or code, just the most important constants and variables are addressed.

Zex

Zex is a single player game based in space. The player can trade and fight. The player plays a person called Zex McGraw.

Aims

The aim of the game is to improve player rating and accumulate wealth.

Ships

There are numerous ships available for a price. The player starts in the cheapest ship, a Finch class.

Nearly all ship classes are based on birds, so we have things like Falcon, Osprey, Hawk, Eagle, Albatross, Petrel, Gannet, Cormorant, Buzzard, Rook. The exception is the Draco which is a small flying lizard (or dragon).

Ships in order of size (size is wingspan of real bird just so I can get the sorting of sizes):

Smallest:

Draco (30cm – FAST)
Finch (30cm)
Petrel (50cm)
Falcon (60cm FAST)
Jay (65cm)

Medium size:

Magpie (90cm)
Rook (120cm)
Hawk (120cm)

Larger:

Buzzard (150cm)
Osprey (150cm)
Raven (150cm)
Gannet (160CM)

Largest:

Swan (200cm)
Eagle (225cm),
Albatross (300-360cm)

Races

All races have Tech Rating and a Production Rating. The tech rating is a general observation as to the level of the technology developed by the race. The production rating is an indication of the gross product of the race as a whole.

Also given is a stability rating between 1 and 5; where 1 is anarchy and 5 is stable. Stable does not necessarily mean a democracy; a steady dictatorship might also be perfectly stable. This does not mean that if a system is exclusively inhabited by one race and in general the race's state is stable that that particular system is stable; it might be a dictator is in the process of being overthrown.

Humans – Allegiance 0

Humans originated in the Sol system, although some say they were seeded there as a genetic experiment by the 'Outsiders'. They gained CTL propulsion around 2112 although the exact circumstances of how they gained it is open to debate. Some say the Kisinte gave it to them in their fight against the R'Mparians; others say the Outsiders had a hand in it. Yourself being the Human, you control how you react to other certain races, your alignment and so on. Humans are very good at mining and generally extracting natural resources from anywhere they can. An important note is that Humans are at war with the R'mparians. Humans have a generally low tech rating. Production rating: Medium. Produces: Raw ores, materials, live stock, low and medium tech manufactured goods. Stability; 4. Allegiance: Kisinte.

R'Mparians - Allegiance 1

R'mparians are evil creatures; humanoid in appearance but small heads. R'Mparians are humans natural enemy; the Humans and R'Mparian have been at war for many years now. R'Mparians have a medium tech rating. Production rating; Medium. Producing Raw ores, processed materials, low to medium tech manufactured goods.. Allegiance: Kryptoni Stability: 3

Alycian - Allegiance 2

Alycians are neither evil nor good, they're neutral to all races. In most cases, Alycians will not attack you unless you attack them or they have good reason. Alycians are the agriculturalists of the galaxy; producing vast amounts of agricultural produce per year. It is widely rumoured Alycians have ties to the Outsiders. Alycians have a Low tech rating and a high production rating. Producing agricultural goods, live stock, meat, low tech manufactured goods. Allegiance: None. Stability: 4

Kisinte - Allegiance 3

A race of two legged wolves. Carnivorous and vicious; it has taken many millennia of genetic modification by the Outsiders to tame these creatures enough to be acceptable

to other races in known space. The Kisintes first discovery on gaining CTL propulsion was the Humans whom they have close ties with (but would given a half a chance love to enslave). The Kisinte when not fighting within themselves are war weary from many millennia battling with the R'Mparians. Tech Rating: Medium Production Rating: Medium. Producing medium tech manufactured goods, requires food, raw materials, processed materials, luxury goods. Allegiance: Humans. Stability; 2.

Xenifor - Allegiance 4

Xenifors, an incredibly peaceful race, are the galactic bankers. Their main trade is in hard cash. Xenifors are unlikely to fight back; just defend themselves and run. However, they remember their transgressors and will refuse to trade for quite a while after being attacked. These creatures live on desolate planets, generally in systems with weak stars found on the outer rings of the galaxy. Because they come from such a place, they are almost always pale and shrivelled looking, but don't let looks deceive you, Xenifors carry lots of useful hi-tech equipment. Xenifors are the largest employer of bounty hunters in known space. Tech rating: High. Production Rating: Low. Allegiance: None. Stability: 5.

Kryptonil (Kryptoni) - Allegiance 5

The Kryptoni are snake like creatures having close ties with the R'Mparians. One of the first races in known space to gain FTL, they are widely travelled, highly educated, rampaging barbarians. Some have said these are the controlling minds behind the puppets they call R'Mparians. It is not uncommon to see a Kryptonil leading a swarm of R'Mparian ships. The Kryptoni rely on other races for production and goods; they are few in number with scarce natural resources available to them in their natural systems. Tech Rating: High. Production Rating: Low. Allegiance: R'Mparian. Stability: 3.

Quabriel - Allegiance 6

Quabriels are the un-homed of known space. Not having anywhere they can really call home the Quabriels are a bunch of pirates, bounty hunters and scavengers. Where a Quabriel planet or even system exists, all other races are generally happy to leave them alone but keep a close eye on what hey are up to. Tech Rating: Low. Production Rating: Low. Allegiance: variable. Stability: 1.

Sellenials - Allegiance 7

Sellenials are three legged, two headed creatures from the western side of the galaxy. The females are about the size of a small sheep, with a powerful hind leg which can easily kill a man with one kick. The brain is positioned under the spine. The males are not sentient, being the size of a human fist they exist purely for breeding purposes. An old race spread over a wide area they have a high tech rating along with a high production rating. Allegiance: None. Stability; 4.

Trondent - Allegiance 8

Trondents are natural space creatures living on vast quantities of space debris. Following a cyclic life pattern, they breed and then die in the galactic core. At birth they head out for the outer reaches. No one knows much about these creatures; what their purpose is, or why they're here. Tech level: None. Production Rating: None. Allegiance: None. Stability: Not known.

Outsiders - Allegiance 9

Nothing is known about the mysterious outsiders, only rumours and speculation. It is believed occasionally the outsiders will plot something within known space, but there are no hard facts to support or corroborate the rumours. Tech Level: Believed Very High. Production Rating: Not Known. Allegiance: Not Known. Stability: Not known.

