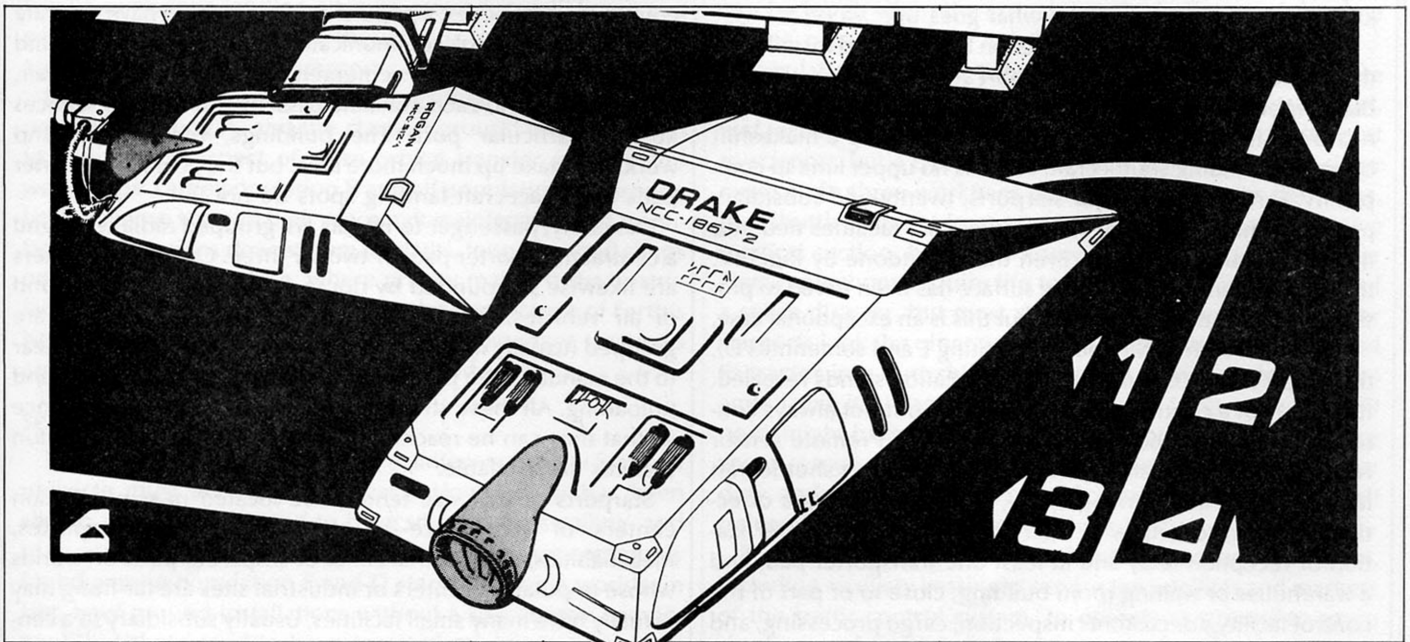
Spaceports In The Star Trek Universe



Say the word "starport" and most people immediately picture a level landing field with a control tower, launching pads and gantries, and needle-nosed ships poised to return to space. For most science-fiction role-playing games, this image, or some variation, is roughly accurate enough to serve as a model for picturing the scene.

Not so in the *Star Trek* universe, where most ships are too immense to land on any planetary body and the transporter is a major mover of people and cargo. The standard image of a starport as a kind of advanced airport in this context becomes as quaint as animal-drawn transport. No needle-nosed ships here.

But starports are still a necessity for transporting goods and passengers to and from space, serving as repair yards, parking areas, and as centers for all types of administrative work: customs, traffic control, civilian business, and military organizations. Starports exist in the *Star Trek* universe; they just don't look like what you might expect.

THE BASIC IDEA

Star Trek starports usually have three components: ground installations, spaceborne facilities, and traffic-control networks. All three are nonunitary (i.e., none are found exclusively in one place or even in one piece). They are very flexible as a result, capable of being tailored to the requirements of individual worlds and systems. They also tend to be extremely idiosyncratic, since no two star systems have exactly the same resources, population, or traffic.

> *The many worlds of the Federation are truly isolated but for their starports, where the denizens of the surface can interface with the bounty of a star-spanning civilization.*

In general, ground installations reflect only the distribution of people and resources on a planet with need for an access to space. Orbital installations are the better indicator of how much traffic a world is willing and able to service and handle. Access is determined by the traffic-control system which steers faster-than-light starships to and from a starport around other planets, navigational hazards, and each other. Primitive facilities can dispense with one or more components, but any worthwhile populated world will have all three.

Because each of the three components can vary so much from system to system, useful groupings are difficult to make for purposes of classification. By far the greatest determinant of a starport's capabilities is the population rating of the particular world (A through E), though enough variation exists within each rating to allow classifying such starports as *small*, *medium*, or *large*. Even this system is arbitrary and leaves gaps; Delta Vega, for instance, an uninhabited automated mining world has port facilities large enough to receive, load, and dispatch the giant robotic freighters which call once every 20 years. Yet Gideon, a heavily populated world, refuses all contact with any spacefaring people and has no starport facilities at all.

By and large, 15 classes of starports define their capabilities fairly well. Since each world's requirements for each of the components varies so greatly, some description of each component's composition capabilities will help to envision how a *Star Trek* starport does its job.

GROUND INSTALLATIONS

Since *Star Trek* shuttlecraft and landing-capable starships are equipped with vertical lift engines (either antigravs or reaction motors), they can land in any clear place slightly larger than their own platforms. The matter transporter, of course, operating from orbit, needs even less space. Ground installations serve, therefore, a predominantly administrative and convenient function by centralizing landing and beam-down locations close to populated or industrial areas, where local authorities can keep track of what lands and what goes up.

The simplest possible construction for a ground installation that could be called part of a starport at all would be a cleared outdoor area, with some kind of communications apparatus nearby to fix transporter coordinates or provide a makeshift beacon for landing shuttlecraft. There is no upper limit to complexity; Earth has five major starports, twenty-odd subsidiary ports, and numerous Star Fleet and private facilities tied into its overall starport scheme. Even this is outdone by Rigel IV, the trading planet, whose entire surface has been paved to provide landing and parking space, but this is an exceptional case.

On worlds with Low Population (rating E and sometimes D), the simplest form of a full ground installation stands revealed. It consists of a control center (sometimes but not always contained in a tower), possessing both local and remote sensor readouts and a central communications system; a shuttlecraft landing target and parking space, usually including a directional beacon to help with final approach; a transporter station or reception relay and at least one transporter pad; and a warehouse or waiting room building, close to or part of the control facility, for customs inspection, cargo processing, and passenger reception. A system this simple can handle up to 150 passengers each way, and between 1000 and 5000 Standard Cargo Units (SCU) a day, in general usage. In theory.

