GETTING SOME READINGS ON SENSORS

by William Blakely

Sensors are awfully useful things for players. They provide vital information about vessels and planets they encounter, preparing for trouble and giving them an idea of what to expect in their adventure. For the same reason they're a headache to the gamemaster, who finds it easy to give out information through them at the start of an encounter but who has to struggle later on deciding what, or whether, sensors can detect. Sensors are so universal, so devilishly useful, that problems with them will always crop up until somebody lays down detailed ground rules on the function and abilities of sensors.

For players and gamemasters who can't wait, here's some simple ideas on the subject that might help.

What Are Sensors?

"Astronomy," goes the old astrophysics joke, "is just one branch of remote sensing." Astronomy only picks up light and some other little portions of the electromagnetic spectrum, while remote sensing deals with all indicators of events happening some distance from the observer. By *Star Trek's* time remote sensing devices encompass a wide range of technologies and media and computer enhancement to provide a great volume of data for people who need it, like starship crews. Sensors of the 23rd century detect and analyze light, radio, gravity, radiation of nearly all types, high-energy particles and phenomena unknown to the 20th century. Most of these devices are detectors mounted just inside a starship's hull behind energy-transparent housings, and when people talk of 'sensors' they usually think of these.

But the data these detectors collect would be incomprehensible if it were not 'cooked down' into usable pictures, numbers, graphs and other displays that a sentient being could understand. An imaging photopolarimeter, like the one the primitive Viking Mars lander carried, doesn't take pictures—it records digital information on light values from very small sequential fields of view. It takes computers to put together an image out of that, and computers to make sense of the flood of sensor data.

For this reason sensor readouts are usually near the computer displays. A skilled sensor operator can choose different processing techniques from the computer to create different displays from the same data and possibly wring more information from it. Most of this information is visual, and so the sensor station is distinguished by the familiar reader, which projects for the operator's eyes only the requested data. It can be projected elsewhere, of course, but unless it's translated by the operator it may be more confusing than helpful.

Sensors are found on starships, on Starbases and other installations in space, and on planetary surfaces. They vary widely in size, complexity and ability: the sensors of Earth's Space Dock are the size of a small city, and can detect a basketball-sized object at the orbit of Pluto, six billion kilometers away. All sensors, whatever size or wherever mounted, share three distinct ranges and operating modes, and three different levels of information gathering: Long-range scans, short-range scans, and very close scans.

Long-Range Scans

Beyond a certain distance sensors of all types work best by simply receiving whatever light or radiation comes to them, rather than sending out a beam and waiting for it to return. Passive sensing has enormous range (astronomy, one type of passive sensing, can detect the entire universe) but it reveals little detailed information. Long-range scans can detect stars and their stellar classification, nebulae, novae and other large scale objects and events. They work best with pure energy or with objects that emit energy or radiation, and worst with objects that merely reflect energy, like planets. A skilled sensor operator can detect planets around stars at long range by passive sensing, but nothing smaller, like colonies or bases, unless they are putting out a good deal of energy. Ships at rest are invisible at long range.

Ships at warp speed are detectable at long range in very particular circumstances. A warp-driven ship rides a large 'dent' in space (the warp itself) which is more detectable the faster the ship is going. The rule of thumb is that a ship travelling at Warp X can be detected no farther than a day's travel at Warp X away. Thus, if a very faint warp burble is detected, and the distance can be inferred, the speed of the ship can be estimated and an intercept course calculated. A ship can thus pick up another ship's trail if it can reach its last known detected position within a day of detection. Not without reason are Orion pirates and Klingon border raiders known as the slowest warpers in space. A faster ship is simply easier to detect from farther away.

Long-range scans are subject to a great deal of interference from closer sources of energy. Matter in the way can block them completely, such as gas or dust clouds, planets and stars. A large radiant body, like a sun, can mask objects close to it. And the smaller an object, the less likely it will be detected, even if it is giving off energy. Survey operations, known to rely a great deal on long-range scans, have often misplaced or even failed to record the existence of some stars, simply because they were too dim and too far away to register.

Short-Range Scans

The boundary between long-range and short-range scans is the distance at which activated deflectors can be discerned. It's an arbitrary distance, but for most Starfleet vessels the range is about 300,000 kilometers. For spaceborne installations like Space Dock the range is much greater. For many merchant vessels this range is somewhat less, but some survey ships have up to twice the starfleet range. Curiously, unless a ground installation has spaceborne instruments, planetary-based sensors are no better than Starfleet's shipborne systems, for reasons discussed below.