Race Table

Race	Tech Level	Production Rating	Allegiance	Stab-ility	Produces	Consumes
Human	Low	Medium (Natural resources)	Kisinte	4	Ores, processed ores, meat, livestock, low to medium tech goods	High tech goods, luxury items, weapons
Rmparian	Med	Medium (mix)	Kryptoni	3	Raw ores, processed materials, cereals, low to medium tech manufactured goods	High tech goods, luxury items, weapons
Alycian	Low	High (Agri/resources)	None	4	Cereals, meat, livestock, low tech goods	High tech goods, luxury items, weapons
Kisinte	Med	Medium (mix/tech)	Human	2	Meat, processed drinks, low to medium tech manufactured goods, luxury goods	Raw materials.
Xenifor	High	Low (Tech)	None	5	Low to high tech goods	All except firearms and illegal goods
Kriptonil	High	V.Low (mix)	Rmparian	3	Low to high tech goods, illegal goods	All except firearms and illegal goods
Quabriel	Low	Low (illegal)	?	1	Nothing	Everything
Selenial	High	High (Tech)	None	4	Manufactured goods, luxury goods	Everything except illegal
Trondent	None	None	None	?	Nothing	Nothing
Outsiders	V.High	?	?	?	?	?

Player Attributes

Generic class

The player has a rating indicated as a level and a generic title – trader, pirate, bounty hunter. These three categories, or traits, each has a variable associated with it – trader_class_count, pirate_class_count and bounty_hunter_class_count. The trader is incremented once per successful sale (i.e. when a profit of more than 150% is made), bounty hunter is incremented each time a ship with a bounty is destroyed by the player and pirate is incremented each time the player destroys a ship and then scoops up cargo in space (once only, irrespective of how much cargo is picked up). Each trait has a level associated with it; each level is a factor of 2 larger, so a level 1 trader has a trader_class-count of between 0 and 1, a level 2 trader has a trader_class_count of between 2 and 4, level 3 5 to 8, level 4, 9 to 16, level 5, 17 to 32, level 6 33 to 64, level 7, 65 to 128 etc.

If any trait level exceeds the others by 50% then that becomes the characters type; otherwise no type is given.
E.G:
If ((trader>bounty_hunter+50%) && (trader>pirate+50%)) then trader.
else
If ((bounty_hunter>trader+50%) && (bounty_hunter>pirate+50%)) then bounty_hunter
else
If ((pirate>trader+50%) && (pirate>bounty_hunter+50%)) then pirate
Else
None

For example if the player had trait levels of:
Trader – 5
Bounty_hunter – 22
Pirate – 7
Then the game would classify the player as a bounty_hunter because trader+50%=7.5 and pirate+50%=10.5. Bounty_hunter is greater than either of these.

If the trait levels were:
Trader – 20
Bounty_hunter – 12
Pirate – 17
Then the player would be unclassified because none is greater than the others + 50%. When displaying the players stats we display the levels. Only if the player specialises in one activity do we classify the player as such, which may open up further avenues such as missions.

Trait levels

The player is given a level for each character trait; trader, pirate and bounty hunter for carrying out the actions detailed above in generic class. If
0-1 – Level 1
2-4 – Level 2
5-8 – Level 3
9 – 15 – Level 4
16-31 – Level 5
32-63 – Level 6
64-127 – Level 7
128-255 – Level 8
256-511 – Level 9
512-1023 – Level 10
1024-2048 – Level 11
2049 – 4095 – Level 12
4096 – 8189 – Level 13
etc.

Allegiance

Whenever the player destroys another ship, the race_allegiance_count for the other races increases. The player's allegiance is calculated as the lowest race_allegiance_count for a race if the difference between that allegiance_count and the nearest other is at least 10. For example is the allegiance_counts (assuming three races) were:
Human 7
R'Mparian 8
Alycian 20
Then the players allegiance would be neutral because the difference between Human and R'mparian is 1, so no clear cut allegiance exists.

If the kill counts were:
Human 7
R'Mparian 23
Alycian 19
Then the player's allegiance would be Human because the difference between human and others is greater than 10.

So, if the player had:
Trader_class_count=13
Pirate_class_count=72
Bounty_hunter_class_count=54
Human_kill_count=5
Rmparian_kill_count=27
Alycian_kill_count=13

Then overall rating would be Neutral, pirate rating 7, trader rating 4, bounty hunter rating 6.

If the player had:
Trader_class_count=13
Pirate_class_count=2
Bounty_hunter_class_count=48
Human_kill_count=5
Rmparian_kill_count=27
Neutral_kill_count=23

Then overall rating would be human, pirate rating 2, bounty hunter level 6 and trader rating of 4.

Equipment and ratings will require a minimum level and possibly allegiance before the player can buy them.

Environment

Yeah, Ok, it's space. And space is big. Bloody big. We can just about manage to run a system on today's hardware. But at the same time we need lots of systems to allow the player to trade efficiently. Within a system trade will be possible but big trades are more easily made between systems. The trading system in Zex runs on data which is based on the trading system from Zex 2 which is based on the trading system from Zex1; nearly everything we need to know can be coded into the data. Zex used data generated in Resedit; this is getting more and more un-maintainable as the days tick by. Zex will use Coffee to import trade data from Coffee text files.

Known Space

This is the galaxy and part of the way outside of it.

The Galaxy

The player plays the game within a galaxy. At the start of the game, the player is on a system in the centre of the galaxy. The Galaxy contains at most a thousand stars. All these stars are generated from a unique seed (Galactic Seed). The stars are placed within a cube weighted towards z and x, with little y weighting so we get a relatively flat galaxy. All stars are visible from any system. Stars are plotted on a galactic map. The galactic map is 2d representation and only displays those stars within the immediate vicinity (say 10LY). The player can travel between systems either via a wormhole or with an FTL engine and special navigation equipment.

Each star is home to a system.