In practice, small population worlds usually depend heavily on one kind of export cargo, and their port facilities are built accordingly. Such installations will be found close to the mines, mills, or fields, with automated handling machinery for the movement of bulk cargoes, such as pipes, conveyor belts, cargo containers, automated trucks, etc. Loading capacity may be closer to 10,000 SCU per day or more, with a comparable off-loading ability for colonies or other nonself-supporting worlds. Starports on a main trade route or with considerable traffic to multiple markets, may have normal storage or warehousing space since they can rely on a constant flow of ships to bear products away, but more limited, isolated or "singe-purchaser" worlds (owned by megacorporations or combines) may have almost nothing but storage space on the ground for the export products waiting for a single massive cargo vessel.

Mid-sized ground facilities (population C and B) tend to be larger, more extensive, and less specialized. The flow of cargo and passengers is heavier, but more diversified. Warehousing, for upbound and downbound goods, will be much more extensive and decentralized. Personnel facilities are greatly enhanced, and include hotels, ground and air transportation, perhaps some medical facilities, and an extensive public-access information and communications system. Starports of this size do geometrically more information transfers than smaller ports, including newsfax, computer data, interplanetary mail, and entertainment media.

The actual machinery for receiving and dispatching people and cargo to and from space, however, may not be tremendously greater than that of simpler starports. It's a busy port that can use, for instance, four personnel transporters and 10 cargo transporters, plus landing and parking space for 20 or so shuttlecraft, as many population C starports do. What makes the difference is all the distribution machinery to keep people and goods flowing through the facilities, meaning more conveyors, vehicles, storage, and workers per pad. Where a population D or E port might have only one building and a couple of warehouses, a population C port could have separate structures for control, communications and computers, ground and air transportation, emergency control, ship repair, maintenance, and each available passenger and cargo services at this particular port. The buildings, roads, rails, and workspace take up much more area, but the actual transporter pads and spacecraft landing spots do not.

Generally, passenger terminals are grouped radially around a central transporter pad, or two, or three. Cargo transporters are likewise surrounded by docks for the loading of ground or air vehicles. Shuttlecraft and starship parking sites are grouped (usually linearly, but there are many variations) near to the manual cargo processing centers for ease of loading and unloading. All these structures are arranged for convenience so that they can be reached by whatever local transportation systems are available.

Starports of this size tend to be located near population centers of some size—cities, cluster-cities, complexes, megahabitats, or industrial zones or strips. Starports on worlds whose population centers or industrial sites are far-flung may actually have many small facilities, usually subsidiary to a central main starport ground installation, with local landing control slaved to the main facility's central control. As population increases, so do the size and often the number of these subsidiary facilities; private fields and docks may even subscribe into the system.

Another feature of population C and B starports is the shifting of some starport functions "upstream" to orbital stations and complexes. One of the first things to go up is customs and import control, which tends to give cause for the building of orbital warehousing, public and private, for downshipping and transfer to other ships, and the construction of orbital hotels and administrative complexes. Upbound passengers and cargo are still cleared on the ground. Only much larger ports, which can afford the personnel and sensors to control all transporter and shuttlecraft traffic, clear outbound people and cargo in orbit, as well as on the ground.

Ground-based loading and unloading never do quite disappear from any starport, no matter how large. Smaller ports see a disproportionate number of landing-capable starships, since they are the most economical way of landing and picking up cargoes from such worlds, but larger ports see larger ships, and the great time advantages of the transporter make themselves felt. Smaller ships, though their share of total tonnage decreases even faster than their actual tonnage carried, never do desert the larger markets and larger ports. Federation-wide, some 55 percent of all cargo and passenger landings (nearly all the passenger traffic) are by transporter. Shuttlecraft handle another 25 percent, and the remainder is borne by landing-capable starships. Thus, customs and immigration offices remain sited on ground installations even though a growing proportion of their work takes place in space.

The largest starports, those serving worlds of population rating A, are even larger and more dispersed. Past a particular size, after all, the advantages gained by a larger single installation are overbalanced by the costs of construction and transportation, so many more starport ground facilities are provided to many more locations. In fact, ground locations served by the same spaceborne and traffic-control systems may not even be on the same planet; Earth, for instance, counts Luna's numerous landing sites as ground installations, and even the LaGrange habitats, though they are in stable orbits, are "ground" to Earth's starport system.

Even more of a starport's functions take place in space at population rating A, and the starport ground facilities begin to take on the aspect of mere orbital transfer stations and workshops. Large population B and all population A starports begin to move some of their spacecraft maintenance and manufacturing functions downstream to plants, foundries, and shops on the planetary surface, where gravity makes heavy manufacturing tasks easier. This explains the appearance of Earth's New Jersey spaceport, where luxurious passenger terminals are nestled cheek-by-jowl with heavy industry.

SPACEBORNE INSTALLATIONS

The bulk of starship parking and maintenance in the *Star Trek* universe must take place in space. However, as has been shown, smaller ports tend to have smaller ships calling, and truly comprehensive spaceborne facilities are not commonly found among population E and D starports. Some worlds, in fact, have ground installations without a spaceborne component, but these tend to be automated mining stations, very young colonies, or other pop-X planets. A world with any appreciable traffic at all needs manned orbital stations and attached repair and rescue facilities to support incoming vessels.

Rescue vehicles, especially if they are war-driven, are extremely valuable spaceborne assets, particularly to the reputation of the world from whose starport they hail. They are money-losers more often than not, but spacers feel a great deal more comfortable knowing the port they are bound for (or passing near to) has a ship on call to come to their aid should they lose warp capability. Rescue craft, alas, are expensive, and warp-capable ones are rarely found at any starport with a population rating of E.

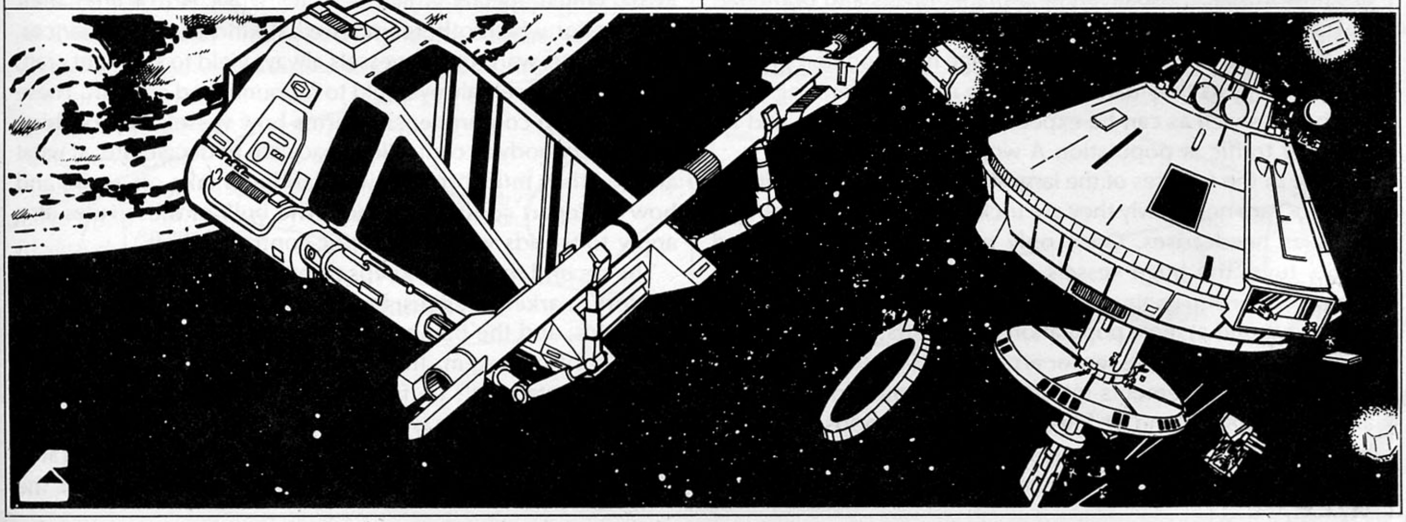
Population rating E starports have bare-bones spaceborne facilities, usually just a single manned space station to monitor communications and the traffic-control net. It may not even have its own transporter system or shuttlecraft, but most have at least one spacecraft available for surface-to-space and in-space service, and often times they may have more. The personnel of such stations usually do double-duty, operating the station and control net and coincidentally, when called upon, doing repair and maintenance work on starships that call. Work can be tough when the crunch comes, but most of the time station personnel have it pretty easy.