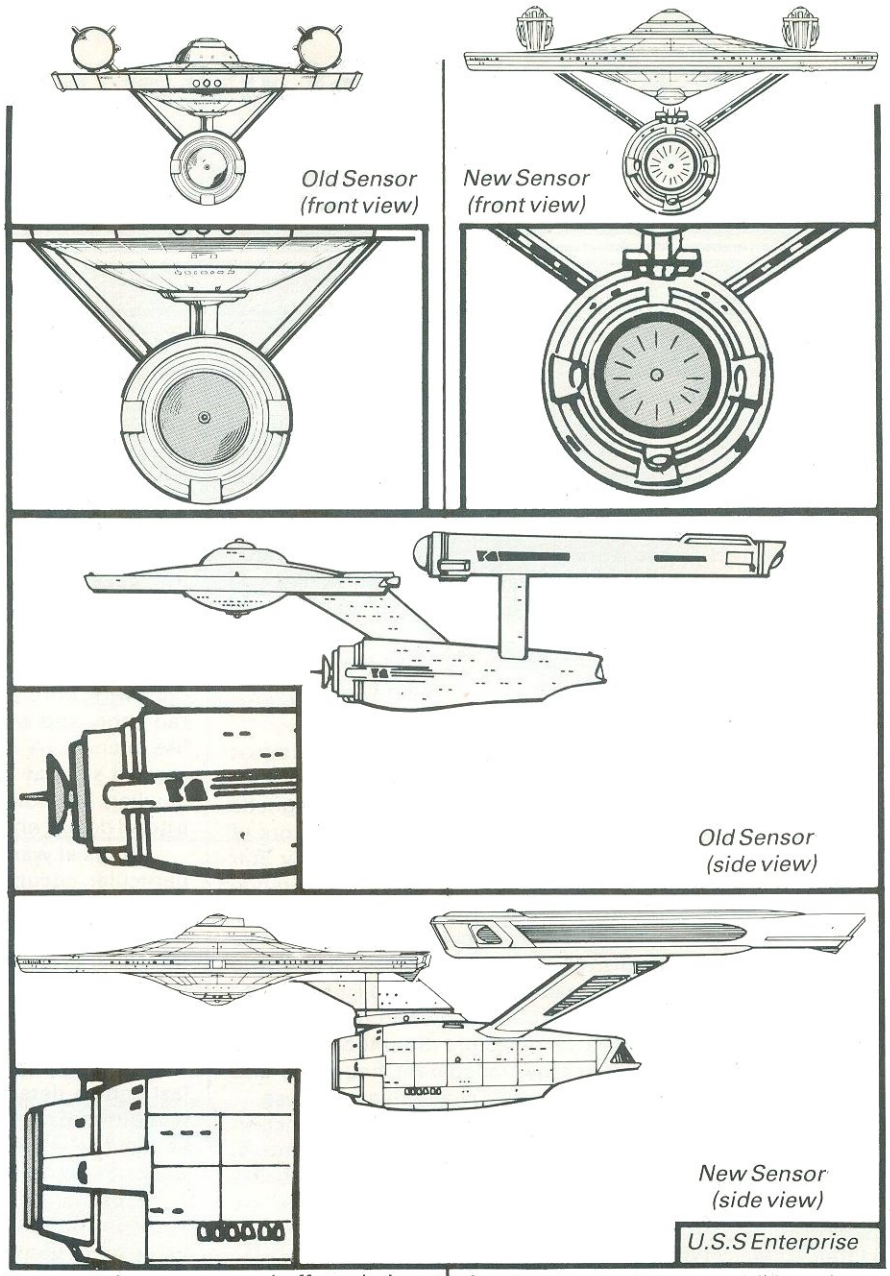
The short-range scan radius is the usual distance active sensors become more important for data collection than passive ones. At this range sensing beams can probe an object and reveal details about its structure, composition, energy output, and dimensions. A ship can be identified if it is of a known type from the 'signature' of its engine output and its configuration. And, of course, energized deflectors can be detected, which is why the short-range scan threshhold is known as the 'combat-decision horizon' to Star Fleet tacticians and the 'fly or fry line' to Academy midshipmen.