Systems

A system consists of a star (sun), or maybe two (binary suns), and a variable number of planets with a variable number of moons. Mother ships orbit planets and moons. Systems have what we call 'primary attributes' – these data specify game details about the system – how stable the system is, dominant race, primary output, number of inhabitants. It doesn't mean every planet in that system has those attributes, but will weigh heavily when creating the planet data. For example if a system is tech: 80%, agricultural: 20 then you would expect to be able to buy tech stuff quite cheaply and sell food and agricultural produce at a good price. Within that system, if there were 10 inhabited planets, then 8 would be producing tech goods, and 2 would be agricultural. Mother ships orbiting those planets would directly reflect that produce. Mother ships further away would reflect the distance from agri and tech planets in their mix of goods available and pricing. If something is easy to obtain then it is cheap.

Sun

The sun(s) give off both light and heat. Both are simulated in Zex. The closer to a sun you get, the hotter it will get. Solar radiation can be scooped up in fuel scoops in times of dire need.

Planets

Are lit and warmed by the sun; they may be inhabited and may be orbited by moons. Planets are categorised according to their systems attributes and trade data.

Planet production, or Gross Domestic Product (GDP)

Planets consume and produce goods.

Planets can produce technological and agricultural goods. Some planets might produce tech goods exclusively, some a mixture of tech and agricultural and some purely agricultural produce.

Each planet is given an overall class on a scale of 0 to some figure depending on their population and size, so for example Planet A might produce lots of tech goods but very little agricultural goods; it might be given a tech class of 7 and an agri class of 3. The Gross Domestic Product of the planet, or GDP and the population are available to the player.

Planets in the temperate zone are more suitable to agricultural production.

Planets at extremes are more costly to maintain and run and hence prices are higher. For example a tonne of wheat might be quite cheap in the temperate zone but might cost three times as much on a barren out of the way, freezing cold tech planet.

Planet diameters range from 2000 kilometres to upwards of 150000 kilometres, when planets are created, more small planets than large planets will be produced.

Population

Earths current population is roughly 6,228,394,430. Earth has a diameter of 12,756 KM's. We can calculate the area of the planet, then divide that by the population to get an idea of the density per square kilometer, viz:

Area of a sphere=4*pi*radius*radius

For earth this is 4*pi* 6378*6378=511185932KM squared. If we divide the population by this figure then we get 12.18 people per square kilometre. Now we can say that earth is half full, so a full planet would have 24.36 people per square kilometre, or more easily 25.

We can call this the Population Density Factor (PDF) which is a normalised value between 0 and 1 where 0 is 0 and 1 is 25 (game const: CORE_PDF_MAX).

Now for any given planet with a known radius and PDF we can calculate the population by calculating the area then multiplying it by PDF_MAX then by the PDF.

For example, a planet with a radius of 6378KM's and a PDF of 0.5 would come out as:
(4*pi* 6378*6378)*25*0.5=6,389,824,157. The true population is 6,228,394,430 which is an error of about 161 million.

The population per square kilometer is p/(4*pi*r*r)= 6,389,824,157/ 511185932=12.5 (which isn't far off the true 12.18)

Thus for any planet of diameter D and a population factor of PDF, we can calculate the area (a) as:
a=4*pi*r*r
We can calculate the population (p) as:
p=a*25*PDF (where PDF is a number >0.0)
We can calculate the population per square kilometre (d) as:
d=p/a

Example:
Planet has a diameter 50000KM's and a PDF of 0.3, the population is:
a=4*pi*25000*25000 = 7,853,981,635 Km2
p=a*25*0.3=58,904,862,262
d=p/a=7.5 per Km2

Example:
Planet has a diameter of 5000Km's and a PDF of 0.3, the population is:
a=4*pi*2500*2500=78539816
p=a*25*0.3 = 589048622
d=p/a = 7.5

Example
Planet has a diameter of 5Km's and a PDF of 0.3
a=4*pi*2.5*2.5=78.53
p=a*25*0.3=589
d=p/a = 7.5

In all these cases we can see the population per square kilometre staying the same at 7.5.

If we double the PDF, to 0.6 then in the last case we get
a=4*pi*2.5*2.5=78.53
p=a*25*0.6=1177
d=p/a=15

So, to sum up, we calculate the area as:
4*pi*r*r
then we can calculate the population as
a*25*PDF
And if need be we can calculate the density per square kilometre as p/a

The PDF's vary as a function of:
Planet Type, atmosphere, planet temperature (Zex contains a function to calculate this based on distance from sun and sun type).

The planet type is calculated from it's size; small to medium tend to be solid, whereas larger ones tend to be gaseous and its position in relation to the sun

The atmosphere again is calculated from the planet type. All planets and moons have some atmosphere; whether it is suitable to sustain life is another matter.

Planet temperature is mainly dependent on its position relative to the sun.

Moons

Are lumps of rock orbiting planets, normally not inhabited, unless **mining** is on-going.

Asteroids

In space you have asteroids. Some systems may contain areas of heavy asteroid concentration. Even if open space, random asteroids may occur.

Units Of Measurement

The basic unit of distance measurement in Zex is the metre. Everything is based on this. Internally Zex has a minimum resolution of 10 cm.

When displaying distances and velocities to the player we will approximate – for instance we may switch to LY's or AU's when displaying distances.

The basic unit of mass is the Kilogramme.

Time

Time in Zex normally runs at the normal rate; however the TempMult has the ability to provide the illusion of accelerated time but only if no large mass is nearby.

The time SW checks for mass when player tries to accelerate time, and if time is accelerated occasionally checks for nearby mass (see real_time.cpp).

Trading

Trading in Zex means acquiring stuff and then selling it. Zex will provide over 120 commodities to trade in divided up into Human, R'Mparian and Alycian goods. Goods can be legal and illegal. Safe and dangerous. Some may require special transport arrangements (frozen or alive for example). In addition a variety of ships equipment and weapons are available. The base data for these items is held as an XML file external to Zex.

Currency

The basic currency in Zex is the 'credit' - Cr. If I have to put a value on it, I'd say 1 credit is worth about 40 UK pounds. Thus 1000 credits is equivalent to £40000.