Population D starports have noticeably larger spaceborne contingents, particularly in the number of service, transport, and rescue vehicles. Actual numbers vary widely from starport to starport, but a typical population D port might have six or more craft: three workbees doing double duty as light tugs, two shuttles, and at least one rescue craft with an extensive medical section, habitually known as "the ambulance." Star Fleet regulations require life to be saved first in the event of a space disaster, but most starport authorities at the smaller starports look the other way if their ambulance has been used to tractor in a hurt ship and its intact cargo—so long as the ambulance itself isn't harmed, of course. Large population D ports might have a second craft used entirely for deep-space vessel rescue and cargo salvage. This tends to be very popular duty, and crews tend to be picked carefully; they are elite, well trained, and usually scrupulously honest.

Population C starports have complete spaceborne systems, including auxiliary vessels to service the satellites and markers of the traffic-control system, to operate as ground-to-space shuttles, and to form at least two search-and-rescue teams, capable of intercepting stricken ships, handling on-board emergencies, and evacuating quickly. Tugs capable of handling Class X size or larger vessels are common.

Fixed orbital facilities, likewise, are much larger and complete, and more heavily populated, with some or all of the complement living in space. With a larger proportion of pure-space vessels now arriving, orbital customs and cargo inspections become regular, as well as close-in traffic control to keep landings, takeoffs, and orbital positions straight among all vessels. Starports of this size also tend to have civilian or private interests leasing office space in the existing station, or building their own. It is not unusual for multiple manned stations to be used to keep traffic straight and accommodate private business at population C worlds, with these stations being spaced evenly in low parking orbit or placed high in synchronous orbits at the outermost limits of transporter range.

Worlds of population rating B have starports with spaceborne assets which are little short of being entire orbiting cities. They



have multiple manned stations, extensive repair yards with expandable "flydocks" for working on starships or constructing them anew from components, fleets of tugs, workbees, rescue and salvage craft, immense administrative offices, living quarters, passenger accommodations, and even warehouses in several orbits, on nearby moons, or in orbit about them. Some even have installations in orbit about other worlds in the same planetary system or its asteroid belts, either as part of the outlying traffic-control network or servicing ground facilities on other worlds. Space-based manufacturing is quite common at this population rating, and entire industries receive raw materials, process them, and ship down finished goods to the planet below, or they ship them outsystem again, without an ounce of product ever touching the ground.

The administrative work that goes into keeping such a complex functioning is mammoth. Simply keeping track of the hundreds of ships, shuttles, orbital structures, and satellites in near-planet space absorbs an enormous amount of sentient and computer time. Having multiple landing and beam-down points complicates things further, as well as the much greater proportion of slower-than-light craft, which claim the right-of-way from warp-driven ships. The cost of maintaining this vigilance is also mammoth, but the port authority of most worlds this size deals with it by taxing not just private industry, but all users and occupiers of near-planetary space who fall within its jurisdiction or use its services. Compared to smaller starports, which bend over backward to attract more vessels and trade, larger starports charge a premium for their use. There is more than enough to draw trade, and money is being made on-world and in space because of that trade.

Population A worlds have starports not merely larger and more extensive than population B starports, but of an entirely different order. Their spaceborne facilities are found orbiting the main world of the system, any moons it may have, and most of the other worlds in the system. It services ground facilities throughout the system, as well as the enormous and elaborate traffic-control network needed to tie them together. Their search-and-rescue vessels, and most of their tugs, are based farther out-system where they are closer to where they are needed. Medical complexes, space hospitals really, are likewise located far out from the starport's center, as are repair yards, construction yards, orbital factories, and even living complexes.

Nearly all administrative features of a population A starport are now in space, usually in near-planet orbits and branched out all over the system. Spaceborne assets of this size are capable of handling the traffic to a huge metropolitan ground port as easily as they handle a private one-ship landing field, or about as well as can be expected, given the heavy and increasing traffic at population A worlds.

Some of the features of the largest starport types are unique, but most are not; slowly they are trickling down to smaller starports as need arises. Once only population A worlds had lander-tugs, the huge vessels capable of carrying immense loads like starship engines to and from a planetary surface. Now they are found at most population B starports, particularly the larger ones. Large-scale sensor arrays, specialized rescue craft, and other improvements introduced at population A worlds are now being found at lower-population worlds and even becoming common. This includes the emplacement of more spacecraft construction, workshops, and factories on the ground. The day is probably not far off when every population B world, as every population A starport now boasts, will have a permanent Star Fleet presence in the form of an administrative office and a permanent rotating contingent of vessels.

Until recently, population A starports were also known for being even thicker with "sky clutter" than B starports, but the construction of Space Dock in low Earth orbit may reverse that trend. In place of many scattered constructs in similar orbits, a single megalithic spaceborne structure offers a large savings in communications and transportation difficulties while controlling runaway growth. It has long been possible to put all spaceborne assets into one gigantic structure, but the costs always seemed to overwhelm the need. No longer. A single structure like Space Dock may be expanded to accommodate new growth without impairing its continuing function. There need be only one structure for every world in a starport system to contain all spaceborne assets needed for that world and its immediate space, with the exception of outlying search-and-rescue facilities. The savings in traffic-control problems alone will probably cause this advance to trickle down to smaller starports in time as well.

Space Dock was built to Star Fleet specifications, and apparently only to fulfill their needs. Whether civilian space operations move into Space Dock as well, or another Space Dock is built purely for private interests, remains to be seen.

TRAFFIC CONTROL

Ships in the *Star Trek* universe are *fast*. They can accelerate from orbital to light velocities in minutes, or seconds. They aren't affected by gravity wells or (to judge by the last movie) immersion in planetary atmospheres. They have no problems operating, or going anywhere, at light speed, even perilously close to planets and each other. This is why, when you have 10 or 200 of them in close proximity to a world, it becomes *very* important to know *exactly* where each of them is and what they are doing, and better still, to be able to direct them in a sensible, non-lethal pattern, so that they can all get where they're going without causing what 20th century rocketmen called "snakebite"—an accident.