Deflectors are not proof against modern sensors, though they will degrade the reception of detailed information and baffle low-tech radar systems. Even through active deflectors a sensing ship will be able to detect the status of weapons, the relative energy output, the composition and the status of the scanned ship's exterior and the strength of its shields. It can tell when shields weaken and when the ship or other structure takes physical damage.

Not every encounter in space is against a potential adversary. Short-range scanning, if not hampered by shields or deliberate interference, is remarkably penetrating. A ship or other artifact can be accurately measured in all external and many internal dimensions, revealing the presence, size and shape of rooms and corridors. This can indicate the approximate form of the beings who made it and use it. Lifeforms themselves, if they are aboard, can be detected and analyzed, their metabolism, atmosphere and light requirements, and living temperature discovered. Natural objects can be scanned and their composition very thoroughly investigated.

Not much can block such scans. Some materials and processes resist scanning. Things changing form, energy state or matter state, from liquid to gas or from kinetic to potential energy, resist scanning, as do radioactive substances; they can confuse sensors and make them give spurious readings, or damage them. Strong magnetic fields, natural or artificial, can do the same thing. Very dense metals like neutronium and some synthetic alloys will block sensors completely, even in very thin layers. And, of course, sheer mass will defeat the sensor probe, so if a structure is large enough like, say, the *Fesarius*, sensors may get very precise readings on what is no more than external shielding and nonessential structural members. Spacers call this 'reading the paint.'

But the galaxy is large, and there are new phenomena and effects being discovered weekly. Sensors, and their hapless operators, may be unable to fully detect and display or even describe an alien object, energy fields of unknown kinds, or wierd and unexplained happenings without a precedent in the computer memory banks. The most famous example is the 'Negative Energy Barrier' that seems to envelope the Galaxy. It is transparent and undetectable by any kind of scan unless sensors are physically very close, and then wholly nonsensical data floods in. The NEB appears to the eye to be sheets of moving fire and color, very like auroral displays, but sensors will only say that energy is flowing into the region, not from it, and that all physical laws (as far as sensors are concerned) have been negated or reversed. Some scientists have speculated that natural laws really are changed at this boundary, and the sensors are only reporting the condition faithfully. Others say nonsense, and point out that ships have been lost in the NEB and returned to report that their engines worked fine, crews ditto, while the sensors and navigating instruments were completely fogbound. The Barrier may be no more than a very anomalous region which no existing sensor apparatus can coherently describe. Since it is too costly and too far to travel to find out for certain, no further research is contemplated and the 'Negative Energy Barrier' will remain a well-known mystery for now.



Very Close Scans

At exceptionally close ranges, less than 1,000 kilometers, often closer, sensors are awesomely powerful. They can, in fact, penetrate right through most artificial and small natural objects. At such small distances sensors are very good for identifying very precise details of structure, composition, energy flows and other fields of interest such as places for transporter operation. They are almost never used for this.

Very close sensor operations involve sending extremely high levels of directed energy through the object to be studied. The result can be devastating to the object and its contents. Even in the 20th Century radar microwaves were used to cook food, and 23rd Century sensors can do much worse at far greater distances. For this reason it is bad manners and contrary to regulations (and law, in some instances) to use sensors at very close range at full power on normally-functioning installations. Scientific bases are **never** subjected to such treatment because of the great damage it can do to experiments in progress. Most of the data these sensors can detect can be more easily and thoruoghly collected by landing parties with hand-held instruments. Low-power very close scans are often used to identify transporter beamdown points for such groups, but they are used very cautiously. Generally very close scans provide the same kind of data short-range scans do for less power, and closer investigation is left to live inspection.

Some data is easier to collect by passive means at very close range. Heat flows within a structure, which can reveal how long a ship's engines may have been on or off, or the possible source of internal heating in natural objects, are best done at this range. The so-called "annihilating radiations," like deltoid and iota rays, are only detectable very close to their sources. These radiations are very deadly to living tissue. Aside from these passive scans, more can be learned from landing parties with tricorders than from very close sensor scans.