Payment

Remuneration

Remuneration is made for the following actions:

1. Destroying asteroids – 1 to 10
2. Destroying a ship with a bounty on it – 1 to bounty value
3. Selling a ships item – value of item
4. Selling goods – value of good.
5. Daily wage – if affiliated with a 'gang' player may get a daily wage of 1 - ? Cr
6. Mission completion

Deductions

Deductions are made for the following actions

1. Connection to GalaNet. This is charged by the minute at 0.1Cr. Trade computer can reduce the cost.
2. Docking fees – there may be a docking fee of between 1 and 5 Cr
3. Fines – you may be fined within a system for destroying ships of that allegience. Fines range from 1 Cr upwards
4. Buying items of ships equipment/goods/repairs.
5. Pay-offs; If an opponent has you up on your knees he may accept a payment to leave you alone. This payment is negotiable. He may also request any cargo you are carrying.
6.

GalaNet

GalaNet is the simulated on-line trading/bulletin-board system. The player can log on when docked. The main features of GalaNet are an area where the player can buy and sell goods, an area where the player can upgrade items of ships equipment, get repairs and refuel and an area where the player can look at various missions.

Missions

Missions in Zex are either obtained off the bulletin-board of GalaNet or they can come in unsolicited. Communications between the employer and the player are via simulated e-mail.

Accepting a mission

Galanet contains a Bulletin Board system where people wanting jobs done can post a brief description of the job. The player can click on the jobs to read the description. The BB has three buttons, 'Accept', 'More Details' and 'Leave'. Accept is enabled if a job is selected. More Details is enabled if a job is selected. Leave is always enabled. Accept causes an email with the complete details to be sent to the player. 'More details' allows the player to ask a few pre-determined questions of the employer such as 'I want more money'. Missions may not be avialble until the player has reached a certain level.

Completing The Mission

When the player thinks they have completed the mission, the reply to the email. The employer checks if the mission has been completed. If so pays the player receives an electronic payment and an email of congratulations/completion from the employer.

Example Missions

1. Transport someone somewhere
2. Take a package to someone.
3. Pick up some cargo and transport somewhere
4. Kill someone
5. Destroy something
6. Rescue a crew from a failing ship
7. Rescue a team from some remote outpost

Flight

Flight in Zex normally follows Newtons laws and Einsteinium theory. However, at all times Hyperwave comms is available (FTL Comms) and FTL flight is necessary between systems.

Zex provides 6 degrees of freedom for objects; everything has a mass and simulated inertia. Objects are moved by applying a thrust to a point on an imaginary unit cube.

Cockpit

The cockpit in Zex is virtualised. That is, irrespective of which ship the player is flying, the cockpit will look the same.

The cockpit incorporates a Heads Up Display unit (HUD). This provides navigational and combat information. Some parts of the HUD are not operative in some ships and some parts are only available on more complex (expensive) HUD units.

Multi-Function Display (MFD)

The right pane of the HUD is known as the MFD. This area can display a variety of information, toggled by the 'P' key by default.

Player view

The player normally looks forward, but views are available left, right and rear.

Camera Implementation

The camera is a separate object loaded into dynamic slot 2 (the player ship is at slot 0 and the velocity vector (VV) object is at slot 1). The camera software maintains a link between the camera object and its parent. The camera is given a CAMERA_CONTROL controller ID and is controlled in object_control_top as an independent object.

Four keys control the front, rear, left & right views from the cockpit. If the camera is set to the front view, then the camera_controller simply copies its parent's orientation quaternion into the camera object.

If the camera is set to one of the other views then first the parents quaternion is copied to the camera object, then a force is applied depending on the view and calc_extern_forces is then applied to update the cameras orientation quaternion with the force left or right all as one atomic operation.

3D_top is modified to use the camera object when running the FOV filters (note that the radar processing runs of the ships orientation, not the camera); in addition the fast objects orient themselves using the camera's quaternion rather than the players ship.

A special case arises with the fast objects. Fast objects always face the camera (as they are all other suns, i.e. stars), this is done in the fast object's controller by copying the cmarea quaternion and inverting it. Normally, we update 50 fast objects per frame.

However, when we switch camera views we need to update all the fast objects otherwise we will end up looking at a load of stars edge on for a frame or two. We do this by modifying the fast object controller to ask the camera software if the view has changed; if it has, the fast object controller updates ALL the fast objects to point towards the camera.

The camera software achieves this by setting a down counter to 2 every time the camera view is changed, and decrementing this counter towards 0 once per frame. The camera software simply returns the counter value to the fast object controller when it calls to see if the camera view has changed.

In actual fact, the camera in Zex now has 6 degrees of freedom (up, down, left, right, roll left, roll right) but we only use two (left & right) and limit it to 90 degrees left, 180 degrees left (i.e. behind) or 90 degrees right.

Targetting

You'll want to target an object to get steering and velocity cues, use the autopilot and fire missiles. There are three ways of targeting an object in Zex.

1. Visual. If you can see the object in any view, you can target it by placing the object in the sights reticule and pressing the 'T' key.
2. Scanner. Pressing the 'R' key causes the OBC to sequentially target objects displayed on the scanner. You can increase or decrease the scanning range with the 'J' and 'K' keys. The targeted object flashes on the scanner display.
3. Solar System Map. Centering the mouse cursor over an object on the Solar System Map will target that object.

If any autpilot modes apart from 'Steer Cue' are selected, your ship will immediately align its heading and velocity vectors with that of the target. Velocity will be indicated relative to the target. A positive velocity indicates you are approaching the target, a negative velocity indicates you are moving away.

If there is no target selected, then the HUD will select the nearest large mass; typically a planet or moon in order to give useful velocity information.

Equipment

Manufacturers

Throughout the galaxy a variety of manufacturers exist providing most of the known ship types and equipment.

General Products

General Products are best known for their fine hulls.

Linacs

Engines are commonly called Linacs after their main manufacturer; Linacs Limited of Corsa Nova Prime. The name Linacs is derived from LINear ACcelerator.

Ships Equipment

damage units – An absolute value given to hulls and shields. All weapons have a damage rating which is subtracted from the damage units.