Spaceborne starport assets are intended to help sort out the mess, but they would be useless if not for two things. The first are the Federation-mandated, Star Fleet-enforced Rules of the Road, which specify which vehicles will yield or alter their courses for which others under what kind of circumstances. For instance, warp-driven vessels always yield to sub-light craft. Outbound vessels always yield to inbound, and so forth. These rules state in comprehensive terms how vessels approaching a planetary body in controlled space are to decelerate, at what altitude they must orbit, how to land and take off again, and how to depart controlled space. The bulk of these rules also apply to worlds without a traffic-control system.

The second thing that keeps things straight is the system of sensors, marker satellites, buoys, communications relays and protocols, and the beings behind them, which is a starport's traffic-control system. In its simplest form, as shown in the diagram, a starport's traffic-control zone is divided into three parts. The Outer Zone is the official limit to the system's control, where all spacecraft must follow the directions of Traffic Control. In the Outer Zone are two travel corridors: the

Approach Corridor and the Departure Corridor, which would look like truncated elliptical cones if they were visible. The third control zone is the Inner Zone, roughly from the planetary surface to 20 diameters out, where warp speeds are not allowed and where spacecraft are achieving, departing, or changing orbits. This diagram is greatly simplified; if there were other planetary objects in this star system, they would also have approach and departure corridors, plus travel corridors between each. The traffic-control solution can be terribly complicated in a huge hurry.

On the other hand, the basic principles of in-system navigation for all types of vessels may be summarized briefly as follows:

1. All approaching ships under warp drive must approach a planet from the trailing direction and within 10 standard degrees of the orbital plane once they are within the outer control zone markers.
2. All departing ships under warp drive must depart in the direction of planetary motion within 10 standard degrees of the orbital plane until they reach the outer control zone markers.
3. Ships may not be under warp drive within 20 diameters of the destination world, not have a speed greater than 0.1c within five diameters of the destination world, unless directed to go slower by Traffic Control.
4. Faster vessels must yield to slower; warp-drive vessels must yield to sub-light; powered vessels must yield to unpowered; manned vessels must yield to robotic.
5. Traffic Control is always right.

Traffic-control systems and their assets vary at least as widely as the other two components of a starport, and often more so, due to the wider variety of problems moving planets, asteroids, stray comets, and the types of ships in system. They can be relatively simple or mind-bogglingly complex. Not all systems share the same precise features, but all have some basics in common.

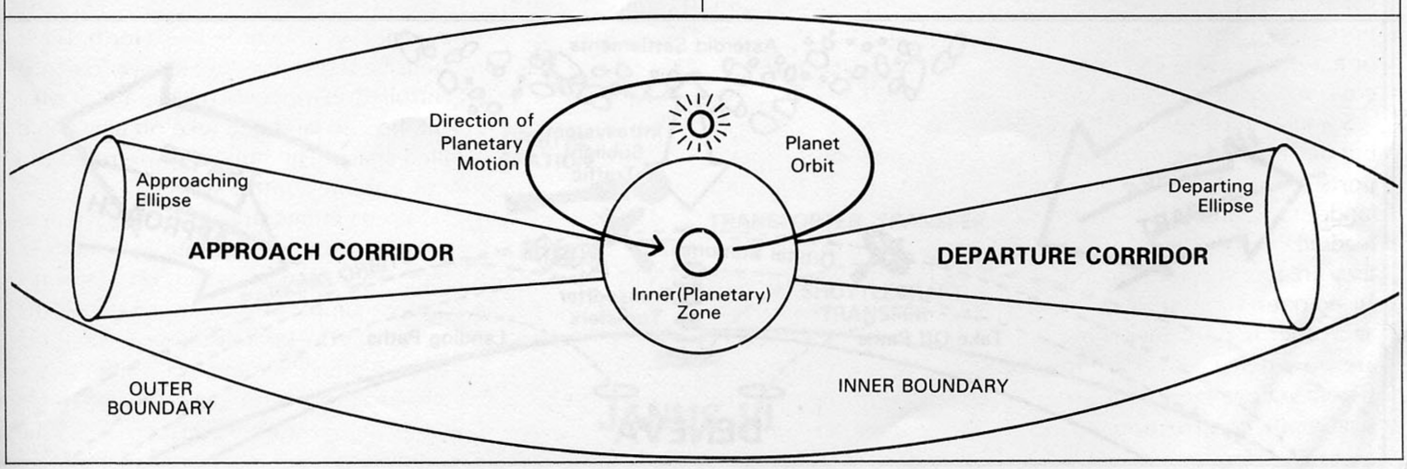
There are three parts to any traffic-control system: Approach Control, Departure Control, and Planetary Control. At smaller starports many personnel double up on some jobs; at larger ones Planetary Control is further divided into a Landing Control and a Takeoff Control section. Approach Control's job is to gather all incoming vessels, establish contact with them by sub-space radio, guide them into the approach corridor, and cause them to arrive, in single order, and at sub-light speeds, at the 20-diameter limit where Planetary Control takes over. Departure Control sequences departing spacecraft leaving Planetary Control's jurisdiction into the departure corridors, or other interplanetary transfer corridor, and guides them in an orderly manner to the edge of the system closest to their intended destination. Planetary Control establishes orbits for all incoming craft, designates orbit changes, landings, and takeoffs from the planetary body, and regulates departures from orbit to other planetary destinations or out-systems. Though all three of these divisions make up Traffic Control, where a star system has multiple system destinations, Traffic Control handles guidance between local Planetary Control authorities.

Sometimes smaller starports, with limited traffic, have only an Approach and Departure Control and a Planetary Control; the very smallest have only a Traffic Control. Larger starports have more subdivisions, including Search-and-Rescue, Harbormaster (space-going "traffic cops"), Salvage, Medical, even a Mobile Repair Control. Each has specific authority over a part of a vast network of ships and unmanned buoys that, if it functions well, never gets noticed at all.

How much each traffic-control system can vary from another is illustrated with these three schematic diagrams of selected starports and their traffic flow.

Janus VI is a low-traffic world, and its traffic-control system is very simple. It is a mining world, the only destination in its star system; it has next to no sub-light traffic with which to contend. Its only concern is ore freighters, manned and robotic, and the occasional supply and mail ship. There is only one main surface installation handling all shuttle and transporter traffic from orbit to ground and back. Parking orbits around Janus VI are unusual, being either very high (7000 to 15,000 kilometers) to give longer loading times for transporter-equipped freighters, or very low (500 kilometers or less) to accommodate loading by shuttlecraft.

Deneva is a mid-population world with moderate traffic to its one inhabited planet and the mining settlements in its asteroid belts; there is a moderate amount of intra-system traffic between these settlements and Deneva itself. Traffic is more variegated; besides the usual freighters there are numerous passenger and research vessels, plus a steady influx of Star Fleet ships, for Deneva is an important scientific outpost. Contrary to popular belief, Star Fleet must follow the same orders from Traffic Control that regular traffic does, but they have the authority, in emergencies, to maneuver independently even in high-traffic areas, relying on their superior sensors and highly



trained crews. Deneva is a good representative of the majority of starports in the *Star Trek* universe: Note that in the diagram the multiple destinations in the asteroid belts have been abstracted into one out-system destination.