The one exception is planetary surfaces. Unless a planet is a completely airless rockball it has an atmosphere and layers within that atmosphere that trap heat, radiation, condensation, dust, and a plethora of other substances and energy flows, all several kilometers or even a dozen kilometers deep. The energies that would go through a ship or space station may not get past a planet's first radiation belt. Resolving the data revealed is by no means easy, either. The unskilled operator who first tries to make sense of a planet's surface may find mountains that move, cities deep in the oceans and lakes several kilometers above the ground. Rarely are such readings accurate. Some unlucky operators have gone so far as to report their "discoveries" to unimpressed superiors, with predictable results. Reading planetary surfaces, atmospheres and hydrospheres requires great amounts of power, time and finesse. Acquiring this finesse takes what Academy slang calls "p'thandika," a pidgin-Vulcan term roughly translated as "filling your eyes with sand".

Atmospheres work both ways. Sensor arrays on planetary surfaces, aside from being pointed in only one direction at any one time, have a hard time looking up through the "soup". Even the best do no better than standard Starfleet ship-mounted systems, and most planet-based sensors do worse.

Interpreting planets is tricky. A rough idea of a world can be gathered in a few orbits, but a complete picture (including weather patterns, ocean currents, migrations of local lifeforms, vegetation patterns, seasonal changes, tectonic activity and much more) may be months or years in the making. A skilled operator can hypothecate a few clues into a useful model of a world, but it is a nearly sure thing that some detail will be missed. Again in the case of Mars, it was known from pre-Space Age astronomy that seasonal color changes on the Martian surface occurred in opposite direction from their Earth analogs (the change began at the poles and spread to the equator, whereas the Earth's tropical regions seem to spread their green towards the poles). The reason was not known until orbiting probes found dust storms originating near the poles and spreading to cover the planet. More recently, Omicron Ceti was explored and colonized before either the deadly Berthold rays or the nonindigenous spore-bearing plants that protected the colonists were detected. This kind of oversight is common, often with less happy results. Even very experienced sensor operators can make mistakes. For well into the foreseeable future landing parties and live investigation will be invaluable in exploring planetary surfaces.

Using Sensors

With a basic Starship Sensor skill of 10 a character can use sensors in any location at all ranges to acquire basic information without rolling for it. Characters with lesser Starship Sensor skill numbers will have to roll for any and all sensor operations.

At long range, no roll is needed to detect large sources of energy, stars, and objects of planetary size or greater in the ship's path. Normal in-flight sensor scans at long range are no more complex than this. Space searches will require a roll on Starship Sensors every hour or less, at the gamemaster's discretion, for more probing scans.

At short range, no roll is needed to detect planets or other objects down to ship size. A ship's dimensions, size, its identity if given by transponder or configuration, and deflectors if activated is known to an operator without rolling for them. Basically, anything about a ship that naked eyes could discern if they were close enough requires no roll to discover. Everything else, including lifeforms aboard and any internal details, must be rolled for.

At very close range, making planetary scans, no roll is required for making passable maps of surface features, determining the composition of the atmosphere, classifying the planet (Class M or otherwise), and determining the presence of life. Everything else must be rolled for, including finding out if any of the planet's life is intelligent or if there are artificial structures or energy sources there. Local weather, such as a landing party might need to know, must also be rolled for.

Sometimes a sensor operator may be asked to provide very specialized data, such as the presence of a particular substance, a unique kind of radiation, or identification of a particular object or event, for which the character may have no background or skill, or whose skill level is very low. A gamemaster can handle this situation in one of five ways, depending on the exact circumstances:

a) Roll under half the operator's Starship Sensors skill, rounding fractions down. The gamemaster or the player may make this roll; the operator is making a "best guess".

b) Roll the average between Starship Sensors and Computer Operation skills. The operator is calling upon the computer to help.

c) Roll the average between Starship Sensors and the required skill. The operator puts their limited knowledge to work.

d) Roll the operator's Starship Sensors and the required skill from another character. Two separate rolls, used when the operator has specialists available by communicator or intercom but not physically present. Relaying the data may require an additional roll on Language or Instruction skill to see if the meaning comes across from one to another.

e) Roll the average of the operator's Starship Sensors and another character's required skill. Operator and knowledgeable character are together and looking at the same data.

Combined operations like these often come up in doing planetary scans. Given enough time, eventually the experts can figure out the situation. The answer may not be in time to be of use to the players, however. Use the combined rolls for dramatic effect, such as for answers that are just in time or, perhaps, just a little late.