Hull

The ships hull is the last line of defence. The hull can take damage, subtracted from its damage units rating; the ship is destroyed at 0 damage units remaining. Damage to the hull needs to be repaired when docked. All ships have a hull rating which is a divisor (implementation: a multiplier between 0 and 1) applied when calculating damage. More expensive ships have stronger hulls than cheaper ones.

General Products hulls are available in a variety of types, or shapes, known as type A through E.

In the following where a shape is given, it is a rough guide only; for example Type A is spherical. This means it might totally ovoid, or it might have a flattened side.

Type A is basically a sphere.

Type B is cigar shaped.

Type C is pyramid shaped flattened on one side.

Type D is cube shaped

Type E consists of a series of spheres (between 3 and 12) with a type B running through them.

In addition to the basic shape, a variety of grades are supplied, from 1 to 7 where 1 is the cheapest and 7 is the most expensive.

Grade 1 is guaranteed to withstand a 5MW pulsed laser for 10 seconds before puncturing.

As a 5MW laser is rated at 500 damage units per second this gives a damage units total of 5000.

Grade 2 is guaranteed to withstand a 5MW pulsed laser for at least 24 seconds before puncturing. As a 5MW laser is rated at 500 damage units per second this gives a damage units total of 12000.

Grade 3 is guaranteed to withstand a 5MW pulsed laser for at least 120 seconds before puncturing. As a 5MW laser is rated at 500 damage units per second this gives a damage units total of 60000.

Grade 4 is guaranteed to withstand a 5MW beam laser for at least 50 seconds before puncturing. As a 5MW beam laser is rated at 4000 damage units per second this gives a damage units total of 200000.

Grade 5 is guaranteed to withstand a 5MW beam laser for at least 87 seconds before puncturing. This hull can be fitted with an optional stasis field generator that guarantees that during collision you will be frozen in time just prior to the collision. In addition a small reaction engine is optionally fitted, so even if everything else gets shot to bits, you can still get to a safe haven. As a 5MW beam laser is rated at 4000 damage units per second this gives a damage units total of 348000

Grade 6 is guaranteed to withstand a 5MW beam laser for 276 seconds before puncturing. This hull is fitted with a stasis field generator that guarantees that during collision you will be frozen in time just prior to the collision. In addition a small reaction engine fitted, for the reasons outlined in the grade 5 hull description. As a 5MW beam laser is rated at 4000 damage units per second this gives a damage units total of 1104000.

Grade 7 is guaranteed impenetrable; it cannot suffer damage. This hull is fitted with a stasis field generator that guarantees that during collision you will be frozen in time just prior to the collision. Shield generators are not needed with this hull. In addition a small reaction engine is fitted, for the reasons outlined in the grade 5 hull description.

None of these hulls are fitted with any external protrusions; they achieve their strength from having no holes in the hull whatsoever. This means that ancillaries such as engines, pods, weapons etc must be fitted on pylons.

General Products back all their hulls with a money back guarantee if the hull does not meet their specifications (which are subject to change at any time, it says in the small print. In the very small print it clarifies that by saying that ‘at any time’ means exactly what it says).

Hulls are always supplied with pylons and engines fitted. In most cases basic weaponry will also be fitted.

Combat Equipment

Lasers

The primary weapon in Zex is the laser. Lasers can be mounted on the front, rear and port and starboard mounts. Some ships have more than one mounting point. For example, a Falcon might have lasers on each wing, whereas a Finch might have just the front mounting. Lasers come in a variety of grades from simple pulse types to beam through to masers (a microwave based laser). In addition to Lasers there are Tasers (Twin beam lasers) with two beams per mounting point. Lasers always fire in the direction they are mounted; so front facing lasers (front and wing) always fire forward. The rear mount fires backwards. All lasers have a 'lock on angle', from 5 to 60 degrees. Anything within that angle (measured from the line of sight ahead) is a target for the laser; once outside that range the laser will lose lock and fire straight ahead.

A beam laser is 8 times as powerful as a pulse laser and a Maser is approximately twice as powerful as a Beam laser.

Laser bays can and do overheat at which point the laser will stop working. All the pilot can do is wait for the laser to cool down.

Laser Descriptions

1. 5 MW Pulse, 10 degrees capture. Damage 500 per second.
2. 5 MW Pulse, 20 degrees capture. Damage 500 per second.
3. 10 MV Pulse, 35 degrees capture. Damage 1000 per second.
4. 20 MW Pulse, 45 degrees capture. Damage 2000 per second.
5. 30 MW Pulse, 60 degrees capture. Damage 3000 per second.
6. 5 MW Beam, 25 degrees capture. Damage 4000 per second.
7. 20 MW Beam, 40 degrees capture. Damage 6000 per second.
8. 50 MW Beam, 50 degrees capture. Damage 10000 per second.
9. 80 MW Beam, 60 degrees capture. Damage 16000 per second.
10. 140 MW Beam, 60 degrees capture. Damage 28000 per second.
11. 80 MW Taser, 40 degrees capture. Damage 16000 per beam per second.
12. 140 MW Taser, 60 degrees capture. Damage 28000 per second.
13. 90 MW Maser, 30 degrees capture. Damage 36000 per second.
14. 140 MW Maser, 45 degrees capture. Damage 56000 per second.
15. 200 MW Maser, 60 degrees capture. Damage 80000 per second.

Cannons

Cannons again can be mounted to the front, rear, port and starboard. Again cannons come in 3 levels. Cannons do not overheat but sometimes jam.

Missiles

Can be mounted under the body or on wings. Missiles come in a variety from simple point and shoot missiles to homing and guided missiles. Again typically 3 levels are available

Particle Hyper-Disruptors (PHD's)

Particle Hyper-Disruptors set up an accelerating chain reaction in the molecules of any nearby object causing the object to expand at an extreme rate, effectively transforming the object to a rapidly expanding ball of dust. The molecules excite any nearby molecules, expanding outwards until no-more mass can be found and the reaction stops.

The player is frozen in time just prior to the explosion, and unfrozen some-time afterwards. Particle Hyper Disruptors normally have a failsafe mechanism that only allows detonation in areas devoid of large mass such as a mothership or planet.