Now comes Earth, the Grand Guignol of traffic-control systems. The starport at Earth is one of three starport complexes; there are comparable ones at Mercury and Mars, with subsidiary operations at Venus, Jupiter, Saturn, and the asteroid belts. All of these operations have ground and spaceborne facilities subordinated to Earth Control, and all receive traffic from out-system as well as each other. Near Earth there is Space Dock, of course, plus all the LaGrange habitats, the Lunar complexes, all five major ground ports and 20-odd subsidiary public ground installations, and a like number of private fields, *plus* the Star Fleet complexes, orbital and ground-based, incorporated into the Earth starport system, for the sake of simplification. Multiple ground destinations at the other worlds in Sol System are the rule, not the exception. The situation only gets worse when one considers that all these destinations are in motion, and that twice a month approach and departure corridors to Earth have to be diverted due to the presence of Luna and *its* approach and departure corridors sweeping through. And Star Fleet, which has authority to override Traffic Control even here, maintains large training areas in the asteroid belts and out-system where traffic is not permitted. This diagram is, of necessity, greatly simplified for clarity.

STARPORT OPERATION: AN EXAMPLE

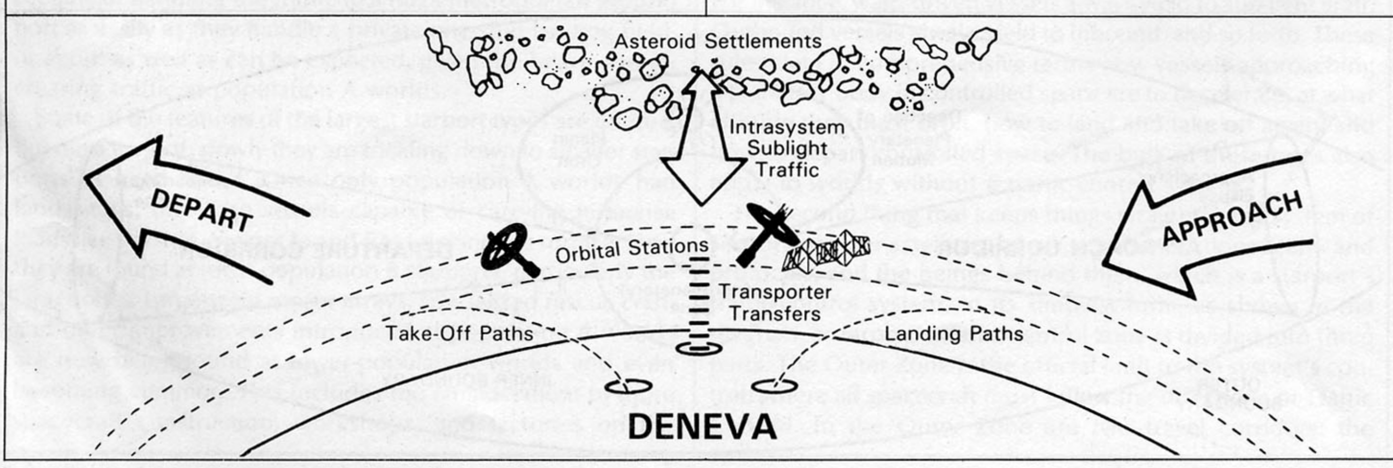
All the data on *Star Trek* starports that could be given would not be sufficient to get a feel for how they handle individual ships. So, for the purpose of illustration, follow the approach, landing, and departure of the *Handley*, a Class V merchant vessel, at a typical population C starport.

Upon detecting the star system's navigation beacon, the captain or communications officer contacts Traffic Control and informs them of the ship's approach. Traffic Control then assigns the ship a course which will bring it to the outer system boundary markers within the ellipse of the approach corridor. Should a vessel fail to alert Traffic Control, system sensors will detect the ship as it crosses the outer zone boundary, and Traffic Control will immediately hail that vessel on all the usual channels. Failure to contact Traffic Control before reaching the outer boundary is not an offense, but since it greatly simplifies the approach problem (and gives the ship a time reference for the coordination of ship's time with the intended landing site), it is greatly recommended. Failure to heed Traffic Control once the outer markers are crossed is an offense against the Navigation Act, and can result in suspension of licenses for pilot and master.

The *Handley* is directed to steer 135mark10 to bring it to the approach corridor for the one planet in the system it wants to reach. Star systems with multiple inhabited worlds have more than one pair of corridors, which Traffic Control is careful to keep from overlapping; this usually involves moving one or the other every standard month or so, or, in more congested systems, every week. (At Earth the corridors shift every six hours.) The course the *Handley* has been given will not take it directly to its destination world, of course, but it will take it to where Approach Control expects to gather it in.

Upon crossing the outer boundary marker the *Handley* alerts Approach Control and gets a new course and speed for the destination planet, in this case 223mark4, warp 2. At this speed (one au a minute), the *Handley* will spend nearly half an hour on approach. More crowded systems place their outer markers farther out and vary approach speeds more widely than smaller starports. Traffic and sun-weather advisories, available on a reference channel and often running continuously through a ship's computer, inform incoming vessels of peculiarities or hazards to watch for on the approach. Active suns with prominences or violent solar winds sometimes wipe out distant-reception functions of both the traffic-control new and incoming spacecraft, and if that happens, a backup system of short-range, powerful beacon satellites is available to guide craft down a "string" in the middle of the approach path to within the planetary magnetosphere. This trip, the weather is fine, and the *Handley* joins several other ships in a converging cone, each ship's speed matched to bring them all to the cone's apex in a uniformly spaced sequence. The *Handley* is informed of one possible problem: Three ships ahead of it is a Class XVIII robotic freighter, which may require additional time to bring into orbit, perhaps as much as half an hour's delay. A starport tug is also working close to the approach lane today, removing a previously undetected small asteroid before its orbit intersects the approach path, and a sub-light shuttle is inbound from an out-system settlement, making an orbital approach to the destination world from outside the warp-speed approach corridor. The captain of the *Handley*, being a cautious sort, instructs the helmsman to look lively when the robotic freighter gets close enough to the shuttle to detect it.

During approach, ships also receive preliminary parking



orbits, invariably circular about the destination world, but at different altitudes, according to size, needs, and capabilities of each ship, and the requirements of local Planetary Control. Most systems put sub-light vessels under warp-driven ships, which are arranged according to size, with the smaller being lower. The highest orbits of all are reserved for very large ships, notably robotic freighters. Practice varies from system to system, however, and often from ship to ship, according to circumstances. Preliminary orbit coordinates generally are good for final approach, but in high-traffic systems it's not unusual for them to be changed once or more before insertion.

At the apex of the cone is the Approach Corridor Inner Boundary Beacon (ACIBB); each vessel, as it encounters it, must call Approach Control and get a final course vector for their parking orbit. Ships may not pass the ACIBB at greater than warp 1, unless directed otherwise by Approach Control. On this trip, the robotic freighter has indeed detected the sub-light shuttle and slowed to just below warp speed, and Approach Control informs the *Handley* that it must do the same to avoid closing the intervals between ships. Most starports prefer a margin of at least five minutes between arrivals for minimal safety.