Searches by Sensors

Detecting particular objects on a planetary surace is harder than it would seem. The lost Eve McHuron, from "Mudd's Women," could not be located in hours of scanning from the *Enterprise*; no doubt the rough terrain and hostile weather were factors. A ship in standrad orbit can only keep any one area on a planet visible for about an hour. A ship may elect to go into synchronous orbit over one area on the planet, however.

In any case, success at locating any specific object the size of a humanoid from orbit is a low probability. For each orbit, or about every two or three hours (less for synchronous orbit, if you wish), a sensor operator may roll *once*. A result of less than or equal to one-tenth his or her Starship Sensor skill means success. All fractions are rounded down (skill rating of 27 would need to roll a 2 or less on percentile dice). Smaller, or buried, or indistinct objects will be harder yet. Weather, topography, and the size of the search area may also reduce the odds. Searches by ground parties are more likely to be successful, even if they seem more inefficient. Sensors have their limits.

Internal Sensors

Nearly every starship commander has wished, at one time or another, to know what is going on within their own ship. Sensors cannot scan the interior of the vessel or structure they are mounted on; not only won't the mountings allow it but they could badly injure or kill those within. It would be like using radar within a building or ship. A Captain must rely on crew reports as if from landing parties for such information or, if the Communications Officer or Science Officer is skilled enough, internal monitors and intercoms can be used to listen or watch for unusual activity. For detailed information there is no substitute for a specialized group, like a damage control party, equipped with tricorders and other equipment. Other alternatives are possible but hard to come by.

Players who remember the episode "Let That Be Your Last Battlefield" may clamor for internal sensors. Mr. Spock, however, followed the progress of Lokai and Bele through the *Enterprise* corridors through the use of the ship's communications system and computer assisted switching to keep track of them. Any character wishing to do the same must roll each Personal Combat turn under both their Computer Operation and their Starship Communications skills. An INT roll may also be necessary to keep a confusing situation clear in the character's mind. This is an exceptional and highly unusual use of ship's equipmentand a violation of the Federation regard for privacy. For characters who wish to keep track of every movement in a ship by suspicious characters, suggest a security team or, for die-hard cases, a transfer to a Klingon vessel with a recommendation for Internal Security duty.

Time and Incentive

The greatest danger to a game is from sensor overusage. The temptation to rely on sensors to learn answers is great and selsor-dependence can creep up on gamemasters unconsciously. To avoid this, every time sensors are called upon remember:

Sensors do not provide final answers. There will always be a hole, a fault, an error or gap that can only be corrected or filled in by someone down there with a tricorder and naked eyes. Resist the urge to give too many clues; if all else fails, give out false information, preferably something that causes the player characters to make costly mistakes that simple investigation could have avoided.

A better way to get people off sensors is lack of time. With computers, department-head meetings, and memory banks full of sensor data you can get encyclopedic answers from a distance. Characters in an encounter will rarely have this kind of time, and a gamemaster must remind them of it. No Captain, even a merchant (perhaps especially a merchant!), can afford to let time seep by while somebody fiddles with the sensors. A gamemaster will hand out the essential facts sensors can detect, and then inform the players that nothing else can be learned. Don't let the players get into the habit of waiting out the gamemaster. Get them physically involved.

Another useful technique is inaccuracy. Remember Omicron Ceti and the Berthold rays. On Gideon an entire duplicate of the *Enterprise* was completely hidden from sensors. A picture of a world or object will never be completely accurate. Players must come to realize this; they may beam down on a seemingly innocuous world only to find such undetected horrors as tree-barracudas, or unsuspected delights such as a race of intelligent birds. Always omit some telling hard to detect deatil that a landing party will stumble across. It doesn't have to be bad news, just memorable.

Most gamemasters may never need this primer. They will be able to keep players from becoming sensor dependent and will always give just enough sensor generated data to spark character interest.

But if you find the Captain bugging the Science Officer for more scans, or if the sensor reports get more attention than the Captain's decisions, or if the Chief Engineer wants to scan the liquor cabinet in his quarters, remeber where you read this.

Editor's Note: As this issue goes to press FASA should be releasing the **Tricorder/Sensors Interactive Display** for ST:RPG. Combined with the excellent article above, this should solve any and all problems with sensors anyone could have.

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