There will be no salvage after a PHD has detonated, so whilst they may save your life, there will be no spoils. Bounties for any captains destroyed in a PHD detonation will be paid.

PHD's are not known for their reliability. Upon detonation, anything enclosing the PHD is placed in a stasis field. Part of the PHD is immune to the detonation and should remove the statis field some time after the reaction has subsided; however there is always the risk of being frozen in time forever when detonating a PHD.

PHD's may be found in a variety of forms, typically personal and military PHD's are legal. Rumor has it that the Outsiders have used system clearance PHD's to clear systems of planets before building new, habitable planets. This systems are easily identified from the ball of dust encompassing the outer reaches of the system.

Defensive Equipment

Damage in Zex is measured in damage units; an absolute value.

Shields

Shields form a protective barrier around the hull. The shields will regenerate; powered from the ships power system. Shields come in a variety of forms and grades. Shield power supply accumulators are also available which will half the shields regenerate time.

Shields have an absolute protection rating in damage units as follows and recharge at the rates specified below:

1. Level 1 – damage units: 2000, recharge 80 damage units per seconds. Total recharge time = 25 seconds.

2. Level 2 – damage units: 5000, recharge 100 damage units per second. Total recharge time = 50 seconds
3. Level 3 – damage units: 10000, recharge 600 damage units per second. Total recharge time = 16.6 seconds
4. Level 4 – damage units: 20000; recharge 800 damage units per second. Total recharge time = 25 seconds
5. Level 5 – damage units: 40000; recharge 2000 damage units per second. Total recharge time = 20 seconds
6. Level 6 – damage units: 80000, recharge 5000 damage units per second. Total recharge time = 16 seconds
7. Level 7 – damage units: 200000, recharge 10000 damage units per second. Total recharge time = 20 seconds
8. Level 8 – damage units: 500000, recharge 30000 damage units per second Total recharge time = 16.6 seconds
9. Level 9 – damage units: 1000000, recharge 60000 damage units per second, Total recharge time = 16.6 seconds
10. Level 10 – damage units: 2500000, recharge 150000 damage units per second. Total recharge time = 16.6 seconds
11. Level 11 – damage units: 5000000, recharge 350000 damage units per second. Total recharge time = 14.3 seconds
12. Level 12 – damage units: 7500000, recharge 500000 damage units per second. Total recharge time = 15 seconds.

As we can see, there are a couple of sweet spots; level 3, level 6 and anything above level 8 recharge the fastest. These figures are without Shield PSU Accumulators which would half the recharge time.

Recharging shields uses fuel at the rate of 100 nano grammes per damage unit per second; thus a level 12 shield which recharges at 500000 damage units per second will use 50 milligrammes of fuel per second. A level 1 shield which recharges at a rate of 80 per second will use 8 micro grammes of fuel per second.

Larger shields require larger fuel tanks.

Electronic Counter Measures (E.C.M)

Can confuse and destroy incoming missiles. These come in various grades; a higher grade having more chance of confusing a missile than a lower grade ECM.

Grade 1 – 30%
Grade 2 – 40%
Grade 3 – 55%
Grade 4 – 75%
Grade 5 – 95%

Chaff

When fired can act as a decoy to incoming missiles. Chaff is cheap and cheerful but once used cannot be used again. To use chaff you need to own a chaff pod to hold the bundles of chaff.

Autopilot

Hypertransport

Hypertransport was a gift to the Alycians from the Outsiders but is now commonplace throughout the galaxy. It works by reducing the ships mass (and its contents) to 0 and then initiating a small charge behind the ship, thus accelerating the ship. The autopilot applies a small reverse thrust to control the velocity and decelerate as the target approaches and mass returns to normal. No-one (but the Outsiders) know how the mass is reduced, but because it is, the Theory of Relativity no longer applies, thus enabling FTL travel.

Hypertransport capability is supplied as 'HT Shells', they can be bought at most motherships for a reasonable fee. All ships capable of interplanetary travel will be able to carry at least one HT Shell. Each shell can only be used once.

Note: The speed of Hypertransport is very much dependent on the distance to travel. On short trips the velocity might be relatively low, on longer flights the velocity can easily exceed the speed of light. FTL travel will interfere with normal velocity and time based calculations and readings. Velocity readings will be quite erratic during Hypertransport as your On Board Computer calculations overflow. This is nothing to worry about; as soon as Hypertransport ends, velocity calculations will return to normal instantly. In addition, your on-board chronometer contains temporal disturbance detection circuitry which will disable the clock during hypertransport. Again, it will indicate correct ships' time shortly after Hypertransport ends.

TempMult

TempMult is a technology used to accelerate time on condition that no significant mass is nearby. Tempmult units come in one of five classes offering a range of time accelerations as follows:
Class 1 – Upto 5x
Class 2 – Upto 25x
Class 3 - Upto 100x
Class 4 – Upto 500x
Class 5 – Up to 10000x

Mother ships

Mother ships are large vessels typically orbiting planets that act as docking points for space ships. Ships in Zex are not built for atmospheric or planetary travel; they are designed to dock with mother ships. Mother ships can either be privately owned or belong to a particular race.

Mother ships typically provide a place to sleep, trade and upgrade ships and ship items.

Privately owned mother ships do not have an allegiance, and will dock anything for a nominal fee. Race owned mother ships will allow free entry to allied pilots and charge other allegiances a fee or not allow them to dock.

For example R'Mparians hate humans and vice versa; therefore ho human owned mother ship would dock a R'Mparian, and similarly A R'Mparian mother ship would not dock anyone allied to the humans. Indeed as these two races are at war with each other, the chances are the mother ships would fire on the pilot.

Galanet

Once docked at a mother ship the pilot will have access to GalaNet; a galactic wide inter-network. Here the local commodities market can be found along with any local ship traders and equipment facilities.

GalaNet also provides a bulletin board where confident pilots can browse jobs available filtered either by planet or system. In some rare cases, galactic level jobs might be available.

Ships

Smallest:

Draco

(30cm) – Actually a small flying dragon (reptile)
Small, fast, well equipped.