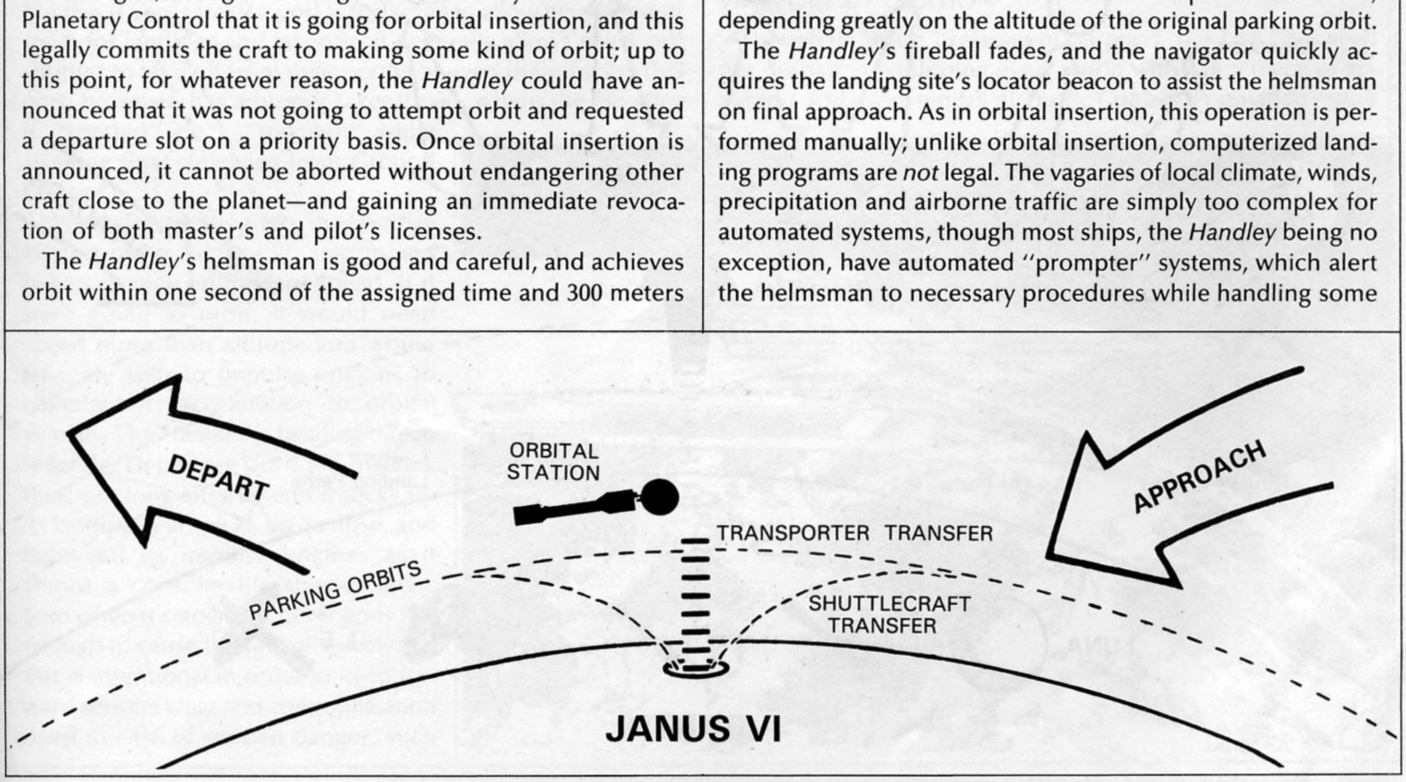
At this point in its journey the *Handley* is close enough to other inbound vessels that it can detect them up to three ships away, fore and aft. Now comes final approach to orbital insertion, one of the true tests of a helmsman's skill. Orbital parameters are given in the form of an altitude, a declination to the local planetary equator, and a precise time to achieve position. Planetary Control gives final clearance for the specified orbit, and then it is up to the individual helmsman to make the slot. Automated piloting programs, if running constantly and coordinated precisely with telemetry relayed from Planetary Control, can achieve very precise orbits, but their flexibility is limited and their use on manned vessels strongly discouraged, though not illegal. The *Handley* announces to Planetary Control that it is going for orbital insertion, and this legally commits the craft to making some kind of orbit; up to this point, for whatever reason, the *Handley* could have announced that it was not going to attempt orbit and requested a departure slot on a priority basis. Once orbital insertion is announced, it cannot be aborted without endangering other craft close to the planet—and gaining an immediate revocation of both master's and pilot's licenses.

The *Handley*'s helmsman is good and careful, and achieves orbit within one second of the assigned time and 300 meters of the assigned position. Both can be corrected easily with ion engines once the main impulse engines are shut down. The *Handley* has officially arrived at its destination planet and may be serviced by all orbital facilities (and charged therefore).

But the *Handley*, having too small a crew and payload to make transporter or shuttlecraft cargo transfer worthwhile, and being landing-capable, files a flight plan with Planetary Control and requests a planetary landing at the starport's ground facilities, submitting at the same time the data Landing Control will need to figure its descent orbit. Traffic is light, and the *Handley* does not need to shift to a lower orbit before it begins atmospheric entry. Landing Control transmits a "landing packet" of data to the *Handley*, including the time of deorbit, expected time of arrival at the requested facility, and the precise curve the ship must follow. Atmospheric entries are extremely hazardous maneuvers, more so than orbital insertions, and the smallest deviations from a calculated path can destroy a ship or shuttlecraft, and possibly involve other vessels in lower orbits, or themselves landing or taking off, as well as people on the ground below. The precise landing path is a safeguard as well as a guide; deviation from it for any reason, unless sanctioned by Traffic Control, is not permitted.

De-orbit is performed without incident, and the *Handley* descends in a slow arc until it reaches the planetary atmosphere and must begin braking. Most smaller vessels like the *Handley* are not yet equipped with gravitic decelerators which work at high skin temperatures, and which in any case add up to 50 percent to travel time on thick-atmosphere worlds, so the *Handley* rides down in a fireball, relying entirely on atmospheric braking through the hull shape. Most of the fireball rides the shock wave ahead of the ship itself, so the worst of the heat does not penetrate the craft. But it can be a tense time, especially since the fireball cuts off all communications and sensor relays until just minutes before touchdown. A descent like this can take as little as an hour or up to three hours, depending greatly on the altitude of the original parking orbit.

The *Handley*'s fireball fades, and the navigator quickly acquires the landing site's locator beacon to assist the helmsman on final approach. As in orbital insertion, this operation is performed manually; unlike orbital insertion, computerized landing programs are *not* legal. The vagaries of local climate, winds, precipitation and airborne traffic are simply too complex for automated systems, though most ships, the *Handley* being no exception, have automated "prompter" systems, which alert the helmsman to necessary procedures while handling some



minor tasks like waste heat dumping and traffic alert monitoring. The helmsman, with the navigator's assistance, steers the ship onto the glide path provided by the landing beacon.