Finch

(30cm)
Small, slow, not well equipped.

Petrel

(50cm)
Small, slow, reasonable equipment

Falcon

(60cm FAST)
Small, fast, dangerous.

Jay
(65cm)
Small, fast, good equipment

Medium size:

Magpie
(90cm)

Rook
(120cm)

Hawk
(120cm)

Larger:

Buzzard
(150cm)

Osprey
(150cm)

Raven
(150cm)

Gannet
(160CM)

Largest:

Swan
(200cm)

Eagle
(225cm),

Albatross

(300-360cm)

NPC's

Traders
Fighters
Pirates
Bounty hunters

Implementation

Graphics

The graphics need to be slightly exaggerated; suns are bigger and brighter than they would be. Other system suns are displayed with 1 of 3 fixed graphics.

All drawing in Zex is done through an abstraction layer with routines named Zxxxx or dlp_

This allows us to change the lower level rendering as technology changes, although some higher level code is quite OpenGL centric.

Menu/static Screens

Static graphics and textures are held on disk in either RAW (8 bit) or R32 (32 bit RAW) format. Another format, RCZ (compressed RAW using our Raw Cruncher which performs simple RLE compression on a RAW binary.) can be found in the resources. All formats expect the first two words of the file to be the width and height in Motorola format, then raw binary data. These formats are handled in pictures.cpp

Loading Screen

Currently just a light blue background and a please wait notice in the middle. Some kind of progress indication would be good here. Displayed when loading the game, starting a new game or loading a game.

Main Menu

After the loading screen for a new game the player is presented with the menu screen. On the left are some animated ships with statistics, on the right the menu with options such as load, new, quit, volume etc. A build option can skip this screen and go straight to a new game for development purposes.

Galactic Map

Not implemented; will show an overview of the galaxy. Mouse driven, player can click on stars for information/targeting.

Solar map

Shows an overview of the current system. Mouse driven, player can click on items for information and targeting. Map centers on selected object. Zoom and un-zoom also available from mouse gestures (drag down and right to zoom, drag up and left to un-zoom).

Docked

This view is displayed when docked. On the left is the view out of the mothership, on the right is a menu with options such as Trade, launch, sleep, save/load game etc. Some player stats are displayed here.

Ship Inventory

Shows all items fitted and cargo carried. Currently just cargo. Maybe a blueprint view for ships items?

Connecting Screen (GalaNet)

When connecting to GalaNet from docked, there is a delay and an image displayed depicting connection to Galanet. If connection successful player sees GalaNet main menu. If not, screen displays connection failed and player returns to docked screen.

GalaNet

Main screen menu shows trade, buy/sell ships items, log off.

Buy/Sell Ships equipment (GalaNet)

Currently implemented as a matrix of 5 by 3 small screens; each screen displays a graphical representation of item for sale along with price and short description. Ships inventory screen also used here to sell items.

Trade Commodities (GalaNet)

Currently implemented as lists; stock availability indicated by colour. Player mouse clicks on an item to buy. Ships cargo inventory screen used to sell cargo.

Bulletin Board (GalaNet)

Not implemented. Probably a list format.

Other screens go here

Sound

Sound in Zex is handled via an abstraction layer called Eclipse. Eclipse provides ‘n’ 3D channels (where ‘n’ is a build setting), ‘n’ mono channels and can play one shot and looped sounds. Under Eclipse currently sits native Mac double callbacks; this is changing to a x-platform library.

All sounds in Zex are loaded at launch time; an array holds pointers to all sounds; sounds are then referenced via an index into this array. All sounds are held in the ‘R’ folder as flat resources.

More sound details go here.

File I/O

The file I/O in Zex abstracted; the underlying file I/O is written using standard C library calls for portability.

Misc Game Notes / Technology

Communications

Radio – short range.
Laser – short range ship to ship.
Hydrogen Line – long range navigation beacons.
Hyperwave – FTL/ultra long distance real time comms.

Game Data

System Data

The system contains one or more suns, some planets and moons. In addition mother ships will be present. Systems are either dominated by one particular race or else, if evenly balanced can be called neutral. The politics of a system can range from anarchy through to dictatorships through to democracy. Viz:
Anarchy (1)
Unstable Dictatorships (2)
Stable Dictatorship (3)
Unstable Democracy (4)
Stable Democracy (5)

Anarchic systems tend to produce more illegal goods, whereas more stable systems produce legal goods.

The system data consists of:
Sun data
Planet data
Moon data
Mother ship data

A system is loaded by the Zex function: set_up_solar_system. Currently this is called when we load a level – levels are either the initial game data or test data.

The system data is managed by POBS (Persistent Object System), which monitors the players ship and loads and unloads system objects into the scene as needed. The engine uses static LOD to reduce workload on the game. All objects loaded by pobs (planets, moons, mother ships have multiple models; 5 in the case of planets and moons.

Trade (Goods) Data

Here is a description of the internal layout of a stock entry:

```
typedef struct
{
char string [0x24];
short dofq;       //1=tonnes, 4=grammes
short _class;     //10-ores, 11-food, 12-tech, 13-luxury/textiles, 14-
firearms
short base_price_human;
short base_price_alien;
short transport_risk,pirate_risk;
```

```
short MFR; //manufacturer: 1=human, 2=alien  etc
short markup,stock,buy_price,sell_price;
short id;         //serial number (index - 0 based)
} hold_desc;
```

An array of these; `commodity_array;` holds all of the commodities available to the player. These commodities are loaded up in `setup_commodity_stocks` ; it is copied from cargos_array which is loaded in `read_in_cargo` at game initialisation.

The string is a description of the stock. The dofq is the units the stock is measured in; whre dofq can be one of: 1=tonne, 2=barrel, 3=case, 4=kilogramme

The class can be one of:

```
#define ORES 10
#define FOOD 11
#define TECH 12
#define LUXURY 13
#define FIREARMS 14
#define DRINKS 15
#define LIVESTOCK 16
```

base_price_human and base_price_alien are the prices on human mother ships and alien mother ships respectively.