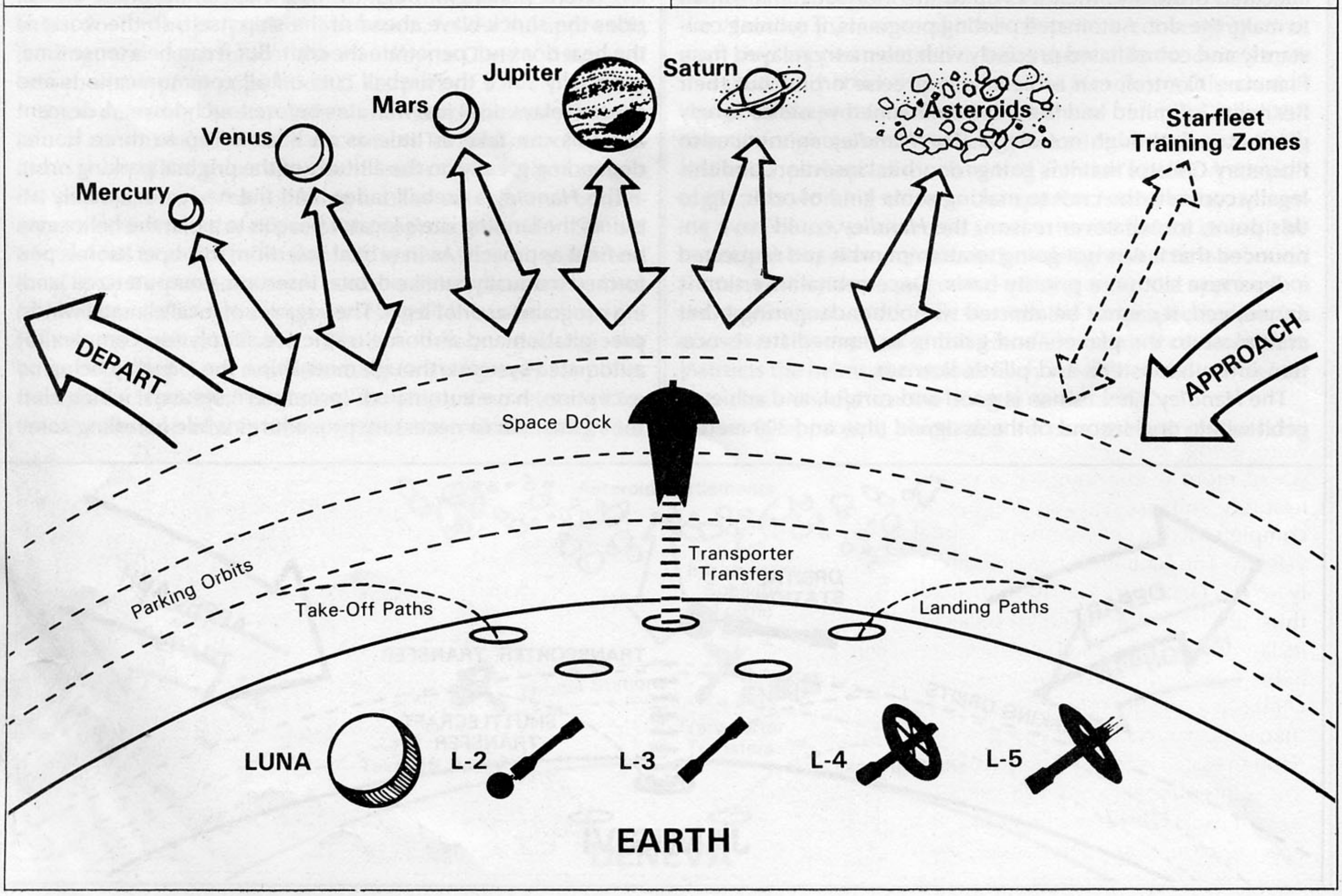
Some starport ground facilities have such advanced short-range ground control systems that they can gather in a landing starship on approach, indicate its landing berth, and have the ship land there. Larger ports have such systems to save time and landing space, since the same landing path may be occupied by three-person shuttlecraft and 50,000-ton freighters at the same time, but this port has a simpler system found in many smaller starports.

As the *Handley* comes below 5000 meters altitude relative, it begins to engage its antigrav vertical lift system—a rather modern innovation for a ship of Class V size, which usually uses reaction thrusters with their lower cost in spite of the attendant heat and blast. The navigator contacts the local Landing Control, informs them that the ship is on final approach, and requests clearance and directions to a berth. Landing Control acknowledges, warns them of a low-level air traffic corridor a kilometer short of the port, and directs them, after touchdown, to take taxi turnoff 7L and follow the markers onto Dock 16.

The port and its landing target now come into visual range, and the *Handley*, already decelerating, aims for the center of the target just past the landing beacon emplacement. Landing gear are extended. A ground facility's landing target is a rectangle of resilient heat-resistant thermocrete, capable of withstanding the blast of landing thrusters and the occasional—very rare—crash landing. A distinctive target shape is typically molded into its surface, and lights outline this shape for night landings. Many pilots make at least a token touchdown on the landing target for the purposes of making a formal log entry at the earliest possible moment of landing, but the *Handley* merely settles to within two meters of the target with a forward speed of just a few kilometers an hour, and immediately glides off the target down the taxiway ahead of it.

Blue arrows and symbols show the various turnoffs to the right and to the left. The *Handley* takes the seventh turnoff, to the left, and follows the arrows to Dock 16, where ground technicians and stevedores wait to help guide the freighter into the slip. This is done. The helmsman lets the ship settle to the ground and lets the lifters fade to nothing. The ship is now landed, and cargo and passenger transfer may now begin.

The *Handley* has no repairs to be performed, and no need for lengthy stays, but after transferring cargo the ship is moved via ground tractor and its own lifters to a berth, where it will await clearance to return to orbit. Larger ports, and those on airless worlds, often have indoor berths for parked vessels, even ones as large as the *Handley*, but this particular world is quite habitable, and all the berths are outdoors. A starship ground berth, on first inspection, is disappointing; it's just a section of hardstand, very strong but hardly impressive, with a number painted or inlaid on it. Connections for long-term power, water, and sewage lines, as well as local communications and datalinks, are all available from the so-called "Christmas tree" at the forward end of each berth. Only ships planning stays of several days or longer make use of all the



conveniences, but while awaiting an orbital takeoff window, a ship will make use of at least the datalink to keep its navigation system updated.

Some ships, particularly larger freighters with containerized cargoes, can file for departure as soon as they hit orbit, knowing precisely how long it will take to offload and load another cargo. Most other vessels wait for their business to be completed, particularly small ships looking for available cargoes on non-standard lines, who do not know if they will lift that day or sometime next week. Dock space is valuable, so as soon as a ship has completed offloading, unless it has another load waiting to come on, it is moved to a parking berth until it can be reloaded, and likely as not, it will be moved back to its parking berth while waiting for orbital clearance.

Takeoff from a starport ground facility resembles landing: A flight plan must be filed, sometimes with a specified orbital position for rendezvous, and Takeoff Control issues a "takeoff packet" with the planned takeoff arc, which again must be followed exactly on pain of violating local and Federation Navigation Acts. The *Handley* wants to simplify its navigation problem of leaving the system. Instead of filing for a parting orbit first and then a departure path, the navigator files for a direct departure—planetary surface to the Departure Corridor and out. This means there is no wait in orbit for a suitable departure time, but it does mean waiting a longer time on the ground while orbital traffic finally clears enough to permit a direct path. The quicker way out of system is *not* the quickest way off-planet.

As the mandated takeoff time approaches, the *Handley* prepares for space by disconnecting itself from the "Christmas tree" and having a ground tractor pull the hovering ship to the takeoff spot. This is another marked rectangle away from the berths and docks, with a clear area before it in the direction vessels will take going into orbit. Smaller ports sometimes have only one target for landing which is also used for takeoffs, but this is very rare; if a port is too small to allow two different spots for landings and takeoffs, it generally allows ships and shuttles to take off from their berths or even their docks. This port, however, has a proper takeoff pad, where the *Handley* is "spotted" on a "toemark" while awaiting final clearance from Ground Control.

When clearance is given, the *Handley* lifts off on its vertical lift system and begins to pick up forward speed. If it were going to orbit, it would need speed more than altitude and would leisurely shift to impulse engines to complete its acceleration to orbital velocity. The *Handley* is heading directly for the Departure Corridor, instead; thus, not long after takeoff it tucks up its landing gear, picks up its nose, and lights off its impulse engines as it climbs a considerably steeper angle than when it came in. It never goes fast enough to cause the fireball effect, and this is intentional in order to keep forward sensors clear and communication open in case of sudden danger, such as an out-of-control landing or an errant craft in low orbit.

The *Handley* encounters no problems as it accelerates out of the atmosphere and along its prescribed course. The navigator informs Planetary Control that the ship is near the end of its programmed trajectory and requests a heading and speed for the Departure Corridor Inner Boundary Beacon (DCIBB). As on approach, the *Handley* gets sun-weather advisories and traffic hazard updates. The weather is clear, and there are no hazards of which to stay clear; at 0.1c the *Handley* is to steer 251mark2 until the DCIBB is acquired.

At the DCIBB several other ships are also gathering, which the *Handley*'s helmsman can acknowledge by the ship's sensors. The navigator informs the system's Departure Control in which direction the *Handley* wishes to proceed once leaving system. Departure Control, which already has this data from the filed flight plan, gives the *Handley* a course that will take it to the point on the departure ellipse closest to its chosen heading. Ships passing the DCIBB begin to radiate outward, following the invisible "walls" of the Departure Corridor as they head out-system. The *Handley*'s course is to be 246mark15, and speed to the outer boundary markers is to be warp 2. The navigator acknowledges, the helmsman adjusts the course, and the *Handley* engages warp drive.

In another half an hour the ship passes the outer markers, and the navigator contacts Departure Control one last time to give the ship's heading. This again helps rescue and recovery forces in the event of disaster, and helps Traffic Control keep track of vessels even after they leave controlled space. It's more a courtesy than a legally mandated necessity, but few ships or captains would omit it.

After setting course and final speed, the *Handley* is out of the starport's control system and free to maneuver at any course and speed it chooses, until it again approaches a new destination world, with its traffic control beacons and starport.

STARPORT GENERATION

Though there are 15 classes of starports, *Star Trek* GMs need not despair at equipping every world with every piece of apparatus and every tendril of Traffic Control. Population rating

is the overwhelming determinant; for further subdivision roll 1D6. A 1 or 2 indicates the starport is *large*; 3 or 4, *medium*; 5 or 6, *small*. Or arbitrarily assign a starport ratio according to a world's traffic—intersystem and intrasystem. A tiny world in a system with other habitable planets or outposts might rate a population E starport, but it could be a *large* one to handle interplanetary shipping.

For quick-roll artists and those with no time to contemplate a star system's innermost needs, the following tables are provided for quick starport generation on any *Star Trek* world.

NUMBER OF GROUND INSTALLATIONS*

PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*	*1D10*
1	1	1	1	1	2
2	1	1	1	2	3
3	1	1	1	2	4
4	1	1	1	3	5
5	1	1	2	3	6
6	1	1	2	4	7
7	1	1	2	4	8
8	1	1	2	5	9
9	1	2	3	6	10
0	2	2	3	8	10+1D10

*Able to handle a landing-capable starship.

NUMBER OF SPACEBORNE INSTALLATIONS MULTIPLIER*

PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*
×1	×1	×2	×4	×8

*Total number of all inhabited structures in all orbits at one planet: Reroll Ground Installations number and multiply by the appropriate number.

RELATIVE SIZE OF STARPORTS (1D10)

	PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*
Small	1-6	1-5	1-3	1-2	1
Medium	7-9	6-9	4-6	3-7	2-6
Large	0	0	7-0	8-0	7-0

NUMBER OF OTHER STARSHIPS PRESENT*

	PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*
Small	1D6-4	1D6-2	1D10	2D10	4D10
Medium	1D6-3	1D6	1D10+4	3D10	6D10
Large	1D6-2	1D6+2	2D10	4D10	10D10

*On the ground. Use spaceborne multiplier for parking orbits)

NUMBER OF SUB—LIGHT VEHICLES MULTIPLIER*

PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*
×1	×2	×3	×5	×9

*Intrasystem, intra-atmosphere, and shuttles: Reroll on Starships and multiply by the appropriate number.

AVAILABILITY OF STARPORT ASSETS (PERCENTILES)

	PopR E	*PopR D*	*PopR C*	*PopR B*	*PopR A*
Repair Tender	60%	75%	90%	90%	100%
Rescue Vessel	10%	25%	70%	100%	100%
Tugs	5%	20%	35%	80%	100%
Orbital Shipyards	0%	25%	50%	100%	100%
Star Fleet Ship	2%	5%	10%	40%	100%
Internal Docking	0%	5%	10%	30%	60%

Notes

Reduce percentage by one-third for *small* starports; increase by one-third for *large* starports.

Repair Tenders cannot repair warp engines or damage exceeding 20 percent of original construction values.

Rescue Vessels will save a crew and passengers from a stricken ship but not cargoes, ordinarily.

Tugs can bring crippled vessels into port, cargo and all, or just the cargo, for Cr1 per ton, cash.

Orbital Shipyards can repair any damage to any ship. Roll on availability again if the ship is non-Federation.

Star Fleet Vessel if present can act as repair tender, rescue vessels, and tugs, if asked nicely and if they aren't too busy. But they're *nosy*.

Internal Docking indicates ships and shuttles may dock physically, if desired, with any habitable starport structures in space (GM's option).

Population X starports (1D6)

Worlds with fewer than 100 inhabitants do not have permanent facilities, but they may have a special feature or several if the GM desires.

1. Orbital marker buoy and sub-space radio relay.
2. Unused space station or converted spacecraft, habitable but empty.
3. Ground-based shuttlecraft (seven passengers or five SCU of cargo).
4. Ground-based cargo shuttlecraft (10 passengers or 10 SCU of cargo).
5. Transporter pad available on surface.
6. Strange spacecraft in orbit (Uh oh...).

—*Peter R. Rogan*