MFR is the manufacturer

markup is the markup applied to the base price.
stock is internal stock qty
buy_price and sell_price is the calculated buy and selling prices (this will depend on stock levels primarily)

An important pricing consideration is that if the manufacturer is of the same race as the allegiance of the place selling the good then the price will be lower.

Trade (Ship) Data

TBD

Trade (Ship Items)

TBD

Ship Data

The ship data is held in Forth files; interpreted by Coffee on boot-up and compiled onto the static OCB for each ship type. See ZD3/Init/ships.def for details

Ship Items Descriptions

TBD

Player Data

TBD

Game State Data

TBD

Test Mode

Zex can be configured in a test mode. In this mode no system is created and no game code is run. The engine loads the game file ZD3/L/test.zlv. Models can be loaded (via this file) and viewed. If a model is targeted (center model then press 'T'), the engine gives the object number and the model can be rotated with the mouse as follows:

Mouse Left-Right – Yaw
Mouse Up –Down – Pitch
SHIFT-Mouse Left-Right – Roll.

In this mode, the camera is still in the players ship which can be flown normally. The camera can be moved to the targeted model via the console with the 'camera' command. For example if when targeted the engine reported the object number was 6, then '6 set_camera_object' in the console will place the camera in the target object.

If the Ships Data System has an entry for the object (i.e. a ship description found in ZD3/Init/ships.def) then '6 set_control' will allow the user to fly the model as a ship, thus getting a feel for how it flies as a ship.

A model is tied to the SDS data via it's identifier. For example if the entry in test.zlv loads the model as 'TEST', then an entry called 'TEST' in ships.def will define the parameters for that model as a ship.

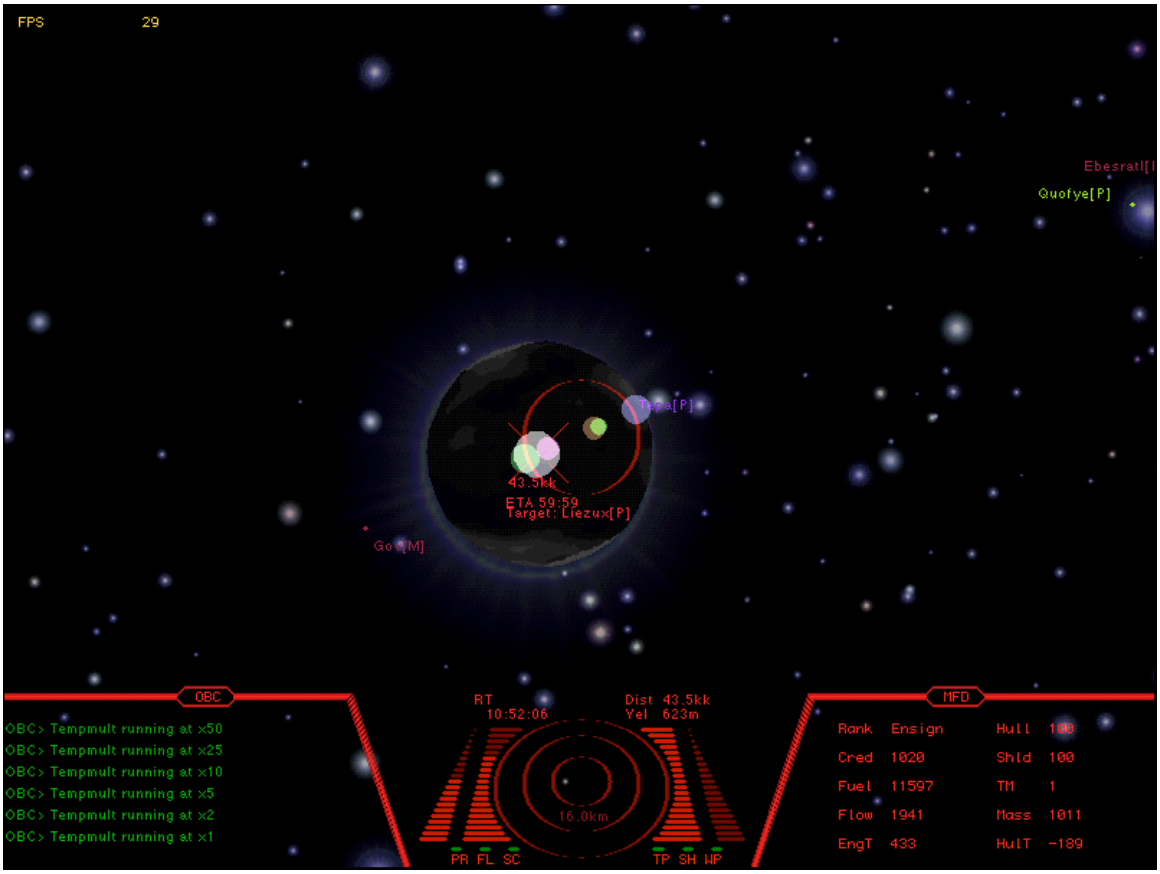
To return camera and control to the normal ship, use the object number '0'.

Known Bugs

1. Hull temperature is inaccurate flying close to, or between binary suns.
2. AP can 'lose it' if time multiplier > 1000
3. Time multiplier can be applied when large mass is near.
4. Commodities are in old Resourcerer format; Resedit won't read it. Need change to something else. Coffee? Fixed Aug 2003 – now in-line C
5. Shields once shown, will not show again. Fixed 070603
6. Shoot mothership; shields show, console logs EXEC: FATAL internal error(1) #0: do_object_control loop! Fixed 070603 – this was because we were generating objects (shields) inside an object while loop (object_control_top)!
7. If Zex is in background, it still accepts keystrokes!
8. Rear view should show exhausts! Fixed 080603.
9. Bad things happen when shot by an NPC – Fixed 100903 – rather than killing the gun particles we were killing everything but the particles!

Nice Piccies

Eclipse – Stu 260503



Revisions

0.74 – Now fully compiles as a c++ project; all files renamed to *.cpp

0.73 – revision given for initial Zex work; Zex 2 made it to revision 0.72. 0.73 gets the flatter galaxy, shields that vanish after 2 seconds.

Credits